

Physiotherapy, Exercise and Physical-Modality Interventions for Erectile Dysfunction in Men with Diabetes Mellitus or Hypertension: A Scoping Review

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Abstract

Aims: To map physiotherapy, exercise and physical-modality interventions for erectile dysfunction (ED) in adults with diabetes mellitus and/or hypertension, characterize intervention and outcome patterns, and identify rehabilitation evidence gaps. **Study design:** Scoping review. **Place and Duration of Study:** Evidence sources were searched internationally during August 2026, with a final citation and eligibility audit completed on 2 September 2026. **Methodology:** A Joanna Briggs Institute-informed scoping review was reported according to the PRISMA extension for Scoping Reviews (PRISMA-ScR). PubMed/MEDLINE, CENTRAL, PEDro, African Journals Online, Google Scholar, ClinicalTrials.gov and WHO ICTRP yielded 921 records; 799 unique records were screened. Mixed cohorts were eligible when diabetes/hypertension findings were separately extractable or the target population comprised at least 50% of participants. Study-family linking prevented double counting. Findings were synthesized descriptively without meta-analysis or formal risk-of-bias appraisal. **Results:** Forty-four sources representing 41 independent study families were included; 37 had outcome data and four were registry-only. Low-intensity extracorporeal shockwave therapy (Li-ESWT) dominated the map (24/41 families), followed by exercise/lifestyle interventions (7/41). Diabetic studies reported both favourable and null findings; severe or uncontrolled diabetes was repeatedly associated with attenuated shockwave response or durability,

whereas hypertension showed less consistent modifier effects. Exercise/lifestyle findings were generally favourable. Pelvic-floor muscle training (PFMT), electrical stimulation, manual therapy and other modalities were sparsely studied. Only two Nigerian families were identified. Conclusion: Rehabilitation and physical interventions are being studied across cardiometabolic ED, but evidence is uneven and dominated by heterogeneous shockwave protocols. Exercise and PFMT warrant larger comparative trials, standardized intervention reporting and longer follow-up. The evidence supports a complementary multidisciplinary rehabilitation role rather than a uniform efficacy claim.

Keywords: Erectile Dysfunction, Diabetes Mellitus, Hypertension, Physiotherapy, Exercise Therapy, Pelvic Floor, Low-Intensity Shockwave Therapy

1. INTRODUCTION

Erectile dysfunction (ED) is a clinically important sexual-health condition with vascular, neurologic, endocrine and psychosocial determinants. Diabetes mellitus and hypertension are especially relevant because both conditions impair endothelial function and vascular responsiveness, while diabetes additionally contributes neuropathy, microvascular disease and metabolic injury. Recent synthesis suggests that approximately two-thirds of men with diabetes experience ED (pooled global prevalence 65.8%), and a 2026 African meta-analysis estimated ED in 65.05% of hypertensive men (Kitaw et al., 2024; Gebrie et al., 2026). The burden is therefore substantial in cardiometabolic services, where sexual function may also act as a marker of wider vascular disease.

Current ED management is multidisciplinary. Phosphodiesterase type 5 inhibitors (PDE5i) remain a central treatment, alongside risk-factor control, psychosexual care, vacuum devices, intracavernosal therapy and surgery when appropriate. Contemporary European Association of Urology guidance also recognizes lifestyle modification and gives a cautious, weak recommendation for low-intensity shockwave therapy in selected vasculogenic ED populations (Salonia et al., 2025). The rehabilitation perspective is important because physical activity, weight management, pelvic-floor muscle training (PFMT), cardiovascular rehabilitation and selected physical modalities are potentially deliverable within or alongside physiotherapy practice, while simultaneously addressing cardiometabolic health.

Three bodies of evidence motivate a cardiometabolic-focused map. First, a 2025 Cochrane review of 21 randomized trials found low-certainty evidence that low-intensity shockwave therapy (LiSWT) may provide small short-term and possible longer-term erectile-function benefits, but heterogeneity and methodological limitations reduced confidence (Ergun et al., 2025). Second, a diabetes-specific scoping review of Li-ESWT concluded that outcomes appeared more favourable in well-controlled diabetes and less durable in some diabetic populations (Mason et al., 2023). Third, a meta-analysis of aerobic exercise trials in broader ED populations reported a mean 2.8-point improvement in IIEF-EF, supporting the plausibility of exercise as treatment (Khera et al., 2023). These reviews, however, do not collectively map the full range of physical and rehabilitation strategies specifically within diabetes and hypertension.

A broader scoping approach is useful because the literature spans randomized trials, uncontrolled cohorts, predictor studies, conference abstracts, preprints and trial registries; intervention protocols and co-interventions vary considerably; and outcomes include International Index of Erectile Function (IIEF), five-item IIEF/SHIM, erection hardness, penile Doppler measures, metabolic variables and patient-reported response. A study-family approach is also required because some trials have multiple publications or registry companions. Mapping these features can clarify where evidence is mature enough for focused effectiveness reviews and where primary rehabilitation research remains necessary.

The primary review question was: what physiotherapy, exercise-based and physical-modality interventions have been studied for ED in adult men with diabetes mellitus and/or hypertension? Secondary questions addressed intervention type and dose, outcomes and follow-up, countries and settings, the influence of cardiometabolic characteristics on response, and evidence gaps relevant to rehabilitation research and practice.

2. METHODOLOGY

2.1 Review design and reporting

This scoping review was conducted with reference to the Joanna Briggs Institute (JBI) methodological framework for scoping reviews and is reported using the PRISMA extension for Scoping Reviews (PRISMA-ScR); search reporting was informed by PRISMA-S (Tricco et al., 2018; Peters et al., 2024; Rethlefsen et al., 2021). The objective was evidence mapping rather than estimation of a pooled treatment effect.

2.2 Protocol and registration

An a priori protocol, screening decision guide, data-charting manual and database-specific search strategies were developed before formal screening. These project documents specified the Population-Concept-Context eligibility framework, study-family rules and charting conventions. The protocol was prospectively registered on the Open Science Framework (OSF) before formal screening (registration QJ6RM; DOI: 10.17605/OSF.IO/QJ6RM; <https://osf.io/qj6rm/>). The final eligibility audit applied the prespecified rule that a mixed cohort could be included when diabetes/hypertension findings were separately extractable or the target cardiometabolic population constituted at least 50% of participants.

2.3 Eligibility criteria

The Population-Concept-Context eligibility criteria are summarized in Table 1.

Table 1. Population-Concept-Context eligibility criteria

Domain	Include	Exclude
Population	Adult men (≥18 years) with ED and diagnosed diabetes mellitus and/or hypertension. Mixed cohorts eligible if target–subgroup findings were separately extractable or the target cardiometabolic group formed ≥50% of the sample.	No ED; no diabetes/hypertension; mixed samples failing the extractability/majority rule.

Domain	Include	Exclude
Concept	Structured physiotherapy, exercise, rehabilitation or physical modality intended to improve erectile function, including PFMT, aerobic/resistance/combined exercise, electrical stimulation, biofeedback, Li-ESWT, manual therapy and multimodal physical programmes.	Drug-only, surgery-only, psychological-only, herbal/nutritional-only interventions without an eligible physical component; stand-alone interventions outside the registered concept.
Context	Any country and any clinical, community or home setting.	None by geography or setting alone.
Sources	Primary studies of any design; English language; any year. Conference abstracts if target data were extractable. Registries retained when they mapped eligible ongoing/completed studies without a usable publication.	Reviews, guidelines, editorials/commentaries and non-primary evidence (retained only for citation searching).

2.4 Information sources and search strategy

Searches were executed during August 2026, with a final citation/eligibility audit completed on 2 September 2026. The loaded search set comprised PubMed/MEDLINE (494 main records plus two supplementary known-item records), Cochrane CENTRAL (102), PEDro (53), African Journals Online (AJOL; 14), Google Scholar (first 200 relevance-ranked records), ClinicalTrials.gov (35) and WHO ICTRP (21), yielding 921 source records before cross-source deduplication. Exact per-source execution dates were not consistently preserved in the final project archive; this documentation limitation is reported in Supplementary File S2. The search framework combined ED terms with diabetes/hypertension terms and physiotherapy/exercise/physical-modality terms.

Several planned sources could not be incorporated into the loaded master. PACTR targeted searches were undertaken but final record capture was incomplete, and Scopus, Embase, Web of Science Core Collection, CINAHL and ProQuest Dissertations & Theses were not executed because institutional access was unavailable during the review period. These are reported as search deviations rather than omitted from the methods. The review therefore does not claim exhaustive coverage of all planned subscription databases.

2.5 Deduplication and source selection

The 921 loaded records were consolidated into a master citation library using titles, DOI/PMID/trial identifiers and manual duplicate review; 799 unique records remained. A 25-record calibration exercise preceded the main title/abstract screen. Reviewer agreement in the calibration set was 23/25 (92.0%) with Cohen's kappa of 0.853. The remaining 774 records were then screened independently by two reviewers using the prespecified decision guide; uncertainty was advanced rather than force-excluded. After reconciliation, 662 of 799 records were excluded and 137 advanced to full-stage assessment.

At full stage, two reports could not be retrieved and were kept separate from exclusions. Of 135 assessed sources, 92 were excluded using one principal reason per report: wrong target population (n=38), target subgroup not separately extractable (n=32), duplicate/companion report (n=10), secondary/non-primary source (n=8), and wrong intervention/concept (n=4). Forty-three sources were retained from the main-search branch. One additional eligible publication (Tsai 2017) was identified during the later

citation/eligibility audit and is therefore reported in the PRISMA 'other methods' branch rather than retrofitted into the original 799-record database set. Figure 1 presents the final flow.

2.6 Data charting, study-family consolidation and verification

A structured charting form captured report identification, study family, country/setting, design and sample, cardiometabolic population characteristics, intervention components and dose, comparator, ED outcomes and time points, co-interventions, quantitative results, safety, rehabilitation relevance, source status and verification notes. Missing information was recorded as not reported rather than inferred. Concurrent PDE5 inhibitor use was explicitly charted because it affects attribution of treatment response.

Multiple reports were consolidated when they represented the same underlying participant cohort or trial, using trial identifiers, recruitment/sample features, intervention details and companion-publication links. This prevented duplicate counting of the LAMINA reports and the University of Virginia Li-ESWT main/long-term publications, among others. The final synthesis denominator is therefore study families rather than reports.

Detailed extraction and family linkage for the historical 31-report/28-family evidence set underwent structured independent Reviewer 2 verification by the second reviewer (O. H. Tony-Okpalaobi). A subsequent eligibility audit corrected an overly restrictive application of the prespecified mixed-sample rule and added 13 sources/families (eight previously parked publications, four registry-only families and one citation-audit publication). These 13 post-audit additions were independently screened and verified against the protocol and the available primary-source records by the same second reviewer. All 44 included sources, representing 41 independent study families, therefore underwent independent second-reviewer verification. Source-status limitations (conference abstract, preprint and registry-only evidence) remained explicit throughout synthesis.

2.7 AI-assisted workflow support

ChatGPT (OpenAI; GPT-5.6 Sol) and Claude (Anthropic) were used during the review workflow to support file organization, formatting of the screening and charting templates, retrieval support, construction of reconciliation tables, language editing and manuscript drafting. No AI tool made any screening, eligibility, family-linkage or data-extraction decision, and neither tool was designated as an author or reviewer. All calibration, title/abstract and full-text screening decisions were made by the human reviewers. The historical 31-report/28-family dataset and the 13 post-audit sources/families both underwent independent human second-reviewer verification. The authors remain responsible for verifying source attribution, interpreting the evidence and approving the final submitted manuscript.

2.8 Critical appraisal

A formal design-specific risk-of-bias or certainty assessment was not undertaken. This was a deliberate choice because the primary purpose was to map the extent, characteristics, interventions and gaps of a heterogeneous evidence base rather than produce a pooled effectiveness estimate; critical appraisal is optional rather than mandatory in PRISMA-ScR/JBI scoping review reporting when not required by the review objective (Tricco et al., 2018; Peters et al., 2024). Design limitations were nevertheless recorded descriptively and were used to moderate interpretation.

2.9 Synthesis and presentation

Findings were summarized descriptively at both report and study-family levels. Families were grouped by intervention category, evidence role (direct target cohort, mixed/subgroup or target-majority, abstract-only evidence), country and source status. Quantitative findings were presented as reported in primary sources

without calculation of unreported effect estimates. No meta-analysis was performed because intervention protocols, populations, comparators, co-interventions, outcome metrics and follow-up periods were too heterogeneous for the mapping objective.

3. RESULTS

3.1 Study selection

The loaded searches yielded 921 records; 122 duplicates or cross-source overlaps were removed, leaving 799 unique records for screening. Following title/abstract review, 137 reports advanced to full-stage assessment. Two reports were not retrieved and 135 were assessed; 92 were excluded. Forty-three sources were included from the main search and one additional eligible report was identified through the citation/eligibility audit, giving 44 included reports/sources. These represented 41 independent study families, of which 37 contained outcome data and four were registry-only. The final source-selection flow is shown in Fig. 1.

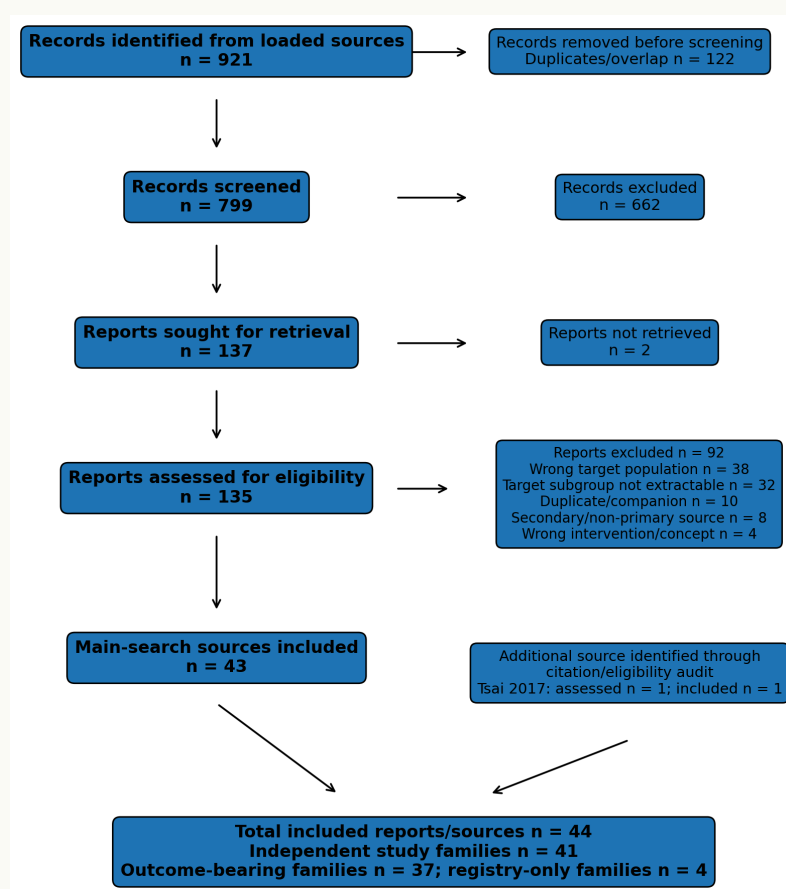


Fig. 1. PRISMA-ScR flow of source selection

Note. The 43-source main-search branch derives from the 799-record master; Tsai 2017 is reported separately under other methods.

3.2 Characteristics of the included evidence

Of the 41 independent families, 18 were classified as direct target cohorts, 21 as mixed cohorts eligible through separately extractable diabetes/hypertension evidence or the protocol's $\geq 50\%$ target-majority threshold, and two as abstract-only target-evidence families. At report level, the evidence base comprised peer-reviewed journal reports, two conference abstracts, one preprint and four registry-only sources. The

geographical distribution was concentrated in Egypt (8 families), the United States (5), Turkey (4) and Italy (3); China, Poland, Nigeria and Taiwan contributed two families each, and 13 other countries contributed one family each. Nigerian evidence identified within the sources searched comprised the LAMINA hypertensive exercise family and the Akande Li-ESWT cohort from Ibadan. The distribution of intervention families is summarized in Table 2.

Table 2. Intervention Map Across 41 Independent Study Families

Intervention family	All families	Outcome-bearing	Registry-only
Li-ESWT / shockwave alone	24	24	0
Exercise / lifestyle	7	5	2
Li-ESWT ± PFMT	2	2	0
Li-ESWT + regenerative therapy	2	1	1
Electrical muscle stimulation	1	1	0
Multimodal physical modalities	1	1	0
Manual therapy + PFMT	1	1	0
Li-ESWT + exercise	1	1	0
Li-ESWT + vacuum erection device	1	1	0
Radiofrequency physical modality	1	0	1

3.3 Shockwave therapy in direct diabetes/hypertension cohorts

Direct diabetic studies showed a heterogeneous response. In severe PDE5 inhibitor-refractory diabetic ED, Ergün and Akyüz reported essentially no symptomatic change after Li-ESWT: mean IIEF-5 increased from 5.29 ± 1.67 to 5.56 ± 1.85 and Erection Hardness Score (EHS) from 1.46 ± 0.50 to 1.48 ± 0.50 (both non-significant) (Ergün & Akyüz, 2022). In contrast, Ahmad et al. found in a three-arm randomized trial of men with type 2 diabetes that mean IIEF-5 change was 3.6 ± 0.9 with Li-ESWT, 2.2 ± 0.9 with PFMT and 1.0 ± 0.5 in the control arm; Li-ESWT also produced the largest increase in cavernosal peak systolic velocity (Ahmad et al., 2026). All three arms received background sildenafil, so these differences represent the effect added by each physical intervention rather than its effect in isolation.

Other diabetic trials generally reported improvement but varied in protocol and comparator. Verze et al. found greater durability with a higher-dose Li-ESWT protocol plus daily tadalafil than with tadalafil alone at 12 and 24 weeks (Verze et al., 2020). Ismail and Abd El-Azeim found an advantage for active Li-ESWT plus tadalafil over sham plus tadalafil at one and three months, with attenuation by six months (Ismail & Abd El-Azeim, 2022). Bhondave and Bhati reported higher IIEF-EF, SHIM and EHS values with active treatment than sham through 12 months, although the paper labels the study observational while also describing computer-generated 1:1 allocation and is therefore treated cautiously (Bhondave & Bhati, 2024). Tao et al. found that combining Li-ESWT with a vacuum erection device produced the highest

12-week IIEF-EF minimal clinically important difference (MCID) response (66.7%) versus 36.4% for Li-ESWT alone and 17.6% for vacuum erection device (VED) alone (Tao et al., 2022).

Combination strategies were also represented by Ji et al., who evaluated Li-ESWT alone, placenta-derived mesenchymal stem cells alone and the combination in diabetic ED. The combined arm showed the largest six-month improvement, but the regenerative co-intervention prevents attribution to a physical modality alone (Ji et al., 2025). In the Nigerian Akande cohort, all participants had hypertension and/or diabetes; erectile scores improved over follow-up, but the uncontrolled design limits causal inference (Akande et al., 2021).

3.4 Shockwave therapy in mixed or target-majority cardiometabolic cohorts

The final eligibility audit added several mixed cohorts in which diabetes or hypertension met the prespecified majority threshold or was separately analysed. In the Australian Duolith randomized trial, hypertension was present in 38/60 participants (63.3%); a clinically relevant IIEF-5 response favoured active treatment over placebo (Chung et al., 2023). In the Malaysian sham-controlled trial, hypertension was present in 56.9% and diabetes in 51.0%; IIEF-5 remained higher after active Li-ESWT than sham across follow-up (Ong et al., 2022).

Additional eligible target-majority cohorts came from Portugal, Libya, Argentina and Taiwan, but several continued tadalafil or other PDE5 inhibitors and were uncontrolled, limiting isolation of the shockwave effect (De Oliveira et al., 2018; Elzwawi et al., 2026; Bechara et al., 2016; Tsai et al., 2017). Tsai et al., identified through the citation/eligibility audit, reported that 35/52 PDE5i nonresponders reached EHS ≥ 3 at one month and 33/35 responders maintained the response at three months; hypertension was present in 27/52 (51.9%) (Tsai et al., 2017).

Predictor studies repeatedly suggested poorer response with diabetes. Absence of diabetes independently predicted treatment success in Anil et al. (OR 2.67, 95% CI 1.24-5.72) (Anil et al., 2026); uncontrolled diabetes was a negative predictor in Tzou et al. and Elshorbagy et al. (Tzou et al., 2021; Elshorbagy et al., 2025); and Rubino et al. reported that only 1/15 men with diabetes improved ED severity category (Rubino et al., 2024). In the Kitrey long-term follow-up, all patients with severe baseline ED plus diabetes had lost the initial Li-ESWT benefit by two years (Kitrey et al., 2018). Geyik nevertheless reported significant IIEF improvement after each of two Li-SWT courses, including within the diabetic subgroup (Geyik, 2022). Oginski et al. found response associations with cardiovascular-risk and antihypertensive-treatment variables (Oginski et al., 2022). A conference report by Benitez et al. indicated poorer response in diabetes, but the reported 4.6-versus-1.9 numerical group ordering was internally ambiguous and was not assigned quantitatively in this review (Benitez et al., 2022). Other mixed-cohort reports similarly examined diabetes and/or hypertension as prognostic factors, but estimates were not sufficiently uniform for pooling (Adelaeim et al., 2021; Vita et al., 2019; Gittens & Roberson, 2020; Hisasue et al., 2016).

3.5 Exercise, lifestyle and cardiac rehabilitation

Exercise/lifestyle interventions formed a smaller but clinically coherent evidence stream. The LAMINA hypertensive exercise family compared interval training, continuous training and sedentary control over eight weeks. Mean IIEF change was $+3.64 \pm 2.27$ with interval training and $+3.50 \pm 2.24$ with continuous training, versus $+0.86 \pm 1.28$ in control (overall ANOVA $P < .001$) (Lamina et al., 2009a; Lamina et al.,

2009b; Lamina & Okoye, 2009). Companion analyses linked erectile improvement with inflammatory and cardiovascular changes.

In Look AHEAD, intensive lifestyle intervention in older men with type 2 diabetes produced substantial weight-loss and fitness differences and was associated with less deterioration in erectile-function category (8% versus 20% with diabetes support/education) (Wing et al., 2010). Kirilmaz et al. reported IIEF-5 improvement after lifestyle modification, exercise and intensive glycaemic control, with a larger increment when sildenafil was added (Kirilmaz et al., 2015). Cardiac-rehabilitation studies by Kalka and colleagues also described improvements in erectile scores alongside exercise-capacity or blood-pressure changes (Kalka et al., 2018; Kalka et al., 2013).

Salama et al. directly compared ESWT, exercise and their combination in men with type 2 diabetes. ESWT produced faster early improvement but attenuated by 12 weeks, whereas exercise continued to improve and the combined arm had the strongest sustained result (12-week IIEF-5 18.20 ± 0.86) (Salama et al., 2023). Two additional diabetic exercise strategies were represented only by registries: a completed Pilates/PFMT trial without a located results publication and an ongoing treadmill-exercise plus vitamin-D trial (ClinicalTrials.gov, 2025; ClinicalTrials.gov, 2026b).

3.6 Pelvic-floor training and other physical modalities

PFMT evidence was limited but included randomized diabetic studies. Ahmad et al. showed that home PFMT improved IIEF-5 and penile haemodynamics versus sildenafil-only control, although Li-ESWT produced larger gains (Ahmad et al., 2026). Shendy et al. compared Li-ESWT plus PFMT with sham shockwave plus PFMT in diabetic ED with polyneuropathy and reported greater improvement in erectile and Doppler outcomes with active shockwave (Shendy et al., 2021). These studies establish PFMT as a relevant cardiometabolic ED research domain, but they are too few to define an optimal protocol.

Evidence for other physiotherapy modalities was sparse. High-tone external muscle stimulation increased penile blood-flow measures acutely in a six-man diabetic pilot but did not improve IIEF symptoms after four weeks (Damásdi et al., 2013). Manual therapy with PFMT was reported only at case-series level, including one diabetic case (Afshar Safavi et al., 2024). A multimodal preprint combined shockwave/pressure-wave therapy, class IV laser, therapeutic ultrasound and exercise with major medical co-interventions; it was retained only as descriptive hypothesis-generating evidence (Mendias & Awan, 2026). A physiotherapist-delivered radiofrequency trial was identified as registry-only evidence with no outcome publication suitable for efficacy inference (Brazilian Clinical Trials Registry, 2024).

3.7 Durability, safety and registry-only evidence

Durability varied. The Kitrey follow-up retained benefit in 53/99 initial responders at 24 months but not in men with severe ED plus diabetes (Kitrey et al., 2018). The University of Virginia family showed improvement through 12 and 24 months, with attenuation by 36 months (Lange et al., 2024; Kennady et al., 2023). Exercise-related improvements in the Salama trial persisted more consistently than ESWT alone through 12 weeks (Salama et al., 2023).

Across the published evidence, no serious treatment-related adverse events were reported in the studies that reported harms; most Li-ESWT studies described no major complications or only minor local effects. Exercise studies did not identify serious intervention-related harms in the extracted reports. Nevertheless, adverse-event collection and definitions were inconsistent and many samples were small, so the review does not support a pooled safety estimate.

The two families combining Li-ESWT with regenerative therapy are reported here for completeness of the map; both were combination designs and neither contributes to claims about Li-ESWT, exercise or PFMT

alone. Four registry-only families broadened the map without contributing efficacy evidence: physiotherapist-delivered radiofrequency in diabetic vascular ED, Pilates plus home PFMT in type 2 diabetes, treadmill exercise plus vitamin D in diabetic ED, and shockwave plus PRP in diabetic microvascular ED. The latter was terminated after only two participants and was retained solely for completeness of the research landscape (Brazilian Clinical Trials Registry, 2024; ClinicalTrials.gov, 2025; ClinicalTrials.gov, 2026b; ClinicalTrials.gov, 2026a).

Representative quantitative findings from the mapped evidence are summarized in Table 3. Results are descriptive and were not pooled.

Table 3. Representative quantitative findings from the mapped evidence

Study	Population	Intervention	Representative result	Mapped interpretation
Ergün & Akyüz, 2022	Diabetes; severe PDE5i-refractory ED	Li-ESWT	IIEF-5 5.29±1.67 to 5.56±1.85; P > .05	Null/limited response
Ahmad et al., 2026	T2DM arteriogenic ED; n=90	Li-ESWT vs PFMT vs control	IIEF-5 change +3.6, +2.2, +1.0 points	Li-ESWT > PFMT > control
Salama et al., 2023	T2DM ED; n=45	ESWT vs exercise vs combined	12-week IIEF-5 13.66, 15.40, 18.20	Combined strongest; exercise durable
Tao et al., 2022	Diabetic PDE5i-nonresponsive ED; n=105	VED vs Li-ESWT vs combination	12-week MCID 17.6%, 36.4%, 66.7%	Combination strongest
Lamina et al., 2009a; Lamina et al., 2009b; Lamina & Okoye, 2009	Hypertension + ED; n=65 parent family	Interval/continuous aerobic training	IIEF change +3.64 / +3.50 vs +0.86 control	Favourable exercise signal
Wing et al., 2010	T2DM; lifestyle RCT substudy	Intensive lifestyle intervention	ED-category worsening 8% vs 20%	Preservation signal
Anıl et al., 2026	Vasculogenic ED; n=219	Li-ESWT	Absence of diabetes OR 2.67 for success	Diabetes adverse modifier
Kitrey et al., 2018	Long-term Li-ESWT responders	Follow-up	53/99 retained benefit at 24 months; severe ED+DM lost benefit	Limited durability in severe DM
Damásdi et al., 2013	T2DM severe ED; n=6	High-tone muscle stimulation	No significant IIEF improvement after 4 weeks	No clear symptomatic benefit
Tsai et al., 2017	PDE5i nonresponders; HTN 51.9%	Li-ESWT + PDE5i	35/52 reached EHS≥3 at 1 month	Favourable uncontrolled signal

4. DISCUSSION

4.1 Principal findings

This review maps a larger and more diverse cardiometabolic ED rehabilitation literature than the initial fast-track evidence set suggested. Forty-one independent families were identified, but the field is markedly asymmetric, and this asymmetry is itself a principal finding of the review rather than an incidental feature of the map: 24 families evaluated Li-ESWT, whereas exercise/lifestyle, PFMT and other physiotherapy interventions were far less common. The central finding is therefore not a single efficacy estimate, but a pattern of uneven evidence development. Shockwave therapy has the greatest research volume, while interventions that are most recognizably embedded in routine rehabilitation practice remain under-studied.

The map also suggests that cardiometabolic phenotype matters. Diabetes was repeatedly associated with poorer shockwave response or reduced durability, particularly in severe or uncontrolled disease, whereas hypertension was less consistently associated with treatment response. This distinction is clinically relevant because eligibility through a hypertension-majority sample is not equivalent to a demonstrated hypertension-specific treatment effect. The review therefore separates target-majority inclusion from true subgroup/predictor evidence.

4.2 Li-ESWT in the context of contemporary evidence

The heterogeneity observed here aligns with the 2025 Cochrane review, which found low-certainty evidence of small short-term and possible longer-term benefit from Li-ESWT, with substantial protocol and study limitations (Ergun et al., 2025). It also fits the cautious position of current EAU guidance, which recognizes a role for Li-ESWT in selected vasculogenic ED but does not frame it as universally effective (Salonia et al., 2025). The present cardiometabolic map adds an important qualification: even when average cohort outcomes are favourable, severe diabetes, poor metabolic control, long disease duration and microvascular/neuropathic burden may reduce the probability or persistence of response.

This is consistent with the diabetes-specific review by Mason et al., which reported more encouraging outcomes in well-controlled diabetes and concerns about durability in diabetic populations (Mason et al., 2023). The expanded 41-family map strengthens that signal by incorporating newer trials and predictor cohorts, but the finding remains associative rather than causal because many modifier analyses were observational, underpowered or not prespecified. Disease duration, vascular disease, neuropathy, concurrent medication including PDE5i, baseline ED severity and wider comorbidity may all contribute to the same pattern and were not separable in the mapped reports. Future effectiveness trials should therefore stratify randomization or analysis by HbA1c, diabetic complications, ED severity and duration rather than treating diabetes as a simple yes/no comorbidity.

4.3 Exercise and lifestyle rehabilitation

Exercise/lifestyle evidence was smaller but conceptually coherent. It rests on five outcome-bearing families with heterogeneous programmes, small samples and frequent co-interventions, so it supports the statement that erectile function has improved following exercise or lifestyle programmes rather than that exercise independently produces those gains. The hypertensive LAMINA family demonstrated improved erectile scores with both interval and continuous aerobic training, while Look AHEAD and cardiac-rehabilitation studies suggested preservation or improvement of erectile function alongside improvements in weight, fitness or blood pressure. These findings are directionally consistent with the broader 2023 meta-analysis in which aerobic exercise improved IIEF-EF by a mean 2.8 points across 11 randomized trials (Khera et al., 2023). That pooled estimate should not be transferred directly to

diabetes/hypertension subgroups, but it supports the biological and clinical plausibility of exercise as part of ED management.

From a rehabilitation perspective, exercise has a particular advantage: it can address erectile function within the same programme that targets cardiorespiratory fitness, obesity, glycaemic control, blood pressure and vascular risk. The mapped evidence does not justify replacing established medical ED care with exercise, but it supports including sexual-function outcomes in cardiometabolic rehabilitation trials and services. Pragmatic head-to-head or add-on trials could test whether supervised exercise produces clinically meaningful ED improvement beyond usual cardiovascular risk-factor management.

4.4 PFMT, multimodal care and the scope of physiotherapy

PFMT evidence is emerging rather than absent. The Ahmad and Shendy trials place pelvic-floor training within diabetic ED research, extending a modality more commonly studied in post-prostatectomy or general ED populations. However, too few cardiometabolic studies exist to determine optimal contraction dose, supervision, biofeedback, progression or whether PFMT is more effective in specific phenotypes. This is a clear opportunity for physiotherapy-led trials.

Combination interventions frequently produced favourable outcomes, particularly Li-ESWT with exercise or VED, but multimodality creates an attribution problem. Tadalafil, sildenafil, stem cells, PRP, weight-loss programmes and glycaemic-control strategies were often delivered concurrently. Future studies should use factorial or clearly controlled designs where feasible, report adherence to each component separately, and avoid attributing a combined effect to the physical modality alone.

4.5 Safety, feasibility and clinical boundaries

Physical interventions were generally feasible and no serious treatment-related adverse events were reported in the studies that reported harms. Ascertainment was inconsistent and samples were mostly small, so these reports should not be read as establishing a safety profile. For men with diabetes or hypertension, rehabilitation-oriented ED management should remain integrated with cardiovascular risk assessment, glycaemic and blood-pressure management, medication review and appropriate urological evaluation. This is particularly important because ED can signal broader vascular disease and because several physical-modality studies continued PDE5 inhibitors during treatment.

Accordingly, the evidence supports a complementary rather than replacement role for rehabilitation. Exercise prescription, PFMT, patient education and selected physical modalities may be incorporated into multidisciplinary care, while treatment selection should reflect ED severity, cardiometabolic stability, contraindications, patient preference, costs and the still-uncertain comparative effectiveness of device-based protocols.

4.6 Geographical and research gaps

The geographical distribution is a major gap. Egypt and the United States account for a substantial share of the evidence, while most countries contribute one or two families. Only two Nigerian families meeting the eligibility criteria were identified within the databases and sources searched, which may understate the national evidence base, despite high cardiometabolic disease burden and the potential relevance of lower-cost nonpharmacological rehabilitation. Multicentre African studies should prioritize locally feasible exercise/PFMT pathways, access, adherence, costs and patient-reported acceptability rather than simply reproducing device protocols developed in better-resourced settings.

Methodological priorities include standardized shockwave device and dose reporting, use of clinically interpretable change thresholds, longer follow-up, better harms reporting, and stratification by metabolic

and blood-pressure control. Patient/partner satisfaction, sexual quality of life, participation, adherence and health-economic outcomes are rarely prioritized. The registry-only families also highlight a publication gap: completed or terminated studies may remain uninformative if results are not disseminated.

4.7 Strengths and limitations

Strengths include a prespecified cardiometabolic eligibility framework, dual title/abstract screening, a calibration exercise with high inter-reviewer agreement, study-family linkage to prevent double counting, detailed dose/outcome charting, separation of registry-only from outcome-bearing evidence, and independent second-reviewer screening and verification of the full 44-source, 41-family included evidence set. The final disposition audit also corrected an overly restrictive application of the protocol's mixed-sample rule and separated reports not retrieved from true exclusions, improving PRISMA transparency.

Several limitations remain. First, the loaded search set did not include final PACTR capture and several planned subscription databases (Scopus, Embase, Web of Science, CINAHL and ProQuest) were not executed because access was unavailable; relevant evidence may therefore have been missed. This review therefore maps the literature identifiable through the sources that were accessible to the authors and does not claim comprehensive coverage of the major bibliographic databases. Exact execution dates and some supplementary query strings were also not consistently preserved, limiting full PRISMA-S reproducibility. Second, Tsai 2017 was identified during a later eligibility/citation audit and is transparently reported under PRISMA other methods. Third, the evidence base includes two conference abstracts, one preprint and four registry-only families, which were deliberately down-weighted. Fourth, no formal design-specific risk-of-bias appraisal was performed. Fifth, phosphodiesterase type 5 inhibitor (PDE5i) co-therapy was not charted as a dedicated extraction variable. Several included studies continued, supplied or permitted PDE5i during the intervention period, so improvements in erectile function cannot always be attributed to the physical intervention alone, and this should be treated as a systematic confounder across the map. Finally, substantial heterogeneity in populations, intervention dose, comparators, co-interventions and outcomes made quantitative pooling inappropriate for this scoping objective.

4.8 Implications for future research

- Prospectively stratify diabetes by HbA1c/metabolic control, complications, ED severity and ED duration, and hypertension by measured control and medication class.
- Standardize and fully report shockwave device, energy flux density, shock count, treatment sites, session frequency and total treatment exposure.
- Develop adequately powered comparative trials of exercise, PFMT and multimodal physiotherapy, including head-to-head or factorial designs rather than uncontrolled add-on programmes.
- Use clinically interpretable outcomes (IIEF-EF/IIEF-5 MCID, EHS, sexual quality of life, partner outcomes, adherence, harms and cost) and follow participants beyond 6-12 months.
- Increase physiotherapy-led and African multicentre research, with pragmatic delivery models suitable for resource-constrained cardiometabolic services.
- Publish results from completed registries and clearly report negative or null studies to reduce publication and selective-outcome bias.

5. CONCLUSION

Physical and rehabilitation-based management of ED in men with diabetes and/or hypertension is an active but uneven field. Li-ESWT is by far the most studied modality, with multiple favourable trials but substantial protocol heterogeneity and a recurring signal of poorer response or reduced durability in severe

or uncontrolled diabetes. Exercise and lifestyle interventions have a smaller yet clinically coherent evidence base, while PFMT and other physical modalities remain emerging. The mapped evidence supports the further evaluation and development of rehabilitation approaches within multidisciplinary ED care, rather than establishing their comparative effectiveness, and it points to better stratified, standardized and longer-term comparative trials rather than assuming a uniform treatment effect across cardiometabolic populations.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

AUTHORS' CONTRIBUTIONS

- K. G. Opabunmi contributed to conceptualization, methodology, investigation, data curation, formal analysis, visualization, project administration, writing of the original draft as well as review and editing.
- O. H. Tony-Okpalaobi contributed to methodology, validation, investigation, independent screening and verification of the included evidence set as well as review and editing.
- U. U. Ozoekwe contributed to investigation, data curation, validation, reference and source verification as well as review and editing.
- O. D. Akinwusi contributed to methodology, formal analysis, interpretation of findings, critical revision of the manuscript as well as review and editing.
- A. S. Musa contributed to data curation, supplementary-material verification, study-family cross-checking, review of visualizations and tables as well as review and editing. All authors read and approved the final manuscript and accept accountability for the work.

CONSENT

Not applicable. This scoping review did not involve direct contact with human participants or use identifiable participant-level data.

ETHICAL APPROVAL

Not applicable. This review synthesized published reports and publicly available trial-registry information and involved no new recruitment, intervention or collection of participant-level data.

DATA AVAILABILITY

The data supporting this scoping review are contained within the article and accompanying supplementary materials. Additional charting, study-family consolidation, PRISMA disposition and verification records are available from the corresponding author upon reasonable request.

PROTOCOL REGISTRATION

The a priori protocol was prospectively registered on the Open Science Framework before formal screening (OSF registration QJ6RM; DOI: <https://doi.org/10.17605/OSF.IO/QJ6RM>; <https://osf.io/qj6rm/>).

USE OF AI-ASSISTED TECHNOLOGY

ChatGPT (OpenAI; GPT-5.6 Sol) and Claude (Anthropic) supported file organization, formatting of the screening and charting templates, retrieval support, construction of reconciliation tables, language editing and manuscript drafting, as described in Methods. No screening, eligibility, family-linkage or data-extraction decision was made by an AI tool. AI output was not treated as a primary evidence source, reviewer or author. The human authors are responsible for factual accuracy, source attribution, originality, interpretation and the final submitted content.

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