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Exercise Based Rehabilitation for Chemotherapy Induced Peripheral Neuropathy: Implications for Balance, Gait and Fall Prevention - A Structured Narrative Review

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Abstract:
Background: Chemotherapy-induced peripheral neuropathy (CIPN) is a frequent, dose-limiting complication of taxanes, platinum compounds, vinca alkaloids and other neurotoxic agents. Sensory loss, pain, weakness and impaired proprioception can disturb balance, gait and participation while increasing fall risk. Pharmacological options have limited preventive efficacy, creating a clinically important role for rehabilitation. Objective: To synthesize literature published from 2012 through 2020 on exercise-based rehabilitation for adults with CIPN, with emphasis on balance, gait and fall prevention. Methods: A structured narrative review framework was used. Peer-reviewed English-language studies and guidance published between January 2012 and December 2020 were considered when they addressed CIPN assessment, functional consequences, exercise, sensorimotor training, balance, strength, gait or falls. Evidence was interpreted clinically rather than pooled statistically. Results: The literature supports the feasibility of individualized aerobic, resistance, balance and sensorimotor exercise during and after chemotherapy. Multimodal programmes show promising improvements in patient-reported symptoms, postural control, lower-limb strength and functional performance, although trials are heterogeneous and frequently small. Exercise should complement oncology management, not replace dose modification or evidence-based treatment of neuropathic pain. Screening for sensory loss, weakness, orthostatic symptoms and environmental hazards is essential. Conclusion: Physiotherapists can translate emerging evidence into a staged programme that combines safety education, progressive strengthening, balance challenge, gait practice and regular reassessment. Larger trials with standardized CIPN outcomes and fall endpoints are required.

Keywords: chemotherapy-induced peripheral neuropathy; exercise; physiotherapy; balance; gait; falls; oncology rehabilitation

Introduction

Cancer survival has improved, but treatment-related morbidity increasingly shapes the long-term health of survivors. Chemotherapy-induced peripheral neuropathy (CIPN) is among the most disabling neurological complications of systemic cancer therapy. It is commonly associated with taxanes, platinum compounds, vinca alkaloids, bortezomib and thalidomide-related agents. Symptoms often begin distally in a symmetrical stocking-and-glove distribution and include numbness, tingling, burning pain, altered temperature sensation and impaired vibration or joint-position sense. Motor involvement may produce distal weakness, reduced ankle control and slower protective stepping, while autonomic involvement may contribute to dizziness or orthostatic intolerance. The result is not merely discomfort: CIPN may prompt chemotherapy dose reduction or discontinuation, interfere with work and self-care, and persist after treatment has ended (Park et al., 2013; Staff et al., 2017).

The burden is clinically substantial. A systematic review and meta-analysis reported that neuropathy is common during neurotoxic chemotherapy and may remain present months after treatment, with risk influenced by drug, cumulative dose and patient factors (Seretny et al., 2014). Conventional symptom-focused care is constrained by limited preventive options. The American Society of Clinical Oncology (ASCO) guidelines published in 2014 and updated in 2020 emphasized the absence of a consistently effective preventive drug and identified duloxetine as the medication with the strongest evidence for established painful CIPN, while also stressing clinical judgment about neurotoxic chemotherapy exposure (Hershman et al., 2014; Loprinzi et al., 2020). These limitations make non-pharmacological rehabilitation important, particularly when functional deficits rather than pain alone dominate the clinical picture.

Exercise is biologically and clinically plausible because it can address modifiable consequences of neuropathy even when it does not reverse axonal injury. Strength training can increase force-generating capacity; sensorimotor activities may improve the use of remaining afferent information; balance practice can strengthen anticipatory and reactive control; and aerobic training can reduce deconditioning associated with cancer treatment. Exercise may also support fatigue management, confidence and participation. During the 2012–2020 period, clinical trials and reviews began to report favourable signals for multimodal exercise, sensorimotor training and technology-supported balance rehabilitation in people with CIPN (Duregon et al., 2018; Kleckner et al., 2018; Streckmann et al., 2019; Zimmer et al., 2018).

Physiotherapy is therefore positioned at the interface between oncology safety and functional recovery. A physiotherapist can identify fall hazards, quantify strength and mobility, prescribe an individually dosed programme, and communicate deterioration that may require medical reassessment. However, the evidence base remains heterogeneous in cancer type, chemotherapy exposure, neuropathy definition, exercise dose and outcome measurement. A balanced review must distinguish promising clinical findings from definitive proof. This structured narrative review synthesizes evidence published from 2012 through 2020 and focuses specifically on the implications of exercise-based rehabilitation for balance, gait and fall prevention.

Review Aim and Methodological Approach

The aim was to describe the functional consequences of CIPN and critically synthesize exercise-based rehabilitation approaches relevant to balance, gait and falls. A structured narrative method was selected because the literature includes randomized trials, pilot studies, observational research, systematic reviews, clinical guidance and mechanistic papers with substantial methodological diversity. The review was organized around clinically answerable questions: how CIPN affects mobility; which assessments are useful for physiotherapy; what exercise components have been studied; how interventions can be progressed safely; and where evidence remains insufficient.

Literature eligibility was restricted to peer-reviewed English-language publications from January 2012 to December 2020. Priority was given to PubMed-indexed research involving adults exposed to neurotoxic chemotherapy and reporting neuropathy symptoms, physical function, balance, gait, strength, falls or exercise outcomes. Relevant cancer rehabilitation guidance and systematic reviews within the same date window were used to contextualize intervention studies. Publications before 2012 and after 2020 were excluded to comply with the predefined evidence period. Because this is a narrative review, no new participant data were collected, no meta-analysis was performed, and no claims of exhaustive systematic retrieval are made.

Interpretation emphasized clinical applicability and risk. A positive change in a symptom score was not assumed to establish fall prevention unless falls or a validated functional surrogate were reported. Similarly, results from supervised programmes were not automatically generalized to unsupervised home exercise. Findings were considered alongside sample size, intervention specificity, adherence, concurrent treatment and safety reporting. This approach permits practical recommendations while retaining appropriate caution about certainty.

Pathophysiology and Functional Expression of CIPN

CIPN is not a single uniform disorder. Different agents produce overlapping but distinct patterns of neurotoxicity. Platinum compounds can damage dorsal-root ganglion neurons and produce sensory neuronopathy; taxanes disrupt microtubule-dependent axonal transport; vinca alkaloids interfere with microtubules and may produce sensory and motor deficits; and proteasome inhibitors can generate painful sensory neuropathy. Oxidative stress, mitochondrial dysfunction, altered ion-channel activity, neuroinflammation and impaired axonal transport are among the interacting mechanisms described in contemporary reviews (Park et al., 2013; Starobova & Vetter, 2017; Staff et al., 2017). These mechanisms help explain why symptoms can progress during cumulative exposure and why recovery may be incomplete.

From a movement perspective, loss of plantar sensation and proprioception reduces the reliability of somatosensory information used to regulate the centre of mass over the base of support. Patients may compensate by increasing visual dependence, widening step width, slowing walking or avoiding low-light and uneven environments. Distal weakness can reduce ankle strategy effectiveness, toe clearance and the ability to generate a rapid corrective step. Pain may further alter loading and reduce activity. When fatigue, anaemia, cachexia, arthralgia, vestibular dysfunction or sedating medication coexists, mobility risk becomes multifactorial rather than attributable to neuropathy alone.

Evidence from cancer survivors demonstrates that CIPN is associated with clinically meaningful functional impairment. Falls research has linked greater neuropathy severity and motor symptoms with increased fall risk (Tofthagen et al., 2012). In a cooperative-group study, survivors with CIPN showed

falls and functional limitations, emphasizing that symptom reports should trigger mobility evaluation rather than remain a medication-only issue (Gewandter et al., 2013). Objective work has also documented postural instability and gait changes among people receiving or having completed neurotoxic chemotherapy. These observations are consistent with a rehabilitation model in which sensory impairment interacts with strength, attention, environment and task demands.

Fear of falling can amplify disability. A patient who experiences unsteadiness may restrict walking, stairs or community activity. Reduced exposure then contributes to weakness and poorer endurance, reinforcing instability. This cycle is particularly concerning in older adults, who may already have age-related sensory decline, sarcopenia or comorbid diabetes. Physiotherapy should therefore address not only impairment but also confidence, graded participation and environmental safety. The therapeutic target is safer function using remaining sensory and motor capacity, not an unsupported promise of nerve regeneration.

Physiotherapy Assessment

Assessment should begin with oncology context. The physiotherapist should identify the neurotoxic agent, treatment schedule, cumulative exposure when available, timing of symptom onset, trajectory and any recent dose change. Red flags requiring prompt medical communication include rapidly progressive weakness, asymmetrical deficit, new bowel or bladder dysfunction, acute severe back pain, cranial nerve signs, suspected infection, thrombosis, pathological fracture or an abrupt change inconsistent with typical distal symmetrical CIPN. Comorbid diabetes, alcohol-related neuropathy, vitamin deficiency, spinal disease and pre-existing neurological conditions may contribute to the presentation.

Patient-reported symptoms should be documented systematically. Useful domains include numbness, tingling, burning pain, sensitivity to touch, hand dexterity, foot awareness, sleep disturbance and interference with activities. Clinician grading systems such as the National Cancer Institute Common Terminology Criteria for Adverse Events are widely used but may be insensitive to subtle change. Patient-reported measures, including the European Organisation for Research and Treatment of Cancer CIPN questionnaire and Functional Assessment of Cancer Therapy/Gynecologic Oncology Group neurotoxicity instruments, can complement examination. No single tool captures the full sensory, motor and functional phenotype; combining report and performance is preferable (Griffith et al., 2014; Haryani et al., 2017).

The physical examination should include light touch, vibration or joint-position sense where appropriate, reflexes, distal and proximal strength, ankle range of motion, foot condition and footwear. Functional testing can include comfortable and fast gait speed, Timed Up and Go, five-times sit-to-stand, repeated chair rise, tandem stance, single-limb stance when safe, and a standardized balance scale selected for the setting. Longer walking tests may help characterize endurance, although fatigue and cardiopulmonary limitations must be considered. Observation should note step width, foot clearance, turning, dual-task cost, reliance on vision and performance on variable surfaces.

Fall history requires direct questions: any fall in the previous year, near-falls, circumstances, injury, time of day, footwear and use of an assistive device. Home hazards such as loose rugs, poor lighting, clutter, pets, slippery bathrooms and unmarked steps should be reviewed. Medication burden, orthostatic symptoms and visual impairment are relevant. A person who appears stable in a quiet clinic may remain unsafe when carrying objects, turning quickly, walking in dim light or navigating crowded environments.

Assessment should end with a shared problem list and measurable goals. Examples include improving chair-rise performance, increasing safe walking duration, negotiating stairs with a rail, reducing near-falls, resuming community walking or maintaining chemotherapy participation without avoidable deconditioning. Reassessment should use the same measures and record changes in treatment status, symptoms and adverse events.

Evidence for Exercise-Based Rehabilitation

The 2012–2020 evidence base suggests benefit but does not support a single universal protocol. Studies vary in whether exercise begins during chemotherapy or after treatment, whether participants have established CIPN or are at risk, and whether neuropathy is defined by symptoms, clinical grading or objective testing. Interventions include walking, aerobic conditioning, resistance exercise, balance tasks, sensorimotor training, whole-body vibration and combinations of these components.

Kleckner et al. (2018) evaluated exercise during neurotoxic chemotherapy within a nationwide randomized trial and reported favourable effects on CIPN symptoms. The intervention combined walking and resistance exercise, supporting the feasibility of embedding physical activity into active treatment. The results are important because they suggest that exercise need not wait until survivorship; however, symptom outcomes and the pragmatic nature of the programme limit conclusions about specific mechanisms or fall reduction.

Zimmer et al. (2018) examined an eight-week multimodal exercise programme in patients with metastatic colorectal cancer receiving chemotherapy. Exercise counteracted progression of neuropathy and improved balance and strength. This study illustrates the value of combining components: resistance work targets force production, balance tasks address postural control, and aerobic activity supports general capacity. It also shows that appropriately screened patients with advanced disease may participate, although generalization requires careful attention to medical status.

Streckmann et al. (2019) studied sensorimotor training and whole-body vibration in people with haematological malignancies and CIPN. The findings suggested potential improvements in sensory and motor symptoms. Sensorimotor training is attractive because it challenges postural regulation using progressively narrower bases of support, reduced hand support, controlled perturbation and varied sensory conditions. Whole-body vibration may offer an additional stimulus, but access, contraindications and heterogeneity of devices make it less universally applicable than conventional exercise.

McCrary et al. (2019) reported encouraging results for individualized multimodal rehabilitation in survivors with persistent CIPN. The clinical significance lies in addressing chronic impairment rather than only acute prevention. Persistent neuropathy can coexist with long-standing avoidance and deconditioning; thus a programme may improve function even when sensory symptoms remain. The intervention supports individualized dose adjustment according to baseline deficits and tolerance.

Systematic review evidence available within the period reached cautiously favourable conclusions. Duregon et al. (2018) found that exercise may improve CIPN-related symptoms and physical function, with combined endurance, strength and sensorimotor approaches appearing particularly promising. Yet small samples, variable measures and risk of bias reduce certainty. Reviews of non-pharmacological management similarly emphasized the need for more rigorous trials rather than presenting exercise as established disease-modifying therapy.

Across studies, the most defensible interpretation is that exercise is feasible for many patients and may improve symptoms or functional consequences. Evidence is stronger for intermediate outcomes such as

strength, balance performance and self-reported symptoms than for actual fall reduction. Falls require large samples and prolonged observation; few exercise trials were powered for this endpoint. Therefore, fall prevention recommendations draw on CIPN-specific evidence plus established rehabilitation principles, and this distinction should be transparent.

Components of a Multimodal Physiotherapy Programme

A multimodal programme should be individualized rather than copied from a fixed template. The starting dose depends on cancer status, blood counts, fatigue, pain, bone integrity, cardiopulmonary function, pre-treatment activity and the severity of sensory or motor impairment. The physiotherapist should coordinate with the oncology team when medical stability is uncertain.

Aerobic exercise supports endurance, circulation, fatigue management and general health. Walking is accessible but may be unsafe for a person with marked foot numbness or poor balance. A stationary cycle, recumbent stepper or supported treadmill can reduce environmental risk. A practical starting prescription is short accumulated bouts at light-to-moderate perceived exertion, progressed by duration before intensity. Symptom response during the following 24–48 hours should guide adjustment. Aerobic exercise should not be framed as a direct cure for neuropathy; its major contribution may be preserving conditioning and activity participation.

Resistance training targets weakness that magnifies sensory loss. Priority muscle groups commonly include ankle dorsiflexors and plantar flexors, knee extensors, hip abductors and extensors, trunk musculature and upper-limb muscles required for assistive-device use. Functional exercises such as sit-to-stand, supported heel raises, step-ups and resisted walking can complement isolated strengthening. Loads should permit controlled technique without breath holding or excessive fatigue. Progression may occur through repetitions, resistance, range, reduced upper-limb support or task complexity. Bone metastases, thrombocytopenia, recent surgery and central-line considerations require modification.

Balance and sensorimotor training should progress across base of support, surface, visual input and task complexity. Early activities may include weight shifting, semi-tandem stance and stepping with stable hand support. Later stages can add multidirectional reaching, obstacle negotiation, changes in speed, head turns, compliant surfaces and carefully selected dual tasks. Reducing vision can increase reliance on somatosensory and vestibular information, but marked plantar sensory loss may make eyes-closed tasks hazardous. Close guarding and external support are mandatory until safety is demonstrated.

Gait training should address the situations in which instability occurs. Practice may include initiation, stopping, turning, backward or lateral stepping, speed changes, stairs, curbs and variable surfaces. Verbal or visual cueing can improve foot clearance and step consistency. An assistive device should be prescribed according to objective need, not stigma. A cane may be inadequate when bilateral sensory loss and substantial instability are present; a walker can increase the base of support but requires adequate upper-limb function and training. Device height, sequencing and community use must be checked.

Flexibility and mobility exercise can maintain ankle dorsiflexion, calf length and comfortable movement, but aggressive stretching over insensate tissue should be avoided. Foot care education is essential: daily skin inspection, appropriate footwear, avoidance of extreme temperatures and early reporting of wounds. Patients with hand symptoms may need strategies for grip, buttons and household tasks, with occupational therapy referral when indicated.

Home programmes should be simple, written clearly and linked to daily routines. High-risk balance tasks should remain supervised. Family members can support environmental modification and adherence without providing unsafe manual assistance. Remote follow-up may help monitor progression, but technology cannot substitute for an initial safety assessment in a patient with significant instability.

Clinical Progression Framework

A staged framework can translate heterogeneous evidence into practice. Stage 1 emphasizes safety and baseline capacity. Education, footwear, home hazards, symptom monitoring and low-risk conditioning are introduced. Exercises use stable support, predictable environments and moderate volumes. The goal is correct performance without symptom exacerbation or near-falls.

Stage 2 develops capacity. Resistance and aerobic duration progress gradually, while balance tasks challenge weight transfer, step control and sensory integration. Functional tasks are selected according to patient goals. Performance should remain controlled, and recovery between cancer treatments may require flexible scheduling.

Stage 3 targets adaptability and participation. Training includes community-relevant challenges such as obstacle negotiation, direction changes, carrying light objects, variable surfaces or dual tasks. The physiotherapist should distinguish productive challenge from preventable risk. Difficulty is increased one dimension at a time so the cause of instability remains observable.

Stage 4 emphasizes self-management. The patient continues aerobic and resistance activity, retains selected balance exercises, monitors symptoms and knows when to seek review. Discharge is not appropriate solely because chemotherapy has ended; persistent CIPN may warrant continued rehabilitation or periodic reassessment. Conversely, indefinite supervised treatment is unnecessary when goals are met and the patient can progress safely.

Frequency and dose should be documented using type, intensity, time and frequency, together with supervision level and progression criteria. During active chemotherapy, daily readiness can vary. A symptom-guided approach may reduce volume on days of pronounced fatigue, nausea or orthostatic symptoms while preserving regularity. Any sudden neurological deterioration should pause progression and prompt oncology review.

Fall Prevention and Safety

Fall prevention requires more than balance exercises. It combines impairment treatment, behaviour, environment and medical coordination. Patients should be advised to use adequate lighting, install handrails where appropriate, remove loose rugs and clutter, use non-slip bathroom strategies and avoid walking barefoot on insensate feet. Night-time routes to the bathroom deserve particular attention. Outdoor advice may include avoiding uneven terrain when fatigued, planning rest stops and using an appropriate device.

Exercise safety screening should consider infection, fever, symptomatic anaemia, severe thrombocytopenia, uncontrolled pain, acute cardiopulmonary symptoms, unstable bone lesions and recent surgical restrictions. Exact exercise decisions should follow oncology guidance and local policy rather than a rigid blood-count rule detached from clinical context. Peripheral intravenous lines, ports and surgical sites influence loading and movement choices.

Pain is not a reliable guide to tissue risk when sensation is impaired. The physiotherapist should inspect feet, footwear and pressure areas and teach the patient to do the same. Thermal modalities require

caution because reduced temperature sensation increases burn risk. Manual techniques should not be applied aggressively to fragile or insensate tissues. Exercise that provokes persistent neurological worsening, repeated near-falls, chest symptoms or unusual systemic fatigue should be stopped and reviewed.

Adherence improves when goals are meaningful and the programme is achievable. Patients may fear that movement will worsen neuropathy, while others may overexert in an attempt to recover quickly. Education should explain that gradual training aims to improve function and compensate for deficits. Use of an activity log, perceived-exertion scale and scheduled review can support self-management. Supervision is particularly valuable at programme initiation and after chemotherapy-related changes.

Implications for Physiotherapy Practice

The evidence supports routine functional screening when patients report CIPN. Physiotherapists should not wait for a fall before assessing gait and balance. Oncology services can incorporate brief mobility questions and referral criteria, including new difficulty with stairs, repeated tripping, near-falls, reduced walking or inability to feel the feet. Early referral may prevent the secondary cycle of inactivity and deconditioning.

Interprofessional communication is central. The physiotherapist should provide concise information about functional change, fall events and progression, while oncologists determine chemotherapy modification and pharmacological management. Nurses reinforce symptom reporting and foot care; occupational therapists address hand function and home activities; dietitians and psychosocial professionals address additional barriers. Rehabilitation should be presented as complementary to, not competitive with, cancer treatment.

Documentation should separate neuropathy symptoms from functional outcomes. A patient may report unchanged numbness yet demonstrate faster gait, safer turning and improved chair rise. Conversely, reduced pain does not guarantee restored proprioception or fall safety. Capturing both domains provides a more accurate account of benefit.

Resource-limited settings can implement core elements without specialized technology. Progressive resistance using body weight or bands, supported balance practice, gait training and education are feasible when delivered by trained professionals. Sensor platforms and vibration devices may enhance feedback or research measurement but are not prerequisites for high-quality care. Clinical reasoning, supervision and progression remain the primary technologies of physiotherapy.

Special Populations and Implementation Considerations

Older adults warrant particular attention because CIPN is layered onto age-related changes in vision, vestibular function, reaction time, muscle power and cognition. The chronological age of a patient should not determine eligibility for exercise; rather, assessment should identify physiological reserve, comorbidity and the level of supervision required. An older adult with mild sensory symptoms and good baseline function may safely follow a community-based programme, whereas another person of the same age with previous falls, polypharmacy and slow gait may require closely guarded balance training and an assistive device. Chair-based aerobic activity, supported resistance work and repeated functional practice can provide a starting point for people with limited standing tolerance. Progression should prioritize movement quality and repeatability rather than rapid increases in load.

People with advanced cancer also require individualized decisions. Metastatic disease does not automatically preclude exercise, as the multimodal trial by Zimmer et al. (2018) illustrates, but the location and stability of bone metastases, pain, fatigue, nutritional status and prognosis influence goals. Rehabilitation may aim to preserve transfers, prevent avoidable dependence, support safe home mobility or enable participation in valued activities rather than restore premorbid fitness. Exercise selection should minimize load across vulnerable skeletal sites, and new focal bone pain requires medical evaluation. The programme must be responsive to changes in treatment and disease rather than tied to a fixed progression calendar.

Diabetes and pre-existing neuropathy complicate attribution and may increase risk. Baseline sensory testing before or early in chemotherapy can help distinguish pre-treatment deficit from subsequent change. These patients need particularly careful skin inspection, footwear advice and glycaemic management through the appropriate medical team. Because sensory feedback may already be reduced, functional tests and fall history become central to monitoring. The physiotherapist should avoid assuming that all deterioration is inevitable or chemotherapy-related; asymmetry, rapid progression or prominent motor loss requires further assessment.

Upper-limb CIPN can indirectly influence mobility. Impaired grip may make a cane or walker difficult to control, and hand numbness can reduce the ability to hold a rail, manage brakes or recover from a loss of balance. Device trials should therefore assess grip security, pain and endurance as well as lower-limb stability. Padded handles, alternative devices or occupational therapy input may be required. Similarly, a patient with marked foot sensory loss may need visual strategies and deliberate foot placement, but excessive downward gaze can alter posture and limit environmental scanning. Training should gradually integrate safe visual checking with forward attention.

Timing within the chemotherapy cycle can influence participation. Some patients experience predictable days of fatigue, nausea, pain or dizziness following infusion. Scheduling higher-demand supervised sessions during relatively stable periods and prescribing lower-intensity mobility on difficult days may improve adherence. This flexible approach is not the same as abandoning exercise whenever symptoms occur. Instead, it preserves a regular rehabilitation habit while acknowledging treatment-related variation. Clinicians should document the relationship between exercise tolerance and the treatment cycle so future sessions can be planned intelligently.

Implementation within oncology pathways is facilitated by simple referral triggers and shared documentation. A short screening process can ask about numb feet, difficulty walking, near-falls and falls, followed by a mobility test when any response is positive. High-risk patients can receive full physiotherapy assessment, while those with mild symptoms receive education and monitoring. Clear escalation pathways are required for new weakness, rapid progression and recurrent falls. Such a tiered system may be more feasible than referring every person exposed to a neurotoxic agent.

Group exercise can expand access for medically stable participants, but baseline assessment remains necessary. Group leaders must be able to modify tasks, provide stable supports and recognize treatment-related warning signs. Individuals with substantial instability should not perform challenging eyes-closed or unstable-surface activities in a crowded setting. Home-based programmes can extend training frequency, yet adherence and technique should be reviewed. Telephone or video follow-up may support symptom monitoring, while in-person review remains important when gait changes, a fall occurs or an assistive device is being considered.

Cultural and socioeconomic context shapes feasibility. Advice to use specialized equipment, large indoor spaces or repeated hospital visits may be unrealistic. Programmes can use household chairs, steps, low-cost resistance bands and safe walking routes, provided risks are assessed. Education should be available in language that the patient and family understand, using demonstrations rather than technical terminology alone. Family support can improve confidence and environmental safety, but caregivers should be taught not to pull on the patient's arm or offer unstable assistance. A sustainable programme is one the patient can perform correctly, safely and consistently within real living conditions.

Limitations of the Evidence and Research Priorities

Several limitations constrain conclusions. Many trials have small samples and combine different cancers, agents and neuropathy severities. CIPN definitions and outcomes vary, making comparison difficult. Some studies evaluate exercise during chemotherapy as prevention, while others treat persistent symptoms after exposure. Exercise components are frequently bundled, so the contribution of balance, resistance or aerobic training cannot be isolated. Blinding participants and therapists is generally impossible, and adherence may select healthier individuals.

Fall outcomes are especially underdeveloped. Improvements on a balance test may be clinically useful but do not prove fewer falls. Future trials should prospectively record falls and near-falls using consistent methods and adequate follow-up. Stratification by neurotoxic agent, baseline neuropathy, age and comorbidity would improve applicability. Core outcome sets should include patient-reported symptoms, objective sensory examination, strength, balance, gait, participation, quality of life and adverse events.

Dose-response research is needed. Studies should report intensity, duration, supervision, progression and fidelity sufficiently for replication. Comparative designs could test targeted sensorimotor training against general exercise, or supervised initiation followed by home-based maintenance. Economic evaluation and implementation research are relevant because oncology rehabilitation access remains uneven.

Mechanistic claims should remain cautious. Functional improvement may arise from stronger muscles, better attention, confidence or sensory reweighting without measurable nerve recovery. Future studies combining clinical outcomes with neurophysiological measures may clarify pathways. Until then, the practical rationale for exercise rests on improving function and safety despite persistent sensory injury.

Conclusion

CIPN can compromise sensation, strength, balance, gait and independence during and after cancer treatment. Literature published from 2012 through 2020 provides encouraging, though not definitive, evidence that individualized exercise-based rehabilitation can reduce symptom burden and improve functional outcomes. Multimodal programmes combining aerobic conditioning, progressive resistance, balance or sensorimotor training and task-specific gait practice appear most clinically relevant.

Physiotherapists should use comprehensive assessment, staged progression and fall-prevention education, with close communication with the oncology team. Exercise is not a substitute for medical decisions about neurotoxic chemotherapy or pharmacological care, and evidence for reducing actual falls remains limited. Nevertheless, addressing modifiable weakness, deconditioning and postural control offers a rational route to safer mobility and greater participation. Standardized, adequately powered trials are required to determine optimal dose, identify responders and establish whether functional gains translate into sustained fall reduction.

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