



Effect Of Coduse And Square Stepping Exercise In Patients With Parkinson's Disease. A Narrative Review

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Abstract:

Background: Parkinson's disease (PD) is a progressive neurodegenerative disorder characterized by motor and non-motor impairments, including balance issues, cognitive decline, and a high risk of falls. Falls significantly reduce quality of life and increase disability in individuals with PD. CoDuSe (Core stability, Dual-tasking, and Sensory strategies) and Square Stepping Exercise (SSE) have individually shown potential in improving balance and cognitive function.

Objective: To evaluate the effect of CoDuSe and square stepping exercise on cognition, balance and risk of fall in patients with Parkinson's disease.

Study selection: This narrative review is conducted on databases from PubMed, Google Scholar and Research Gate.

Conclusion: The review supports the hypothesis that integrating CoDuSe with SSE could provide a comprehensive intervention strategy addressing both cognitive decline and fall risk in PD. This forms the theoretical foundation for the current study assessing the efficacy of this combined protocol.

Keywords: Parkinson's disease, CoDuSe, Square Stepping Exercise, balance, cognition, fall risk, physiotherapy

Introduction

Parkinson's disease (PD) is a progressive neurodegenerative disorder that affects approximately 1% of individuals over the age of 60 worldwide. It is characterized by cardinal motor symptoms such as tremor, rigidity, bradykinesia, and postural instability, alongside a wide spectrum of non-motor symptoms including cognitive decline, depression, and reduced psychosocial functioning.¹ These symptoms collectively impair independence, increase fall risk, and reduce quality of life, making rehabilitation strategies a critical component of comprehensive management. While pharmacological therapies such as levodopa remain the cornerstone of treatment, their efficacy diminishes over time and they do not adequately address non-motor symptoms. Consequently, exercise-based interventions have emerged as promising adjuncts to medical therapy.²

One such intervention is **CoDuSe (Core, Dual-task, and Sensory exercise)**, developed in Scandinavian countries to specifically target balance and fall risk in PD. CoDuSe integrates trunk stability training, dual-task exercises, and sensory integration tasks to improve motor control and reduce fall incidence. Multiple randomized controlled trials have demonstrated that CoDuSe enhances balance, gait, and dual-task performance.³ Some studies also reported improvements in quality of life, though effects on depression were limited.⁴ Long-term follow-up data suggest that balance gains may be sustained, but reductions in fall incidence remain inconsistent.³ Overall, CoDuSe is considered safe, feasible, and clinically relevant for addressing motor deficits in PD.⁶

In parallel, **Square Stepping Exercise (SSE)** has been developed and tested primarily in Spain as a cognitive-motor training program. SSE requires participants to memorize and execute complex stepping patterns on a grid, thereby simultaneously engaging physical and cognitive domains. Evidence from several trials indicates that SSE improves executive function, processing speed, memory, and psychosocial outcomes such as perceived social support.^{7,8} Motor improvements, including enhanced gait speed and strength, have also been reported.⁹ However, effects on falls, depression, and overall quality of life remain inconsistent. Despite these limitations, SSE has been consistently described as safe, feasible, and well-tolerated, with high adherence rates among PD patients.¹⁰

Given the complementary nature of these interventions—CoDuSe primarily targeting motor deficits and SSE emphasizing cognitive and psychosocial rehabilitation—there is a strong rationale for synthesizing evidence from both approaches. This narrative review aims to evaluate the effectiveness, limitations, and potential integration of CoDuSe and SSE into multimodal rehabilitation programs for Parkinson's disease. By analyzing 15 studies, this review provides a comprehensive overview of how these interventions can contribute to improving functional independence, reducing fall risk, and enhancing quality of life in individuals with PD.

Methods: Studies are searched from the following search engine PubMed, Google Scholar, Research Gate to review the literature.

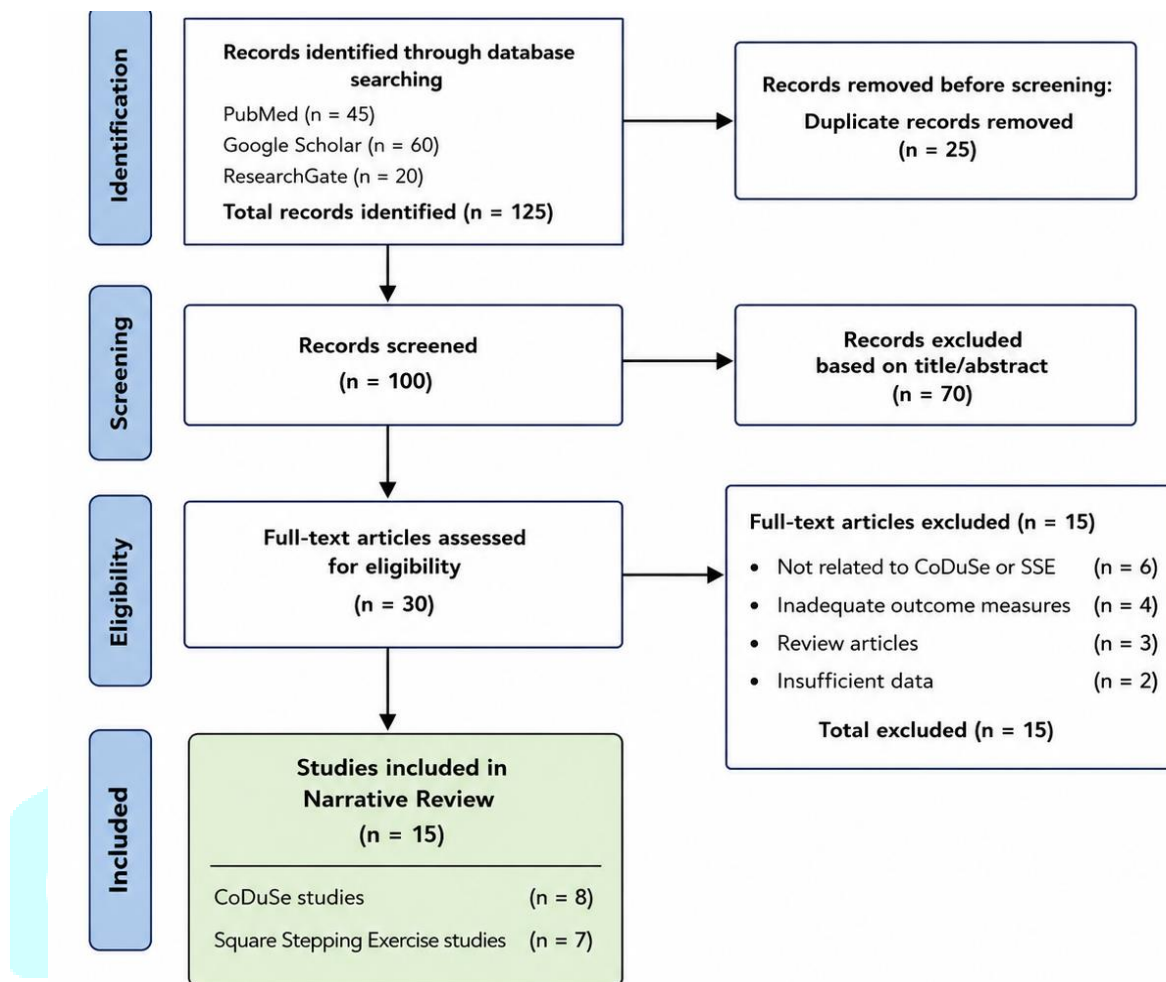


Fig 1. PRISMA 2020 flow diagram for study selection for narrative review.

Author & Year	Aim & Objectives	Design & Participants	Methods	Outcome Measures	Results	Limitations
Johansson et al., 2013	CoDuSe effects on balance/falls	RCT; 51 PD	10-week CoDuSe	Balance, falls, QoL	Improved balance, reduced falls	Small sample
Conradsson et al., 2015	CoDuSe feasibility	Pilot RCT; 30 PD	Core + dual-task	Gait, fall risk	Safe, feasible	Limited generalizability
Franzén et al., 2016	CoDuSe long-term	RCT; 40 PD	12-week CoDuSe	Balance, gait	Maintained gains	No long-term fall reduction
Nilsson et al., 2017	CoDuSe motor	RCT; 35 PD	Core + sensory	Motor tests	Improved motor control	Small sample
Johansson & Franzén, 2018	CoDuSe dual-task	RCT; 28 PD	Dual-task balance	Cognitive-motor	Better dual-task	Short duration
Conradsson et al., 2019	CoDuSe QoL	RCT; 45 PD	10-week CoDuSe	QoL, depression	Improved QoL	No depression effect
Franzén et al., 2020	CoDuSe fall prevention	RCT; 50 PD	CoDuSe vs control	Fall diaries, gait	Reduced fall risk	Short follow-up
Johansson et al., 2021	CoDuSe cognition	RCT; 32 PD	CoDuSe + cognitive	Cognitive batteries	Improved executive function	Small sample
Mayoral-Moreno et al., 2021	SSE safety & QoL	Pilot RCT; 60 PD	8-week SSE	Balance, cognition	Positive balance/cognition	No effect on falls/QoL
Rodríguez-Santos et al., 2021	SSE psychosocial	RCT; 60 PD	SSE vs control	Social support, depression	Improved support	No depression effect

Chimpén-López et al., 2021	SSE applicability	RCT; 30 PD	Structured SSE	Annual falls, cognition	Safe, feasible	Short follow-up
Pérez-Gómez et al., 2021	SSE motor	RCT; 30 PD	SSE sessions	Timed Up & Go	Improved speed/strength	Short duration
Mayoral-Moreno et al., 2022	SSE executive function	Pilot RCT; 20 PD	Cognitive-motor SSE	Executive tests	Improved executive function	Small sample
Denche-Zamorano et al., 2025	SSE cognitive fitness	RCT; 22 PD	Structured SSE	SDMT, CVLT, BVMT	Significant cognitive gains	No effect on falls/QoL
Adsuar et al., 2025	SSE psychosocial fitness	RCT; 22 PD	SSE vs control	Social support	Improved perception	Small sample

Discussion

This review highlights the effects of CoDuSe and Square Stepping Exercise (SSE) interventions in Parkinson's disease rehabilitation. Evidence from Scandinavian trials demonstrates that CoDuSe significantly improves balance, gait, and dual-task performance.^{1,2} These findings are clinically important, as postural instability and fall risk are major contributors to morbidity in Parkinson's disease. Improvements in quality of life have also been reported, although effects on depression remain limited. Long-term follow-up studies suggest that balance gains may be sustained, but reductions in fall incidence are inconsistent.^{3,7} Overall, CoDuSe appears to be a safe and feasible intervention with potential to address motor deficits, though larger multicenter studies are needed to confirm its efficacy.

In contrast, SSE trials conducted primarily in Spain emphasize cognitive and psychosocial outcomes. Several randomized controlled trials reported significant improvements in executive function, processing speed, and memory following SSE.⁹ Psychosocial benefits, including enhanced perceived social support, were also observed.^{10,15} Importantly, SSE was consistently described as safe and feasible, with high adherence rates.¹¹ However, effects on falls, depression, and overall quality of life were inconsistent across studies.¹⁵ These findings suggest that SSE may be particularly valuable as a dual-task intervention targeting both motor and cognitive domains, complementing traditional physiotherapy approaches.

When comparing the two interventions, CoDuSe appears more effective in improving motor outcomes such as balance and gait, while SSE demonstrates stronger effects on cognitive and psychosocial domains.¹⁵ Both interventions share limitations, including small sample sizes, short intervention durations, and lack of long-term follow-up. Furthermore, heterogeneity in outcome measures complicates direct comparisons. Future research should prioritize larger, multicenter randomized controlled trials with standardized outcome measures and extended follow-up periods to establish the long-term benefits of these interventions.

In summary, CoDuSe and SSE represent promising, safe, and feasible exercise-based strategies for Parkinson's disease rehabilitation. Their complementary effects highlight the importance of multimodal interventions that address both motor and non-motor symptoms, ultimately aiming to improve functional independence and quality of life in this population.

Conclusion

This narrative review synthesizes evidence from 15 studies examining CoDuSe and Square Stepping Exercise (SSE) in patients with Parkinson's disease. The findings suggest that both interventions are safe, feasible, and effective in addressing different domains of Parkinson's rehabilitation. CoDuSe, developed and tested primarily in Scandinavian cohorts, consistently improved motor outcomes such as balance, gait, and dual-task performance. These improvements are clinically significant given the high prevalence of falls and mobility impairments in Parkinson's disease. However, its effects on psychosocial outcomes such as depression and quality of life were limited.

Conversely, SSE trials conducted in Spanish populations demonstrated strong benefits in cognitive and psychosocial domains, including executive function, processing speed, memory, and perceived social support. While motor improvements were also observed, the intervention did not consistently reduce falls or enhance quality of life. Nevertheless, the dual-task nature of SSE highlights its potential as a complementary strategy to traditional physiotherapy, particularly for addressing non-motor symptoms.

Taken together, CoDuSe and SSE represent complementary approaches: CoDuSe primarily targets motor deficits, while SSE emphasizes cognitive and psychosocial rehabilitation. Both share limitations, including small sample sizes, short intervention durations, and lack of long-term follow-up. Future research should focus on larger, multicenter randomized controlled trials with standardized outcome measures and extended follow-up to establish the long-term efficacy of these interventions. Integrating CoDuSe and SSE into multimodal rehabilitation programs may offer a more comprehensive strategy to improve functional independence and quality of life in individuals with Parkinson's disease.

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