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BRIEF REPORT

Is Highly Challenging and Progressive Balance Training Feasible in Older Adults With Parkinson's Disease?

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Abstract

Objective: To develop a highly challenging and progressive group balance training regime specific to Parkinson's disease (PD) symptoms and to investigate its feasibility in older adults with mild to moderate PD.

Design: Intervention study, before-after trial with a development and feasibility design.

Setting: University hospital setting.

Participants: Feasibility was evaluated in older adults (N=5; mean age, 72y; age range, 69–80y) with mild to moderate idiopathic PD.

Intervention: A balance training regime emphasizing specific and highly challenging exercises, performed 3 times per week for 12 weeks, was developed through discussion and workshops by a group of researchers and physiotherapists.

Main Outcome Measures: Indicators of feasibility included attendance rate, safety (adverse events, physical function, and pain), participants' perceptions of the intervention (level of difficulty of the exercises, motivation level, and appreciation), and efficacy of the intervention (balance performance assessed with the Mini-Balance Evaluation Systems Test [Mini-BESTest]).

Results: The incidence rate was high (93%) for attendance and low (1.2%) for adverse events. Ratings by the participants indicated progression throughout the training period. All participants considered the training motivational and stated that they would recommend it to others. The efficacy of the intervention measured with the Mini-BESTest showed that 4 out of 5 participants improved their balance performance.

Conclusions: These findings support the overall feasibility of this novel balance program in older adults with mild to moderate PD. However, to further evaluate the efficacy of the program, a larger randomized controlled trial is required.

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Parkinson's disease (PD) results in various impairments of balance performance affecting different physiological systems (motor, sensory, cognitive)[1,2] that contribute to a negative trend of declining physical activity accompanied by falls, injuries, and decreased quality of life.[1] Exercise is nowadays regarded essential in PD treatment, and new findings suggest that intensive, challenging, and cognitively demanding exercises induce neuroplasticity.[3,4] However, balance exercises emphasizing these training characteristics have been sparsely tested in clinical trials in PD,[5] probably because the feasibility and safety of such training conditions remain uncertain. Here, we are describing the development of a novel training regime and testing of its feasibility in older adults with PD prior to conducting a randomized controlled trial. Based on a system model of balance control, our specific objectives were to construct a balance training regime addressing the motor learning principles of specificity (ie, exercises directed toward motor, sensory, and cognitive impairments in PD) and progressive overload (ie, highly demanding balance exercises with a structured progression over time).

Methods

The study was approved by the Regional Board of Ethics in Stockholm, and all participants signed informed consent forms.

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Development of a novel training regime

This training program was developed, through discussions and workshops, by a group of researchers and physiotherapists, each with different expertise in the fields of PD, rehabilitation, and athletic training. To achieve the desired specificity of this intervention, which was inspired by King and Horak,[6] we linked motor and sensory symptoms to common balance impairments in PD. This resulted in 4 defined exercise components to be addressed, each with separate aims (table 1). To target cognitive impairments, dual-task (DT) exercises, that is, the simultaneous performance of an additional cognitive (eg, counting, remembering items) and/or motor (eg, carrying and/or manipulating objects) task was integrated into the program. Furthermore, highly challenging training conditions were defined as exercises in which the participants were forced to use reactive postural adjustments to control their balance. The adjustments of the level of difficulty were performed by the trainers, and they were instructed to aim for a level where these adjustments occurred intermittently. Here, the level of difficulty was increased if postural reactions were absent and decreased if exercises caused excessive postural instability.

The conceptual framework for this program is based on a pragmatic approach that is similar to clinical practice in which balance exercises are adjusted to the capacity of each participant instead of using a fixed scheme of predetermined exercises. Consequently, such an approach requires skilled trainers with the abilities to choose or construct adequate exercises aimed at each exercise component and to perform a continuous evaluation of the quality of each training session. Hence, the trainers were physiotherapists who, prior to the intervention, had been educated in the theoretical and practical aspects of the program.

The program, which was designed as group training for a group size of 5 to 7 participants supervised by 2 physiotherapists, was considered appropriate in terms of safely allowing the performance of highly challenging exercises. Based on recent recommendations regarding the dosage of training in PD,[5] a 12-week intervention (comprising three 45-min sessions per week) was chosen. Progression over time was facilitated by dividing the training period into three 4-week blocks (A, B, and C). Each exercise component was introduced separately to the participants in block A, with emphasis on the quality of performance rather than on difficulty level. In block B, the level of difficulty for each exercise component was increased and basic DT exercises were introduced, whereas movement complexity was further increased in block C by combining the exercise components and increasing the demands of DT exercises. To further promote training progression, the aim was to increase the amount of walking exercises and decrease the amount of standing exercises throughout the 3 blocks.

Feasibility of the training program

Feasibility was used as an umbrella term encompassing the constructs of participation, safety, training progression, perception of the intervention, and training efficacy. The incidence rate for attendance (total number of training sessions performed) and safety (adverse events, ie, a fall, an injury, or a medical event that restricted participation in training or everyday activities) was monitored during training. In addition, ratings of the physical functioning (PF) and bodily pain (BP) subdomains of the Medical Outcomes Study 36-Item Short-Form Health Survey at the end of blocks A, B, and C were used as indicators of safety. Here, previously reported minimal detectable changes for the PF and BP scales of 28 and 25 units, respectively,[7] were used to dichotomize data (changed/unchanged) for each participant. The participants' perception of the intervention was assessed via a questionnaire regarding the level of difficulty for each training block, motivation level, whether they would recommend the intervention to others, and an open question about the training intervention. Training efficacy was measured with the Mini-Balance Evaluation Systems Test (Mini-BESTest), a 14-item clinical test of balance performance with a maximum score of 28 points.[8] Baseline and 12-week postintervention assessments were conducted by trained physiotherapists during ON-medical state.

List of abbreviations:

BP	**bodily pain**
DT	**dual-task**
Mini-BESTest	**Mini-Balance Evaluation Systems Test**
PD	**Parkinson's disease**
PF	**physical functioning**

Participants

Five community-living individuals (1 woman) with mild to moderate PD (mean Hoehn and Yahr score, 2.6) were recruited from the physiotherapy clinic at a university hospital in Stockholm, Sweden. Mean (range) age, disease duration, and Unified Parkinson's Disease Rating Scale motor score at baseline were 72 years (range, 69−80y), 7.6 years (range, 2−15y), and 34 (range, 24−54), respectively. Three participants had experienced at least 1 fall during the preceding 12 months. None used a walking device indoors, had a Mini Mental State Examination score of $\leq$24, or had another medical condition that influenced balance performance or participation in the training program. None of the participants took part in other therapies during the intervention period.

Results

The average attendance rate for the group was 33 of 36 sessions (93%; range, 28−35). Throughout the training period, all participants took part in a total of 167 sessions resulting in 2 adverse events (1 fall and 1 event of dizziness related to low blood pressure) and an incidence rate of 1.2%. None of these events caused injury or pain that interfered with the participants' ability to proceed with the balance training or other activities. Mean group and individual values for PF and BP were unchanged, with the exception of 1 participant whose PF improved. After block A, 4 of the 5 participants rated the training as mostly consisting of low-challenge exercises. After blocks B and C, 3 of 5 participants rated the exercises as highly challenging. None of the participants rated the training as too easy or too challenging at any time, and near-fall events (ie, situations requiring the trainers to support the participants in order to prevent falls) occurred several times per session. All found the training regime motivating and stated that they would recommend it to others. However, 2 participants thought the training period was too long. Mini-BESTest scores increased for 4 of the 5 participants (fig 1).

Table 1 Balance impairments in PD and their practical implementation for balance training

Balance Impairments	Exercise Principles
Sensory integration - Visual dependency - Poor adaptation to sensory environments - Impaired verticality	Walking tasks on various surfaces with or without visual constraints
Anticipatory postural adjustments - Instability during postural transitions and transfers	Voluntary arm/leg/trunk movements, postural transitions and multidirectional stepping, emphasizing movement velocity and amplitude
Motor agility - Impaired regulation of gait in relation with varying environmental demands - Difficulty shifting between different tasks and sequences of action	Intersegmental/interlimb coordination during varying gait conditions and reciprocal movements. Quick shifts of movement characteristics (velocity, amplitude, and direction) in predictable and unpredictable conditions
Stability limits - Narrow base of support - Instability in standing	Controlled leaning tasks in standing with varying bases of support, stimulating weight shifts in multiple directions through arm and trunk movements

Discussion

The results show that highly challenging and progressive group balance training was feasible in older adults with mild to moderate PD. The high attendance rate, along with no change in PF or pain, indicates that the participants found the training feasible with a tolerable training dose. Although few adverse events occurred, the physiotherapists prevented participant falls several times per session. This was expected and might suggest that the exercises were highly challenging; it also shows the adequacy of both the size of the training group and the number of trainers in relation with the high-risk exercises. Moreover, participant ratings indicate a progression throughout the training period.

All participants stated that they would recommend this training program to others; however, some participants found the period too long. Indeed, feedback from the trainers also implied that the introduction phase (Block A) was too long (4wk) in relation with the duration of the total program. Therefore, to ensure a high level of motivation without decreasing the training dose, we suggest condensing the program to 10 weeks (by shortening the introduction phase to 2wk) and instead extending each training session to 1 hour for the final study protocol.[9]

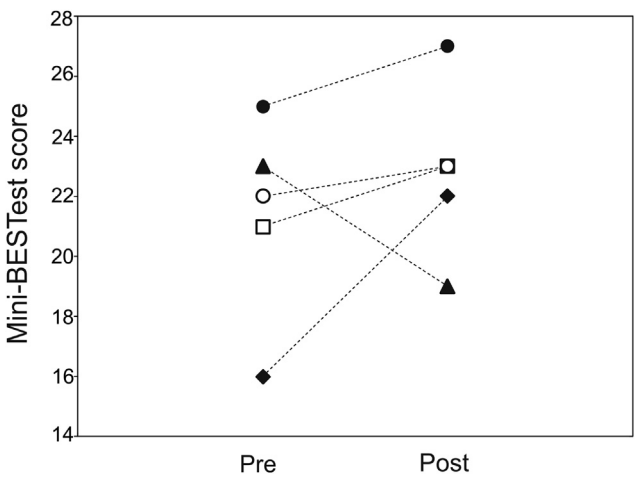

Fig 1 Individual data on the Mini-BESTest (higher values indicating better balance performance) at pre- and postintervention evaluations.

Training efficacy is difficult to interpret because of the small sample size and a general lack of minimal detectable changes for the Mini-BESTest in mild to moderate PD. However, a previous study on various neurologic disorders has indicated a required change of >3.5 points on an individual level and 1 point on a group level to identify a real change.[10] Hence, our data might show an effect on group level, but they only indicate change in 1 participant at an individual level.

Study limitations

This pilot study has several limitations. Above all, the small sample size and lack of a control group profoundly limit the generalizability of these results, especially the effect of the training. Future studies need to evaluate the feasibility and the effect of this program in a large randomized controlled trial with outcome measures targeting the wide range of disabilities related to balance disorders in PD.

Conclusions

This study shows that this new, highly challenging, progressive group balance training program is feasible and promising. Characterized by a high participation rate and few adverse events, it was also highly appreciated by the participants. Developing a training program and testing its feasibility before launching a large randomized controlled trial provides valuable insights and knowledge that will be useful in further research.

Keywords

Exercise; Feasibility studies; Parkinson disease; Rehabilitation

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