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Topic/Clinical Question: Evidence-Based Programs for Parkinson's Disease: A LSVT BIG Case Report and Summary of the Evidence Surrounding Treadmill Training, Tai Chi, Dance, and Boxing
Databases Searched: PubMed, CINAHL, Cochrane

Author/Year	Purpose/Design/ Subjects	Intervention (Control/Treatment Groups)	Measurements/ Outcomes	Findings	Conclusions/Limitations
LSVT BIG					
Ebersbach et al. 2010	**Purpose:** Evaluate and compare the effectiveness of the LSVT BIG program, a Nordic walking program, and an independent home exercise program in improving motor performance in patients with Parkinson's disease **Design:** Prospective randomized controlled trial **Subjects:** 58 participants completed the study and thus were available for assessment at the 16-week follow-up (20 LSVT BIG, 19 Nordic walking, 19 home)	**Control:** The control group in this study was the home exercise group. This group received a one-hour educational and training session in the home about a home exercise program that included stretching exercises, exercises that utilized high-amplitude movement, postural exercises, and exercises targeted at increasing muscular power. **LSVT BIG Group:** received intervention according to the protocol. Sessions were 1 hour in duration, 4x/week for 4 weeks **Nordic Walking Group:** received intervention according to a standardized Nordic walking protocol for beginners. Sessions were 1 hour in duration, 2x/week for 8 weeks	**Outcome Measures:** UPDRS-III score, TUG, 10m walk test Collected at baseline and 16 weeks later	• There was a statistically significant difference between the groups for change in UPDRS-III scores from baseline to follow up ($p<0.001$) • Pairwise comparison demonstrated a significant difference between the LSVT BIG group and Nordic walk group in favor of LSVT BIG ($p<0.001$, 95% CI (-7.87, -3.39)), and the LSVT BIG group and the home exercise group in favor of LSVT BIG ($p<0.001$, 95% CI (-9.87, -3.59)) • There was a statistically significant difference between the groups for change in TUG time ($p=0.033$) • Pairwise comparison demonstrated a significant difference between LSVT BIG group and the Nordic walking group in favor of LSVT BIG ($p=0.036$, 95% CI (-2.48, -0.18)), and the LSVT BIG group and the home exercise group in favor of LSVT BIG ($p=0.024$, 95% CI (-2.21, -0.17)). • There was not a statistically significant difference between the groups for change in 10m walk test ($p=0.059$) • However, pairwise comparison demonstrated a significant difference between the LSVT BIG group and the home exercise group in favor of the	**Conclusions:** LSVT BIG training resulted in improved motor performance, and that the degree of change was superior to a Nordic walking training program and a home exercise program. LSVT BIG training was superior in improving gait as compared to a Nordic walking training program or a home exercise program. Looking at absolute effect sizes, UPDRS-III score was the only measure that was clinically significant based on MCID. **Limitations:** The weaknesses of the study were the inability to control medication changes throughout the study, the inclusion of Hoehn and Yahr stages 1-3 only, and the lack of methodologic detail. Additionally, with a

				LSVT BIG group (p=0.015, 95% CI (-1.28, -0.06) • UPDRS-III scores: absolute effect size of 5.05 points • TUG Score: absolute effect size of 0.75 seconds • 10m walk test: absolute effect size of 0.112 m/s	protocol such as LSVT BIG, where a large component of the treatment is based on patient-identified functional limitations, it is important to at least note what they were, as some functional tasks could have inadvertently work on gait as well.
Millage et al. 2017	**Purpose:** to explore how LSVT BIG can impact individuals with stage I PD **Design:** single group pretest-posttest design **Subjects:** 9 participants, all stage I of "clinically probable idiopathic PD." Time from diagnosis to start of LSVT BIG varied from 2 months to 65 months	All participants received LSVT BIG intervention according to the protocol. Sessions were 1 hour in duration, 4x/week for 4 weeks	**Outcome Measures:** • Primary: gait speed, Berg Balance, Functional Gait Assessment, UPDRS III • Secondary: Four-Square Step Test clockwise and counter-clockwise, PDQ-9	• 7/9 participants achieved the MCID for gait speed • 4/9 participants achieved the MCID for functional gait assessment • 4/9 participants achieved the MCID for berg balance scale • 7/9 participants achieved the MCID for UPDRS III • 8/9 participants achieved the MCID for four-square step test clockwise • 9/9 participants achieved the MCID for four-square step test counter-clockwise • 6/9 participants achieved the MCID for PDQ-9	**Conclusions:** 8/9 participants demonstrated improvements on at least one of the primary measures at the conclusion of LSVT BIG. These improvements were maintained at 3-month follow-up as well. While this study supports the hypothesis that LSVT BIG is effective in improving function in patients with stage I PD, additional research is needed to show efficacy. **Limitations:** This study is a low level of evidence and of low methodological quality. The study has a small sample size, was not blinded, and there were no control groups. There were no tests for heterogeneity, but it is likely fairly high based on the characteristics of the patients included.

Treadmill Training					
Mehrholz et al. 2015	**Purpose:** to assess whether treadmill training is effective in improving gait in patients with PD and to report on the most effective combination of parameters **Design**: systematic review of 18 randomized controlled trials with low to moderate risk of bias and a meta-analysis of treadmill training versus all other treatment approaches **Subjects**: 633 participants included; male and female; all ages; diagnosed with PD using the UK Parkinson's Disease Brain Bank Criteria	**Treatment:** treadmill training alone. Strategies used: with and without body weight support, incremental belt speed increase, home based treadmill walking, treadmill walking with music cues, treadmill walking with visual and auditory cues, forward/backward walking and side stepping, downhill training. ~120-180 (up to 225) minutes of training per week for the majority of studies. **Control:** included overground gait training, usual care, robotic gait training, home walking program, traditional physical therapy with visual/auditory cues, education classes, seated exercises, stretching and resistance training, and no intervention	**Outcome Measures:** • Primary: gait speed and stride length • Secondary: cadence, walking distance, safety of treadmill training as measured by incidence of adverse events	**Pooled Data from Meta-Analysis:** • Treadmill training significantly improved gait speed (mean difference 0.09 m/s, 95% CI (0.03,0.14)), whereas all other treatment approaches did not • Treadmill training significantly improved stride length (mean difference 0.05 meters, 95% CI (0.01-0.09)), whereas all other treatment approaches did not • No change in walking distance or cadence for either group • No identification of what treatment parameters or frequency/intensity are most effective	**Conclusions:** use of treadmill training can improve some gait parameters, like speed and stride length, but it is unknown whether these effects are long-term **Limitations:** The study was quite heterogenous in terms of study population and experimental/control conditions so the results could be limitedly applicable to all people with PD. Study did not include older patients with Hoehn & Yahr stages >3, thus generalizability to this subset of patients is limited. There was a lack of long-term follow up in a majority of the studies, so no conclusions can be drawn about that. There was no identification of ideal parameters/intensity as was stated in the objectives.

Tai Chi					
Yang et al. 2014	**Purpose:** to summarize and evaluate evidence on efficacy of Tai Chi for PD **Design:** A systematic review of 7 randomized controlled trials and 1 non-randomized controlled trial and a meta-analysis **Subjects:** 470 subjects total, male and female, mean age from 63-69, Hoehn & Yahr stages 1-3	**Treatment:** Tai Chi of various styles including Yang, Sun, and 24-short form **Control:** included no intervention, walking, stretching/resistance exercises, and Qigong exercises (similar to Tai Chi)	**Outcome Measures:** UPDRS III, Berg Balance Scale, tandem stance test, single leg stance test, functional reach test, Timed Up and Go, and 6-minute walk test	**Pooled Data from Meta-Analysis:** • UPDRS III Score: Tai Chi significantly (p=0.03) improved score; mean difference -0.57, 95% CI (-1.11 to -0.04) on its own, but was not found to be superior to other active controls (p=0.11) • Berg Balance Scale: Tai Chi significantly (p<0.00001) improved score; mean difference 1.22, 95% CI (0.8 to 1.65). Tai Chi was significantly (p<0.0001) superior as compared to active controls (mean difference 0.74, 95% CI (0.38 to 1.10) • One leg stance test: Tai Chi did not demonstrate improvements • Tandem stance test: Tai Chi did not demonstrate improvements • Gait Velocity: Tai Chi did not demonstrate improvements • Step Length: Tai Chi did not demonstrate improvements • 6-minute walk test: Tai Chi did not demonstrate improvements • TUG: Tai Chi significantly (p<0.00001) improved score; mean difference 1.06, 95% CI (0.68 to 1.44). One study reports that Tai Chi was superior to stretching for TUG performance (no data reported)	**Conclusions:** Tai Chi is effective in improving motor function, balance, and functional mobility in patients with PD, but there is not sufficient evidence to demonstrate that it is effective in improving gait or endurance. Tai Chi is only superior to other active treatments in balance outcomes. **Limitations:** The study aggregated the results and thus did not look at the difference in efficacy between styles and frequency/duration, thus it is difficult to apply to practice. There was a lack of long-term follow up in a majority of the studies, so no conclusions can be drawn about that.

Ni et al. 2014	**Purpose:** to explore whether Tai Chi safely benefits people with Parkinson's Disease **Design:** Systematic review of ten randomized controlled trials and a meta-analysis. **Subjects:** 470 participants total, male and female, mean age 60-72, mild to moderate severity PD	**Treatment:** Tai Chi alone or in combination with stable medication. Seven of the studies included the use of stable medications like levodopa as part of the treatment **Control:** varied based on study but included stable medication alone, Qigong, no intervention, resistance training, stretching, routine physical exercise, a walking program, and dance	**Outcome Measures:** • Primary: UPDRS III • Secondary: Berg Balance Scale, Functional Reach Test, Timed Up and Go, PDQ-39, gait velocity, stride length, falls, and adverse events	**Pooled Data from Meta-Analysis:** • UPDRS III: Tai Chi with medication was superior to other active controls with medication and medication alone at reducing score (mean difference -4.34, 95% CI (-6.67 to -2.01)). There was no difference between Tai Chi without medication and no intervention in reducing score • Berg Balance Scale: Tai Chi with medication was superior to active controls with medication and medication alone at increasing score (mean difference 4.25, 95% CI (2.83 to 5.66). Tai Chi without medication was also superior to active controls without medication (mean difference 9.33, 95% CI (3.06 to 15.60) • Functional Reach Test: Tai Chi with medication was superior to active controls with medication at increasing max reach distance (mean difference 3.89, 95% CI (1.73 to 6.04). Tai Chi without medication was also superior to active controls without medication (mean difference 3.05, 95% CI (2.04 to 4.06). • TUG: Tai Chi with medication was superior to other active controls with medication and medication alone at decreasing TUG performance time (mean difference -0.75, 95% CI (-1.3 to -0.21). There was no difference between Tai Chi without medication and active controls in reducing time.	**Conclusions:** Tai Chi plus medication results in significantly greater improvements in general motor symptoms, balance, mobility, health-related quality of life, and stride length. Tai Chi without medication is less effective, and there is not enough evidence to support the use of Tai Chi in improving gait velocity. A long-term Tai Chi program could result in greater reduction in falls. **Limitations:** The study made conclusions about a combination of Tai Chi and medication as treatment, but there was no exploration of the two factors separately so it is difficult to say whether the effects are from the Tai Chi alone or the combined treatment. There was a lack of long-term follow up in a majority of the studies, so no conclusions can be drawn about that. No exploration of efficacy between styles and frequency/duration. Lastly, no analysis of benefits of Tai Chi versus the cost and service

				• PDQ-39: Tai Chi with medication was superior to active controls with medication and medication alone at improving score (mean difference -1.10, 95% CI (-1.81 to -0.39). There was no difference between Tai Chi without medication and active controls without medication in improving score. • Gait Velocity: No significant difference between Tai Chi with medication and active controls with medication and medication alone in increasing gait velocity. No significant differences between Tai Chi without medication and no intervention or active controls without medication in increasing gait velocity. • Stride Length: Tai Chi with medication was superior to active controls with medication and medication alone at increasing stride length (mean difference 0.56, 95% CI (0.03 to 1.09). There was no difference between Tai Chi without medication and no intervention or active controls without medication in increasing step length. • Falls: A 6-month Tai Chi intervention resulted in 67% fewer falls than a 6-month stretching intervention. Patients receiving a 12-week Tai Chi intervention without medication had a similar rate of falls as compared to no intervention controls.	availability, so you have to wonder about clinical utility.

Dance					
Lotzke et al. 2015	**Purpose:** to summarize the current evidence for the effectiveness of Argentine Tango in patients with Parkinson's and to identify gaps in the research **Design:** systematic review of 13 studies (9 RCTs, one non-RCT, 2 case studies, and 1 uncontrolled pre-post study) and meta-analysis **Subjects:** no information on total number of participants, but ranged in age between 63 to 86 (most were between 63 and 69) and were Hoehn and Yahr stages I-III	**Treatment:** Argentine tango interventions. Duration ranged from 3.45 minutes to 1.5 hours, at a frequency of 2x/month to 5x/week, for a time period of 2 weeks to 24 months **Control:** no intervention and active controls that included exercise classes, home exercise programs, and educational sessions All interventions were conducted in a group setting, most of them were partnered interventions where the participants with PD were paired with individuals without PD	**Outcome Measures:** UPDRS III score, mini-BESTest, Berg Balance Scale, TUG, 6-minute walk test, and freezing of gait questionnaire	**Pooled Data from Meta-Analysis:** • UPDRS III: effect size -0.62, 95% CI (-1.04 to -0.21) in favor of tango • Mini-BESTest: effect size 0.96, 95% CI (0.60 to 1.31) in favor of tango • Berg Balance: effect size 0.45, 95% CI (0.01 to 0.90) in favor of tango • TUG: effect size -0.46, 95% CI (-0.72 to -0.20) in favor of tango • 6-minute walk test: No significant effects • Freezing of Gait Questionnaire: No significant differences	**Conclusions:** There were significant overall effects in favor of tango that were moderate for motor severity, small for gait as measured by the TUG, and strong for balance. However, there were not significant overall effects in favor of tango for gait as measured by the 6-minute walk test or for freezing of gait. **Limitations:** The included studies had small number of participants, and were of varying levels of evidence. Also, most of the studies were from the same research groups. More diverse, methodologically sound studies are needed to strengthen the findings.
Sharp et al. 2014	**Purpose:** to evaluate the effectiveness of dance compared to other exercise interventions and no intervention	**Treatment:** Dance intervention **Control:** no intervention and unspecified exercise interventions	**Outcome Measures:** UPDRS III, Berg Balance Scale, Freezing of Gait Questionnaire, 6-minute walk, and PDQ-39	**Pooled Data from Meta-Analysis:** • UPDRS III: Findings were positive in favor of the dance intervention at the conclusion of the intervention (-10.6 points, 95% CI (-15.05 to -6.16), p=0.00001) and at 3 months (mean difference -6.4 points, 95% CI (-10.73 to -2.07), p=0.004)) as compared to a no intervention control. There was no significant difference between	**Conclusions:** Dance is an effective intervention in PD, as it demonstrates significant improvements in UPDRS III scores, Berg Balance Scale scores, and PDQ-39 scores. It is also superior to other exercise interventions in

	Design: systematic review of 6 trials and a meta-analysis **Subjects:** chosen regardless of duration of Parkinson's, current medications, or level of impairment. 199 pooled participants. Mean age ranged from 63-71, mean Hoehn and Yahr stage ranged from 2.1 to 2.5, approximately equal male/female			the dance intervention group and exercise control group • Berg Balance Scale: Findings were positive in favor of the dance intervention at the conclusion of the intervention (0.72 points, 95% CI (0.31 to 1.14, p=0.0006) and at 3 months (mean difference 0.5 points, 95% CI (0.009 to 0.91), p=0.02)) as compared to a no intervention control. Scores were also significantly improved with dance as compared to an exercise control (mean difference 3.98, 95% CI (1.52 to 6.44), p=0.002) • Freezing of Gait Questionnaire: No significant difference between dance intervention and no intervention or exercise control groups immediately post-intervention or 3 months later • 6-minute walk test: No significant difference between dance intervention and no intervention or exercise control groups immediately post-intervention or 3 months later • PDQ-39: Scores were significantly more improved in dance intervention group as compared to an exercise control group (mean difference -4, 95% CI (-7.13 to -0.87), p=0.01)	improving balance and quality of life outcomes. **Limitations:** Though most of the included studies used Tango, other dance types were used. Future studies are needed to compare the efficacy of different forms of dance to determine whether Tango is superior or not. None of the trials employed follow-up, so longevity of results cannot be commented on. Non-randomized trials included, which are of lower methodological quality and thus increase the risk of bias.

Boxing					
Combs et al. 2013	**Purpose:** to compare the effects of boxing training to traditional group exercise on balance, mobility, and quality of life in patients with Parkinson's Disease **Design:** prospective, single-blind, randomized controlled trial **Subjects:** 31 participants divided into boxing training group or traditional exercise group	Both groups received 24-36 sessions, 90 minutes in duration over the course of 12 weeks **Control:** Was a traditional exercise group. 15 minute warm up of seated exercises and stretching, followed by an hour of strengthening (large muscle groups with dumbbells for UEs and body weight for LEs), endurance (walking and stair climbing), and balance activities (activities on varying surfaces with eyes open/closed). Concluded with a 15 minute seated cool down **Treatment:** Was the boxing group. Same 15 minute warm up, followed by an hour of boxing activities in a circuit format and endurance activities. Concluded with a 15 minute seated cool down	**Outcome Measures:** Berg, Activities-specific Balance Confidence Scale, TUG, dual-task TUG, gait velocity, 6-minute walk test, and Parkinson's Disease quality of life scale Collected within first week of intervention and one week after completing the intervention	• Traditional Exercise Group: statistically significant improvements in BBS (p=0.005), ABC (p=0.022), TUG (p=0.021), dual-task TUG (p=0.010), and PDQL (p=0.022) from pre to post. Large effect size (>0.8) for BBS, ABC, TUG, and PDQL. • Boxing Intervention Group: statistically significant improvements in BBS (p=0.005), TUG (p=0.003), dual-task TUG (p=0.003), gait velocity (p=0.001), 6MWT (p=0.013), and PDQL (p=0.012) from pre to post. Large effect size (>0.8) for BBS, TUG, dual-task TUG, gait velocity, 6MWT, PDQL. • Statistically significant difference found between groups only for the ABC in favor of the traditional exercise group (p=0.015, d=0.97)	**Conclusions:** Both groups demonstrated significant improvements in outcome measures of interest, but there were very few significant intergroup differences. The traditional group exercise resulted in more significant improvements in balance confidence over boxing. Otherwise, the two interventions are largely comparable in effectiveness. **Limitations:** Small sample size makes results tough to generalize. Lack of follow-up makes determination of long-term effects of boxing difficult. High numbers of drop outs and lower compliance for boxing group, which impacted the strength of the results and also indicates that boxing training might not be a preferred type of exercise. In general, very limited number of studies on boxing in patients with Parkinson's Disease.

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