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DRUM-PD: The use of a drum circle to improve the symptoms and signs of Parkinson's disease (PD)

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Abstract

Background—Physical therapy can improve motor function in patients with PD. Music performance may be used to improve motor skills by rhythmic entrainment. Drumming has long been a part of traditional healing rituals worldwide, and is increasingly being utilized as a therapeutic strategy.

Methods—This pilot controlled prospective cohort trial assessed feasibility and effects of twice-weekly group West African drum circle classes for 6 weeks on PD patients' quality of life, symptoms, motor findings, cognition, and mood. Ten patients with PD were recruited into the drum circle group. Ten patients with PD were matched pairwise to each of the drum circle participants, and enrolled in a no-intervention control group. Both groups completed the PD-specific Parkinson Disease Questionnaire (PDQ)-39 quality of life assessment and the Geriatric Depression Scale (GDS), and underwent motor and cognitive assessments by a rater blinded to group at baseline, 6 weeks, and 12 weeks.

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Allison Willis contributed to statistical analysis and manuscript preparation and editing.

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Results—Drummers had significantly improved PDQ-39 scores from baseline to 6 weeks (-5.8 , $p=0.042$), whereas the control group's scores were unchanged. Walking performance was significantly faster at baseline for controls; after 6 weeks of drumming this difference was no longer significant, and remained non-significant at 12 weeks. The drummers trended ($p=0.069$) toward improvement in walking from baseline to 12 weeks. Other outcomes did not significantly change from baseline to 6 or 12 weeks.

Conclusions—Drum circle classes significantly and reversibly improved quality of life in patients with PD. This pilot trial's findings merit larger controlled investigations comparing drumming classes to established interventions in PD, such as physical therapy.

Keywords

Parkinson disease; music-based interventions; rhythmic entrainment; group therapy

Introduction

PD is a common progressive neurodegenerative disorder that adversely impacts both motor (tremor, muscle rigidity, bradykinesia, and postural instability/gait difficulty) and non-motor (cognition, mood, autonomic nervous system, among others) function.¹ PD significantly lowers patient-reported quality of life, and there is a lack of validated nonpharmacological interventions addressing quality of life in this disorder.²

Physical therapy of various types has been demonstrated to improve motor function in patients with PD.¹ Dance therapy can also improve gross motor outcomes in PD, as evidenced by recent randomized trials of community-based dance such as Argentine Tango in PD participants.^{2,3} Therapeutic instrumental music performance has been used to improve gross and fine motor skills by rhythmic entrainment in several neurological disorders.⁴ The instrument is itself a target of movement, and immediate auditory feedback is provided. Additionally, the action of playing an instrument usually decreases amplitude of involuntary movements in PD.⁴ A recent review of controlled clinical trials assessing the effects of music and music therapy (singing, playing instruments, and rhythm-based exercises) in neurological patients demonstrated statistically significant benefits for mood (depression, anxiety, emotional control) in dementia, stroke, and chronic quadriplegia.⁵

Drumming has long been a part of traditional healing rituals in many cultures worldwide, and is now being increasingly utilized as a therapeutic strategy.⁶ A functional MRI study of healthy volunteers found that synchronized drumming was associated with increased activity in the caudate nucleus (a component of the basal ganglia, which are dysfunctional in PD), and enhanced prosocial behavior.⁷ A controlled study of group drumming in low-income children demonstrated statistically significant improvement on several research measures of depression, anxiety, and inattention.⁸ Another study of at-risk adolescents found that a drum-based intervention program resulted in higher levels of collaboration and teacher cooperation, as well as increased self-esteem.⁹ Finally, a recent open label pilot study of drumming and rhythm exercises targeting executive function in 10 patients with Huntington disease (1 preclinical, 9 early to advanced) noted improvements in executive function, as

well as changes in MRI measures of white matter microstructure in the genu of the corpus callosum (connecting the prefrontal cortices of the two hemispheres).¹⁰

Recently, a group of PD participants at our institution reported a greatly improved sense of well-being after attending a single drum circle class for 45 minutes. This provided the impetus for the current study, the first known to the investigators, of using drum circle classes as instrumental therapy for PD. We therefore conducted a feasibility and efficacy study of West African drumming as a therapy for Parkinson disease. Our a priori hypothesis was that drumming would result in improved patient centered outcomes as evidenced by improved self-reported quality of life (measured by the PDQ-39). Secondary analyses examined improvement in mood and objective motor and cognitive function.

Standard Protocol Approvals, Registrations, and Patient Consents

Written informed consent was obtained from all participants in the study (consent for research). Institutional Review Board (IRB) approval was obtained for the protocol and consent form before the study was initiated.

Methods

This study was approved by the IRB at the University of Pennsylvania. All study activities took place at the Parkinson's Disease and Movement Disorder Center at the University of Pennsylvania.

Study Design

This study was a 12-week pilot prospective cohort trial designed to assess the feasibility and effect of twice-weekly drum circle classes on PD participants' quality of life (the primary outcome), symptoms, motor findings, cognition, and mood. Inclusion criteria for the study were a diagnosis of idiopathic PD based on UK Parkinson's Disease Society Brain Bank Clinical Diagnostic Criteria for PD,¹¹ and motor impairment with unilateral or bilateral bradykinesia on Movement Disorder Society Unified Parkinson Disease Rating Scale-Motor subscale (MDS-UPDRS-III).¹² Participants who were unable to consent to the study, did not have objective bradykinesia (limb or body) on MDS-UPDRS-III, were unable to walk or stand without support, unable or unwilling to sit for at least 45-60 minutes, or unwilling to participate in twice-weekly drum circle classes for 6 consecutive weeks were excluded from the study. Control group (usual care) participants were recruited from the Parkinson's Disease and Movement Disorder Center at the University of Pennsylvania by the study coordinator after the drumming group was recruited. Control participants were matched with drumming group participants by age, gender and disease stage. Ten participants were recruited for each group; recruitment began in September of 2013 (first consent), and was completed in October of 2013 (last consent).

The intervention for this study was participation in a West African Drum circle class, taught by local African drumming instructors at a dance studio. Instruction lasted 45-60 minutes, and occurred twice per week for 6 weeks (12 sessions total between October and December 2013). The duration of participant participation was approximately 14 weeks, allowing for 1

extra week each to complete baseline (October 2013) and 12-week (January 2014) assessments. The drum circle classes were for PD participants only; each PD participant was given a personal drum and followed along with the rhythms set by the drumming instructor, who gradually increased the complexity of rhythms from class to class.

All study assessment took place at the same location, and participants were assessed within the same calendar week. At each study visit (Baseline, 6 weeks, and 12 weeks), all participants completed the PDQ-39¹³ (scored from 0 to 100 on several dimensions, with higher scores indicating greater impairment) to assess participants' quality of life (the primary outcome), MDS-UPDRS to assess motor symptoms and signs, instrumented Timed Up and Go (iTUG)¹⁴⁻¹⁶ test to assess gait speed, and the Postural Sway test¹⁷ to assess participants' postural stability. The iTUG and Postural sway tests were administered using the free iPhone application OPDM Mobility (Kinetics Foundation, CA: kineticsfoundation.org); the iPhone (version 5) was clipped to each participant's belt or waistband duration of these tests. The Montreal Cognitive Assessment¹⁸ (MoCA; scored from 0 to 30, with scores equal to or greater than 26 considered normal) was administered to assess cognition, as it reliably discriminates mild and severe cognitive impairment from normal. The GDS-15¹⁹ (scored from 0 to 15, with scores 5 or greater considered to be consistent with depression) was administered to assess symptoms of depression. These two measures were included because mood and cognition are known to affect study participation and self-reported quality of life. To minimize variability, all assessments were administered in the same order for all participants. Motor assessments were performed during the participants' best "On" state; they were asked to take their usual dose of dopaminergic medications 1 hour prior to motor assessment. Participants' willingness to continue in the study was monitored verbally during each visit by the researcher administering the assessment. Participants were reminded at each visit to refrain from discussing their participation in Drum circle classes (if any) so as to maintain the blinding of the examiner. The participants in the drum circle group were also asked to write about their subjective experiences with the drum circle classes. As such, the research methods used were both quantitative (the analysis of results from the above scales and tests) and qualitative (assessment of participants' written descriptions of their drum circle experiences). Participants' written responses to their experience with drum circle classes were completed within 2 weeks of the 12th Drum circle class, and were assessed for common elements and themes.

Statistical Analysis

Descriptive statistics included means and standard deviations. Assessments of Drum circle and Control participants were compared using chi-square tests and student's t tests. Within and between-group data analysis was performed using non-parametric statistics (Wilcoxon Signed Ranks test; Mann-Whitney U test).

Results

Baseline Characteristics (Table 1)

Recruitment for this study was completed within 6 weeks of the study's approval by the Institutional Review Board. Eighteen out of 20 participants (8/10 drummers, 10/10 controls) completed the study. One participant dropped out due to unrelated illness, and a second participant found traveling for the drumming classes too cumbersome. Thus, the drumming classes were attended by 8 participants. The control group's GDS scores were lower at baseline than the drumming group's (control 0.4 ± 0.7 vs. drummer 3.0 ± 4.5 , $p=0.005$), indicating fewer reported depression symptoms, although both groups' scores were below the accepted range for mild depression (GDS score ≥ 4). Additionally, the control group's iTUG performance was faster at baseline (-2.4 s, $p=0.016$). There were no statistically significant baseline between-group differences in age, gender, Hoehn and Yahr stage, MoCA, PDQ-39, MDS-UPDRS-III scores or postural sway measures (jerk, root mean square (RMS) amplitude, and sway area).

Intervention (Figures 1-3)

Drummers reported significant improvement in overall quality of life (QOL) after 6 weeks of drumming as assessed by the PDQ-39 instrument (-5.8 , $p=0.042$), whereas the control group's scores were stable ($+1.2$, $p=0.173$). The drumming group's PDQ-39 scores non-significantly worsened from 6 to 12 weeks ($+3.3$, $p=0.138$), and 12-week scores were no different than scores at baseline (22.4 vs. 24.9). With respect to self-reported mood, the baseline difference in GDS scores between groups was less significant after 6 weeks (control 0.7 ± 0.8 vs drummer 2.0 ± 1.4 , $p=0.037$) and became non-significant after 12 weeks (1.1 ± 1.0 vs. 3.0 ± 3.2 , $p=0.154$). In the drumming group, total MDS-UPDRS-III scores improved by 2.8 points at 6 weeks, and worsened by 4.8 points between 6 and 12 weeks; these differences were non-significant ($p=0.735$, and $p=0.206$, respectively), and were in contrast with the self-reported improvement in mobility reported by most participants at the end of 12 drumming sessions (see below). After 6 weeks of drumming, the baseline between-group difference in iTUG scores was no longer significant (-1.8 s, $p=0.237$), and remained non-significant at 12 weeks (-0.8 s, $p=0.696$). There was also a trend toward improvement on the iTUG from baseline to 12-week scores for the drumming group (1.1 s. improvement, $p=.069$). MoCA scores, postural sway measures and other outcomes did not significantly change from baseline to 6 or 12 weeks in either group.

The drumming participants' qualitative written responses were recorded within 1 week after completing the drumming sessions. Several participants reported subjective symptom improvements in rigidity and mobility during and after drumming. Additionally, several diary responses by the participants spoke to their newfound ability to connect with their peers. One participant wrote: "PD can be isolating, and I realized that I never had a chance to socialize with men who had the disease...It was a welcome challenge to get up, dressed and out of the house in the morning. I took two buses, and enjoyed being amongst those who had a purpose." Another noted: "I learned the importance of connecting to the group in a joyful way...It was not the mastery of the drumming technique, but the flow of the energy

between us all...It was great being in a drumming circle instead of a drooling circle...being anchored in the present.”

Discussion

The improved survivorship afforded by the availability of multiple therapies for early and advanced Parkinson disease demands that new adjunctive therapies be developed to improve and maintain perceived quality of life. This is the first study known to the authors evaluating the effects of West African drumming on motor and non-motor symptoms and signs in Parkinson disease. We found improvement in quality of life in this small sample of PD participants who participated in drumming. Drumming also improved self-reported mobility, although MDS-UPDRS motor scores did not change. This may indicate that drumming does not improve MDS-UPDRS, or that MDS-UPDRS scores are a suboptimal outcome measure for a rehabilitative intervention like drumming, failing to capture important improvements in self-perception. Baseline differences in GDS and iTUG scores between the control and Drumming groups may be due to random variation in this small sample of participants.

Our study results may be considered in the context of an earlier randomized controlled trial of music therapy (MT) in PD.²⁰ Pacchetti et al. randomly and equally assigned 32 PD patients (Hoehn and Yahr stage 2/3) to 3 months of weekly MT (choral singing, voice exercise, rhythmic and free body movements, and active music making that did not involve drumming), or physical therapy (passive stretching exercises, specific motor tasks, and strategies to improve balance and gait). MT led to a statistically significant improvement of bradykinesia as measured by the Unified Parkinson's Disease Rating Scale ($p < .034$).²⁰ Over time, changes on the self-reported Happiness Measure confirmed a beneficial effect of MT on emotional functions ($p < .0001$), and improvements in activities of daily living and in quality of life were also documented in the MT group ($p < .0001$), while PT only improved rigidity ($p < .0001$).²⁰ The current study also detected statistically significant quality of life improvement with a specific rhythm-based intervention not used by Pacchetti et al. Our pilot study was not powered to detect between-group differences in outcome measures, and therefore does not conflict with the results of Pacchetti et al.; rather, it adds to the impetus of developing additional controlled studies of music and rhythm-based interventions for motor and non-motor outcomes in PD.

The emotional salience provided by music-making in a group environment is likely an important driver of the quality of life improvement reported by the participants. Rhythmic entrainment is an important driver of any motor improvement expected from studies utilizing rhythmic therapies such as drumming. Recent studies have found that selective groups of neurons entrain to particular beat frequencies.²¹ This provides a plausible mechanism of action for drumming as a therapeutic intervention in PD, in which there is loss of automaticity and motor coordination due to basal ganglia dysregulation. Our qualitative data support this hypothesis, as several study participants reported subjective improvement in gait freezing after participating in drumming classes. Moreover, Argentine Tango, which has been demonstrated to improve motor outcomes in PD,³ has its roots in African drumming rhythms. Future assessments should specifically evaluate the response of gait freezing in PD

to drumming. The nontraditional use of a drum may improve patient-specific deficits, and merits consideration in PD: for instance, two drums on either side of a patient would facilitate weight-shifting and trunk rotation.⁴ Erect posture may be facilitated by placing a drum or another instrument at patient's eye level or higher. Also, striking one's heel onto a tambourine placed on the floor allows for the practice of a healthy gait pattern.⁴ In addition, objective measures of upper extremity bradykinesia, such as the MovAlyzeR[®] digital writing tablet, or online programs developed for this purpose (by the Kinetics Foundation, for example) may be utilized to aid assessment in future studies of drumming interventions in PD.

The study is limited by small sample size (befitting a pilot study), and it is not possible to draw any causal conclusions regarding the trends and non-significant results obtained. However, our study allows for sample size calculations in planning a more definitive randomized controlled trial of drumming in PD. Based on the iTUG data obtained in this study, 46 participants per group would need to be studied to reject the null hypothesis of no benefit for iTUG from drumming, with Type I error of 0.05 and power of 0.8. Based on the PDQ-39 data obtained in this study, 25 participants per group would need to be studied to reject the null hypothesis of no benefit for PDQ-39 from drumming, with Type I error of 0.05 and power of 0.8. The statistically significant participant-reported improvement in quality of life obtained in this study is encouraging and merits further evaluation. Generalizability of this study's results is limited, as this was a single center pilot study. Additionally, the control group did not have an intervention during the drumming period; the study would be strengthened by using an active comparator group performing physical therapy or exercise, or regularly attending a support group to control for the prosocial aspects of drumming. Alternatively, comparing the combination of an established intervention such as physical therapy with drumming to physical therapy alone would assess whether drumming can provide unique benefits over and above those of exercise-based interventions.

In summary, 6 weeks of twice-weekly West African drum circle classes improved self-reported quality of life in participants with PD as measured by the PDQ-39. This improvement waned within 6 weeks of completion of classes, reinforcing the hypothesis that a causal relationship existed between class participation and the improvement in reported QOL, but also suggesting that continued drumming may be necessary to sustain the measured benefits. Larger, controlled investigations comparing group drumming classes to traditional physical therapy or other non-music based group interventions may provide further evidence of efficacy and establish drumming as an alternative physiotherapy for PD.

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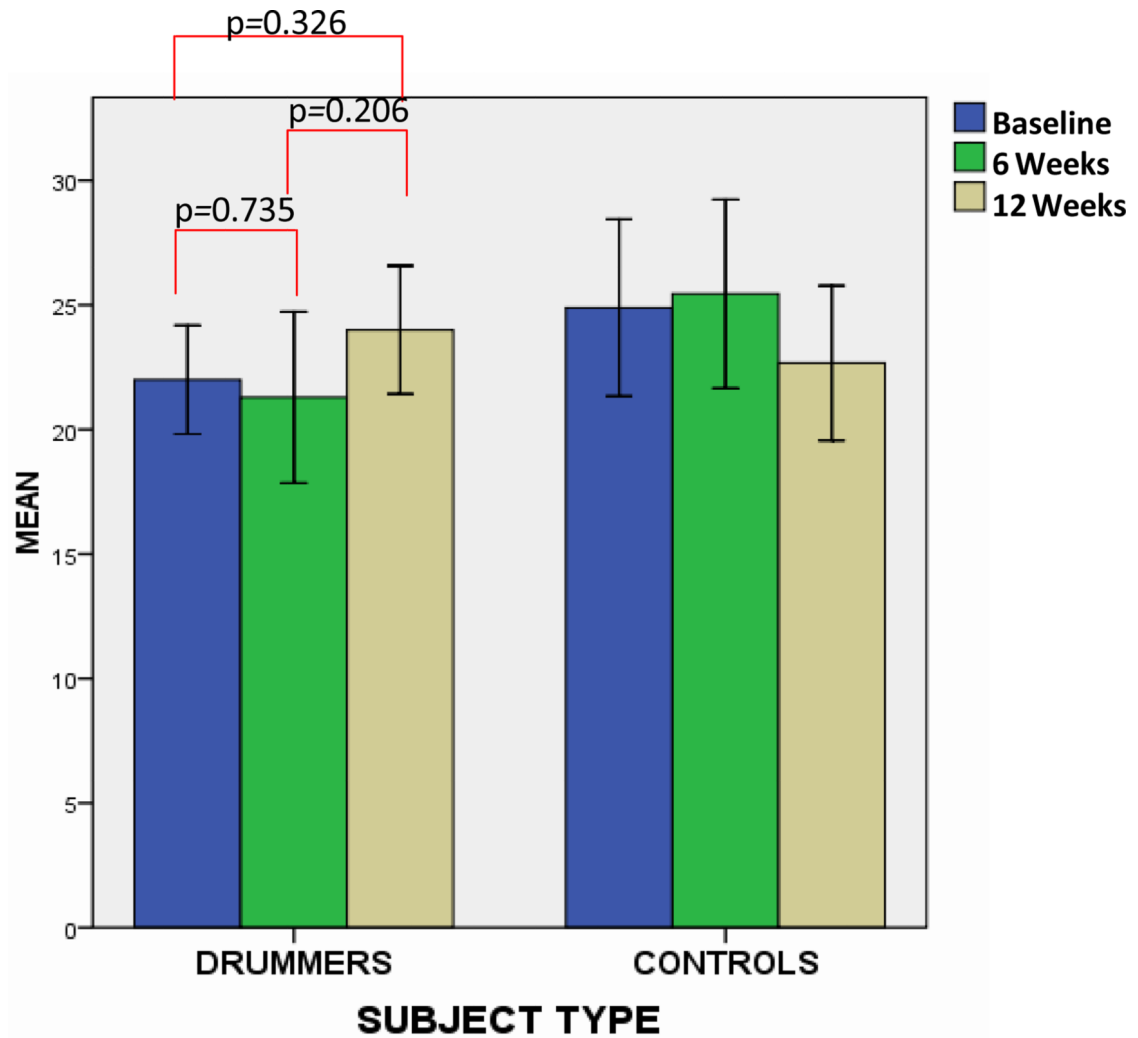


Figure 1. MDS-UPDRS-Motor Score Results

MDS-UPDRS=Movement Disorder Society-Unified Parkinson Disease Rating Scale

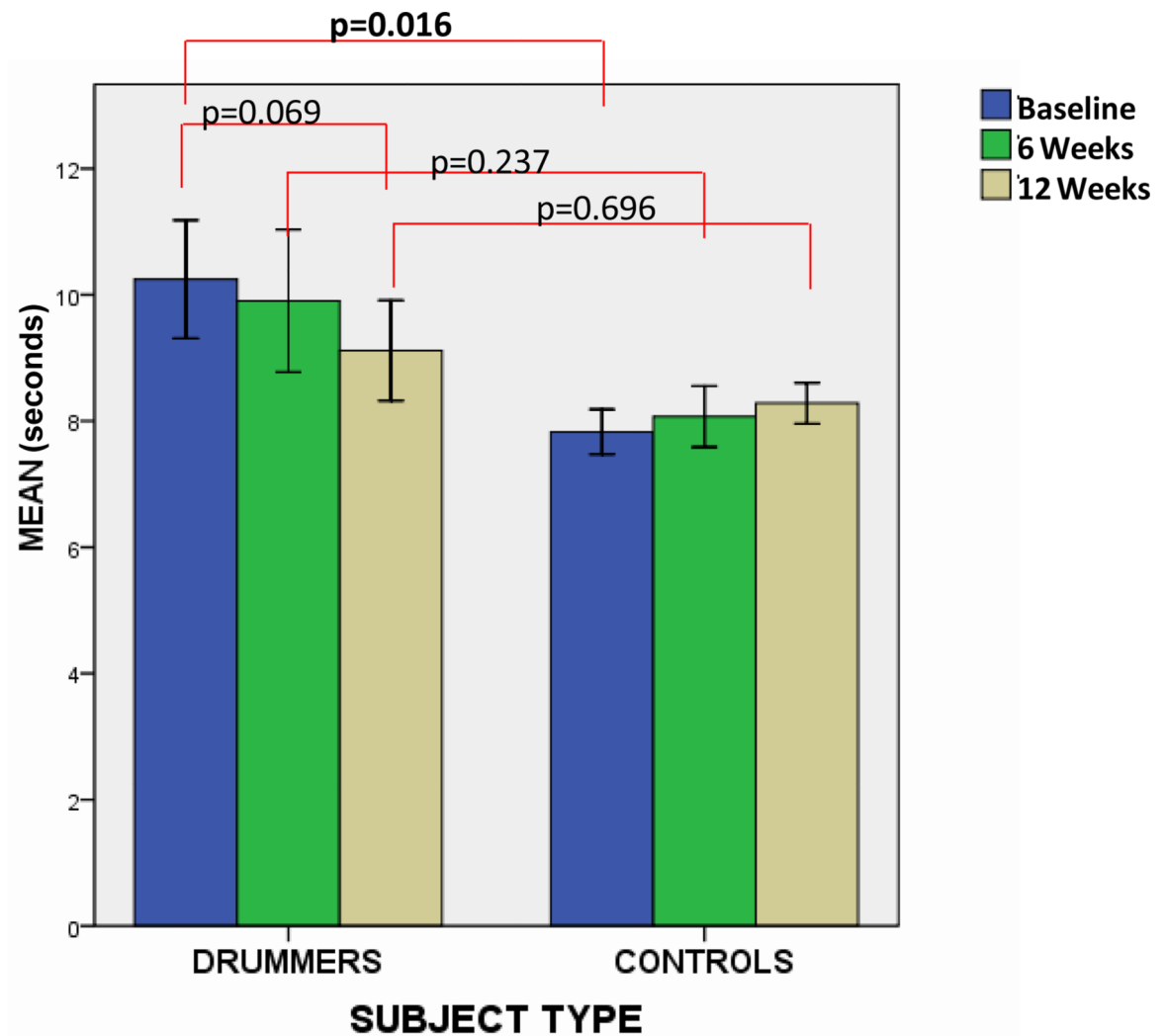


Figure 2. iTimed-Up and Go Results
Bolded values indicate $p < 0.05$.

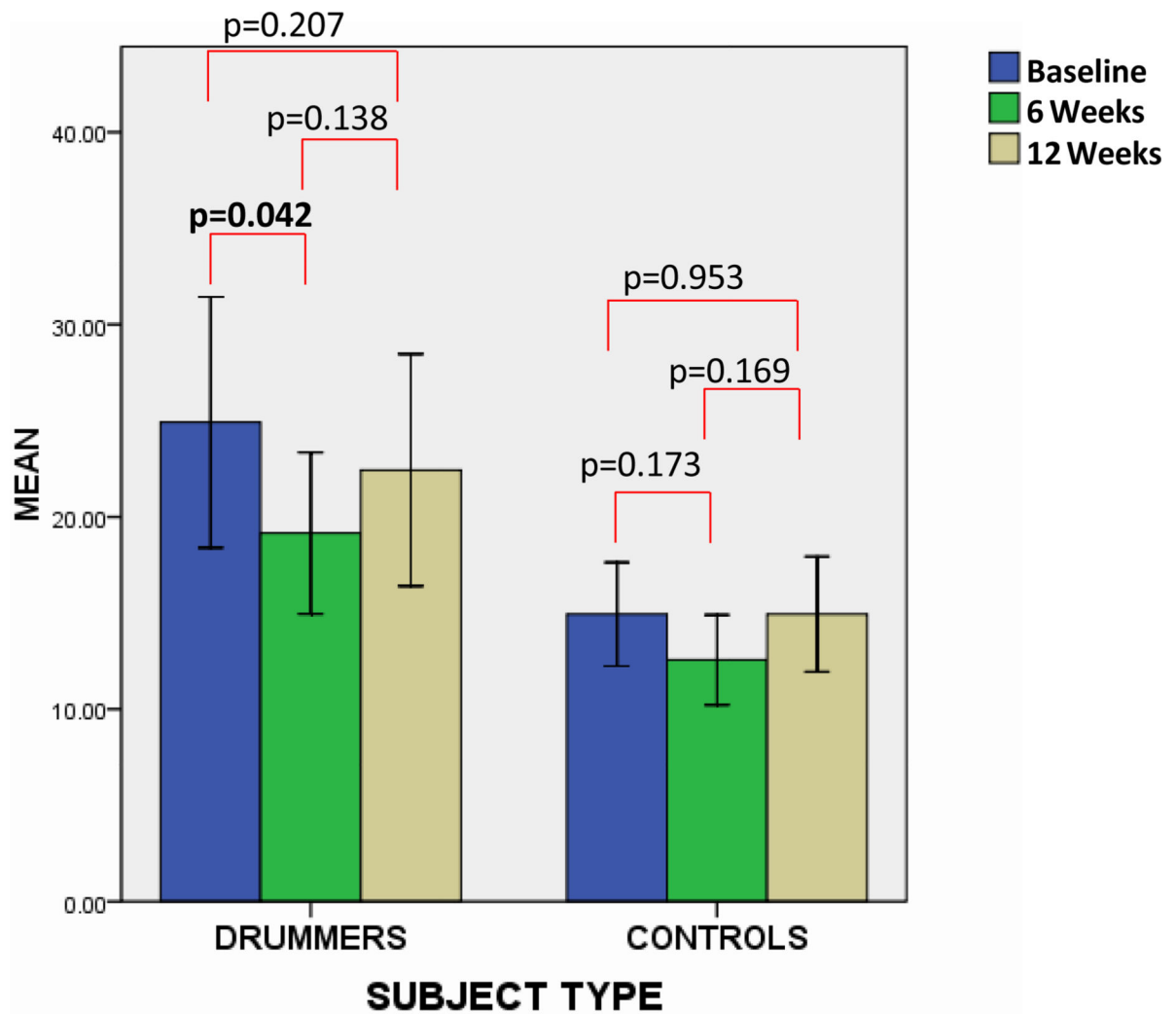


Figure 3. PDQ-39 Score Results
PDQ-39= Parkinson Disease Questionnaire-39
Bolded values indicate $p < 0.05$.

Table 1Baseline Characteristics^a

Characteristics	Drummers (n=8)	Controls (n=10)	Significance (p)
Age	72(8)	71(7)	0.78
Gender (% Female)	63%	60%	0.92
Hoehn & Yahr Stage	2.20(0.46)	2.20(0.24)	0.83
MDS-UPDRS-III	22.00(6.00)	25.00(11.00)	0.47
iTUG (seconds)	10.20(2.60)	7.80(1.10)	0.02
<u>Postural Sway</u>			
Jerk (m ² /s ⁵)	0.37(0.33)	0.45(0.45)	0.89
Area (m ² /s ⁵)	0.01(0.01)	0.01(0.00)	0.36
RMS (m ² /s ⁵)	0.06(0.03)	0.07(0.01)	0.48
MOCA	27.00(2.40)	26.80(2.50)	0.87
GDS	3.00(4.50)	0.40(0.70)	0.01
PDQ-39	24.90(18.50)	14.90(8.50)	0.36

Bolded values indicate p<0.05.

Abbreviations: MDS-UPDRS-III=Movement Disorder Society-Unified Parkinson Disease Rating Scale, Motor Score; iTUG=instrumented Timed Up and Go; RMS=Root Mean Square amplitude; MOCA=Montreal Cognitive Assessment; GDS=Geriatric Depression Scale-15; PDQ-39=Parkinson Disease Questionnaire-39

^a All data reported as Mean(SD), except as indicated.