

# Pilot study of a targeted dance class for physical rehabilitation in children with cerebral palsy

SAGE Open Medicine  
Volume 4: 1–5  
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DOI: 10.1177/2050312116670926  
smo.sagepub.com  


Citlali López-Ortiz<sup>1,2,3</sup>, Tara Egan<sup>4</sup> and Deborah J Gaebler-Spira<sup>2,4</sup>

## Abstract

**Introduction:** This pilot study evaluates the effects of a targeted dance class utilizing classical ballet principles for rehabilitation of children with cerebral palsy on balance and upper extremity control.

**Methods:** Twelve children with cerebral palsy (ages 7–15 years) with Gross Motor Function Classification scores II–IV participated in this study and were assigned to either a control group or targeted dance class group. Targeted dance class group participated in 1-h classes three times per week in a 4-week period. The Pediatric Balance Scale and the Quality of Upper Extremity Skills Test were administered before, after, and 1 month after the targeted dance class.

**Results:** Improvements in the Pediatric Balance Scale were present in the targeted dance class group in before versus after and before versus 1 month follow-up comparisons ( $p$ -value = 0.0088 and  $p$ -value = 0.019, respectively). The Pediatric Balance Scale changes were not significant in the control group. The Quality of Upper Extremity Skills Test did not reach statistical differences in either group.

**Conclusion:** Classical ballet as an art form involves physical training, musical accompaniment, social interactions, and emotional expression that could serve as adjunct to traditional physical therapy. This pilot study demonstrated improvements in balance control. A larger study with a more homogeneous sample is warranted.

## Keywords

Cerebral palsy, pediatric rehabilitation, targeted dance class, Pediatric Balance Scale, pilot study

Date received: 25 December 2015; accepted: 23 August 2016

## Introduction

This pilot study evaluates the effects of a targeted dance class (TDC) utilizing classical ballet principles for rehabilitation of children with cerebral palsy (CP) on balance and upper extremity control. This study builds upon the results of a previously reported classical ballet-based intervention for physical rehabilitation in children with CP.<sup>1</sup> The training principles of classical ballet for postural control with trunk stabilization, static and dynamic balance, and focused movement control of individual joints were utilized to design the TDC as an adjunct to physical therapy practices. This TDC demonstrated positive perceived benefits for the children as reported by the participants, their parents, and the therapists involved. However, quantitative outcome measures were not administered. This pilot study was designed to test for statistical differences in clinical outcomes of balance and upper and extremity control before and after a TDC based on classical ballet class design.<sup>1</sup>

CP is the most common developmental motor disorder in children.<sup>2</sup> The prevalence of CP in children in the United States is estimated to be between 3.1 and 3.6 cases per 1000

<sup>1</sup>Department of Kinesiology & Community Health, College of Applied Health Sciences, University of Illinois at Urbana–Champaign, Urbana, IL, USA

<sup>2</sup>Department of Physical Medicine and Rehabilitation, Feinberg School of Medicine, Northwestern University, Chicago, IL, USA

<sup>3</sup>Joffrey Ballet Academy, The Official School of the Joffrey Ballet, Chicago, IL, USA

<sup>4</sup>Rehabilitation Institute of Chicago, Chicago, IL, USA

### Corresponding author:

Citlali López-Ortiz, Department of Kinesiology & Community Health, College of Applied Health Sciences, University of Illinois at Urbana–Champaign, 221 Louise Freer Hall, MC-052, 906 South Goodwin Avenue, Urbana, IL 61801, USA.

Email: lopezort@illinois.edu



live births.<sup>3</sup> Children with CP present abnormal muscle activity and motor control.<sup>4</sup> Although CP is a static encephalopathy, movement impairments manifest at an early age and tend to worsen with time in detriment to (1) musculoskeletal structures and functions, (2) activities of daily living, and (3) participation in society.<sup>4-6</sup> Consequently, the main goals of rehabilitation for children with CP include decreasing the risk for skeletal deformity and promoting function and social participation in engaging activities.<sup>7</sup>

With those principles of rehabilitation in mind, a classical ballet-based TDC was piloted and studied in a group of children with CP. A past study on the effects of the TDC utilized outcome surveys to assess the subjective perceptions of the parents, therapists, and children involved. The parents expressed concern for long travel distances to the studio location. However, the parents and therapists involved perceived the TDC as therapeutically beneficial and as a desirable adjunct to conventional therapy. Therapists identified advantages in training coordination, muscle tone, self-esteem, and social development in the TDC that are not present in conventional therapy; others thought that the TDC provided an alternative structure to traditional therapy.<sup>1</sup> The children perceived their participation in the program as “fun” and not “therapy.”<sup>1</sup> Participants’ positive perception of therapy is of crucial importance as motivation has been recognized by the National Institutes of Health Taskforce on Neuroplasticity for Clinical Applications as key for neuroplasticity during rehabilitation.<sup>8</sup>

This pilot study reports quantitative clinical outcomes for children with CP following a TDC. The TDC adhered to the structure and guidelines of the previous study, with three environmental modifications described in the methods section regarding transportation, location, and refreshments.

The main goal of this study was to determine the changes in clinical balance and upper limb function measures after participation in the TDC for 12 sessions of 1-h duration over a period of 1 month.

## Methods

All procedures were approved by the local institutional review board and by the research review board of the city’s public schools. The school selected was a public school with a large enrollment of minority children with physical and intellectual disabilities. Parents and their children with CP were invited to participate in the study during the time of report card pick-up. Parental consent and child assent were obtained prior to participation in the study. Inclusion criteria were as follows: (1) to have a Gross Motor Function Classification System (GMFCS) score of II–IV, (2) to be of 6–15 years of age, (3) to have the ability to follow two-step directions, (4) to be medically stable, and (5) no history of surgery or seizures within the past 6 months. Verification of inclusion criteria was conducted by a physical therapist affiliated with both the school and a tertiary rehabilitation hospital. After the initial consent/assent process, the participants were

assigned to a control group (CG) or a TDC group according to the family and child availability at the scheduled class time. We considered this allocation process to be random as no sources of bias could be identified. Conservatively, we chose a paired t-test statistical design that would correct for possible unaccounted biases. The Consolidated Standards of Reporting Trials (CONSORT) flow chart for this study is presented in Figure 1. A total of six children were enrolled in the intervention group and six in the CG. One child in the intervention group was transferred to a new school after the second week of the intervention; therefore, we do not report data on this child. The CG and TDC group continued to receive physical and occupational therapy during the school day. The TDC group participated in the TDC 1 h at three times per week for 4 weeks in addition to physical and occupational therapies. Transportation barriers to the TDC were eliminated by offering the class as a school activity after the school day and by providing free transportation home after each class. The TDC was held in the gymnasium or on the stage of the school auditorium as opposed to a dance studio setting. All children were offered refreshments at the end of the school day and before the TDC.

The training principles of classical ballet for postural control with trunk stabilization, static and dynamic balance, and focused movement control of individual joints were incorporated in the TDC to target the motor impairments of the participants following the design of our previous study.<sup>1</sup> Eighth-grade regular education peers, one school aid, one physical therapy student, and one physical therapist volunteered to assist during dance classes. The participants with GMFCS level II required one volunteer to assist during the class while the participants with GMFCS level III required two to three volunteers for assistance depending on the classical ballet movement being instructed. At the end of the 4 weeks, the participants and volunteers performed a dance class demonstration in the school’s theater for their school peers and parents. The participants’ characteristics are presented in Table 1.

The clinical outcome tests included the Pediatric Balance Scale (PBS) and the Quality of Upper Extremity Skills Test (QUEST). The PBS is designed to evaluate functional static and dynamic balance.<sup>9,10</sup> The QUEST is divided into four upper extremity function domains: dissociated movements, grasps, weight bearing, and protective extension. Both tests have been validated for their use in pediatric CP.<sup>11,12</sup> These tests were performed within 1 week prior to the initiation of dance classes, within 1 week, and 1 month after the end of the intervention. Matched pairs two-tailed t-tests for differences on pre versus post and pre versus 1 month follow-up data were conducted. Statistical significance for rejection of the null hypotheses was set at  $p < 0.05$ .

## Results

The results of the clinical tests conducted pre, post, and 1 month after the end of the intervention in each individual

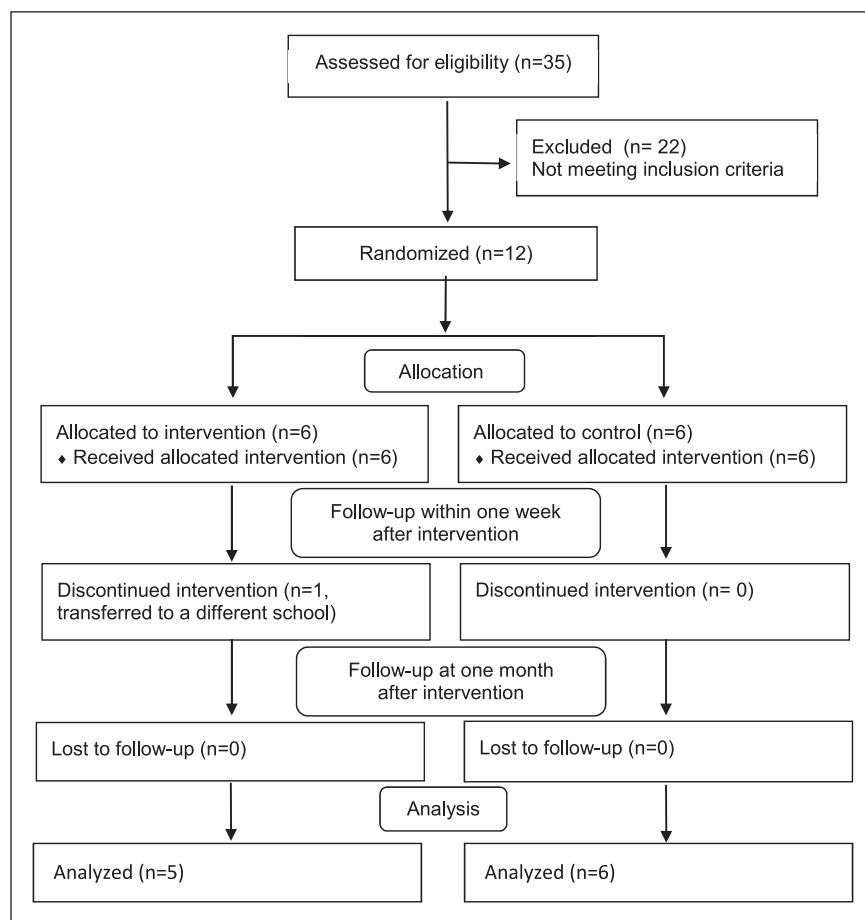


Figure 1. CONSORT flow diagram.

Table 1. Characteristics of participants.

Participant	Age (years)	GMFCS	Distribution
1	8	II	Diplegia
2	14	II	Hemiplegia
3	13	II	Diplegia
4	8	III	Quadriplegia
5	7	III	Triplegia
6	10	IV	Quadriplegia
7	15	II	Diplegia
8	10	IV	Quadriplegia
9	13	II	Quadriplegia
10	10	II	Diplegia
11	12	III	Quadriplegia

GMFCS: Gross Motor Function Classification System. Participants 1–5 were randomly assigned to the dance class intervention while participants 6–11 were randomly assigned to the control group.

child are presented along with the p-values for the paired t-tests (Tables 2 and 3). The PBS showed statistically significant improvements in the TDC intervention group immediately after the intervention (mean paired difference=7.5, p-value=0.0088) and not in the CG (mean paired

Table 2. Results of clinical tests.

Subject	PBS			QUEST		
	Pre	Post	Follow-up	Pre	Post	Follow-up
1	45	49	48	97.15	100	99.1
2	34	37	41	52.4	51.8	48.61
3	45	50	50	98.15	99.1	100
4	20	24	23	52.65	73.45	79.25
5	15	24	26	65.9	76.1	69.28
6	5	11	5	50.3	66.65	65.35
7	20	32	30	77.95	83.85	72.55
8	5	7	5	56.42	74.38	83.75
9	27	46	33	98.15	99.1	100
10	55	55	56	98.15	98.15	99.1
11	12	18	20	90.93	92.3	95

PBS: Pediatric Balance Scale; QUEST: Quality of Upper Extremity Skills Test. Values obtained at pre, post, and 1 month follow-up for the PBS and the QUEST for all participants.

difference=4.2, p-value=0.067). The effect size for the TDC group was Cohen’s d=-0.37 (medium effect size). Similarly, the PBS demonstrated statistically significant

**Table 3.** Results of the paired t-tests for all clinical scores reported in Table 2.

Results of paired t-tests for $\Delta > 0$				
	PBS		QUEST	
	Pre versus post	Pre versus 1 month	Pre versus post	Pre versus 1 month
Intervention	0.0088	0.018	0.158	0.321
Control	0.05	0.062	0.192	0.363

PBS: Pediatric Balance Scale; QUEST: Quality of Upper Extremity Skills Test.

improvement for the pre versus 1 month follow-up in the TDC group ( $p$ -value=0.019) and not in the CG ( $p$ -value=0.31). The effect size for the TDC group was Cohen's  $d = -0.18$  (small effect size). The QUEST did not show statistical differences in either group.

## Conclusion

As children with CP age, availability and use of physical therapy declines for many reasons. Motor development curves of children with CP show improvements until age 6 years and plateau around 7 years of age; thus, the goals in physical therapy shift during the school age years.<sup>13</sup> As inactivity increases, children with CP lose strength and endurance and some may decline in mobility.<sup>14</sup> Goals during the 7–16 age period shift from acquisition of skills to improving strength and endurance as sitting and inactivity increases. Children in school have competing interests of homework, friends, and outside activities which limit available time for center-based therapy. In addition, the parents experience medical fatigue and struggle to transport children to off-site therapy centers.

In this study, the class was paired with the school day, embedded within the school, and transportation was provided to the child's home to minimize transportation burden for the child and parent. The children who participated in the TDC did not view the ballet classes as therapy but as an afterschool activity that was enjoyable and social. The use of afterschool time for a diverting physically challenging activity such as a dance class is a common able-bodied experience; thereby, our TDC provided a normalizing experience for children with CP. The TDC environment was not stressful since the classes occurred in the participants' school with familiar peers. A TDC afterschool for children with CP, designed to improve the outcomes of the International Classification of Function of the World Health Organization,<sup>15</sup> is an innovative intervention that is perceived as fun, artistic, and accessible.

This pilot study demonstrated positive effects on balance as a result of 12 h of a TDC. However, the changes in the upper limb QUEST scores did not reach statistical significance. The children in this study had GMFCS scores ranging

from II to IV. This range of GMFCS scores includes children with limitations in walking ability, requiring handrails to climb stairs, and children who rely mostly on walkers and wheelchairs for ambulation in their daily lives. The age range was broad as were the motor impairment characteristics (Table 1). The heterogeneity of the sample as well as the small sample size underlie the lack of statistical significance for the QUEST scores, as such heterogeneity introduces higher outcome variability and reduces the power of the statistical tests. A study with a homogeneous sample would possibly yield statistically significant changes in the QUEST. Therefore, the main limitations of this pilot study are two-fold: the heterogeneity of the sample along with a small sample size.

Pediatric rehabilitation stresses the importance of community-based programs that address body structure and function, activities, and participation. In combining targeted strengthening, balance, and training paradigms through dance, the child participates and learns group dynamics and social skills. Improving the child's perceptions of therapy as a fun group activity enhances rehabilitation outcomes. For the child moving into adolescence, a group setting of peers is more appropriate versus the one-on-one therapy that is typical for the younger child working on obtaining mobility skills. The TDC seems to be clinically effective for improving balance and is a multifaceted adjunct for rehabilitation in school-aged children with CP.

## Clinical messages

- The TDC improved PBS scores in children with CP ages 7–15 years.
- The TDC did not improve the QUEST scores in children with CP ages 7–15 years.

## Acknowledgements

The authors are grateful to Reika McNish and anonymous reviewers for their valuable comments on the article, to the volunteers who assisted in the classes, and to the administrative support of Chicago Public Schools. This randomized clinical trial was not registered because this is a pilot study and not a clinical trial.

## Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

## Ethical approval

Ethical approval for this study was obtained from the Northwestern University Institutional Review Board No. STU00073070 and the Chicago Public Schools Review Board.

## Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This study was supported by the Physician Engagement Community

Grants Initiative, Northwestern Memorial Hospital, Chicago, IL, USA.

### Informed consent

Written informed consent was obtained from legally authorized representatives before the study. Written assent was obtained from the children after written consent was obtained from a parent.

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