

# EXPLORING HOW FUNCTIONAL IMPROVEMENT IS RELATED TO INTERACTION BETWEEN CHILDREN WITH CEREBRAL PALSY AND HORSES DURING EQUINE-ASSISTED THERAPY: A PILOT STUDY

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## Introduction

The prevalence of cerebral palsy (CP) is 3.3 per 1,000 births in the United States and is the most common cause of motor disability in children [1]. One treatment strategy that may benefit persons with CP is Equine-Assisted Therapy (EAT) utilizing equine movement controlled by the therapist [2]. A few researchers provided kinematic evidence-based effects of EAT, but no one has studied the effects of EAT on kinetics. Thus, we hypothesize the following: 1) the functional mobility of children with CP would improve as the number of EAT sessions increased, 2) there exists the kinetics-related interaction between the rider and the horse during EAT sessions.

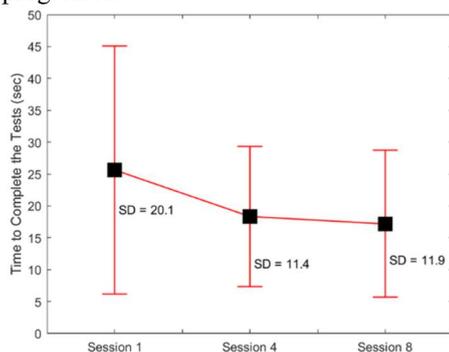
## Methods

Four children with CP aged 3 - 12 years participated. Eight 20-minute sessions of EAT treatments were conducted, with data collection on sessions 1, 4, and 8. Functional mobility was measured using the Timed Up and Go (TUG) test for 3 subjects and 10-Meter walk (10MW) test for 1 subject, all performed before and after EAT on data collection days. Kinetic measurements were done with acceleration representing force normalized by mass. The acceleration data of the children and horses during EAT sessions were measured using 6 Inertial Measurement Units (IMU). The trends of acceleration data were determined using frequency domain and time domain analyses. For frequency domain analysis, Fast Fourier Transform (FFT) was performed to display a repetitive pattern of each signal and dominant frequencies. Besides, the differences between the frequency spectrum of the horse's back and subject were calculated to study the correlation in the frequency domain. For time-domain analysis, correlation by a time shift between the horse's back and the subject's movement was studied and the time delay between their movements was characterized.

## Results and Discussion

### Functional Mobility

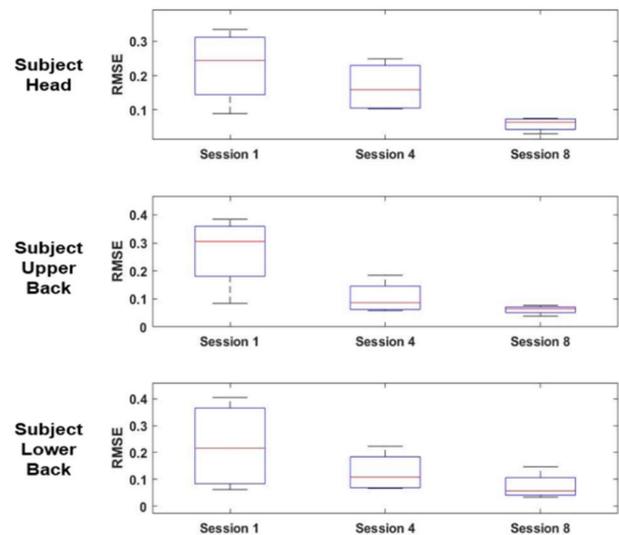
As the number of sessions increases, TUG or 10MW significantly improved over the course of the study (Figure 1). From those results, it might be said that there would be positive changes in the functional mobility of children with CP as the therapy progressed.



**Figure 1:** The outcomes of functional mobility tests with error bars. Black points indicate the means of the test results. SD stands for standard deviation- [3].

### Kinetic-Related Interaction

The mean values and variation in the difference between the frequency spectrums dropped significantly as EAT sessions progressed (Figure 2), suggesting that the dominant frequencies of the movement of children with CP synchronized with those of horses. The results of correlation by a time shift also showed that there was an increase in the correlation between the horse's back and the subject as therapy progressed.



**Figure 2:** The boxplot of difference between frequency spectrums of the horse's back and subject each session [3].

With continued EAT sessions, participants appeared to become more familiar with the horse's movement pattern. Participants seemed to learn automatic postural responses since the subject's movement tended to synchronize with the horse's movement as EAT progressed. Therefore, this study showed that positive kinetic interaction between the movements of children with CP and a horse might occur during EAT.

### Significance

This study showed : 1) that children with CP were able to produce synchronize their movement with the horse's movement and 2) the existence of kinetic interactions between the child and the horse. EAT has the potential to be a valuable treatment intervention that maximizes the functional mobility of children with CP potentially due to the progressive synchronous interaction between the rider and the horse. This study is expected to lay the foundation for a better understanding of the interaction between children with CP and horses.

### References

- [1] Kirby et al., *Research in Development Disabilities* **32**: 462-469, 2011
- [2] MacPhail et al., *Pediatric Physical Therapy*, **10**: 143-147, 1998
- [3] Yonghee Lee, MS Thesis, Texas A&M University, 2019