Wearable Sensors for Early Identification of Poor Neurodevelopment in Guatemala

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Introduction

In rural Guatemala, the number of infants at risk for impaired development is among the highest in the world, due to high rates of undernutrition, poverty, and limited preventive health care. The situation is compounded by suboptimal accuracy of detection of atypical development. As limb movements are one of the earliest outputs of the developing central nervous system, our goal is to quantitatively differentiate typical and atypical early limb movement patterns in infants at risk for developmental disability due to stunting in rural Guatemala using wearable motion sensors. We propose that wearable sensor assessment will be more accurate than current clinical assessments in predicting developmental outcomes. Here we present preliminary data from our aim to determine the relationship between infants' earliest spontaneous limb movements and developmental outcomes at 12 months in infants at risk using wearable motion sensors.

Methodology

- infants at risk (birth - 12 months)
- full day leg wearable sensors (Figure 1): 3 visits for each infant, 1 month apart, between 0-6 months of age
  - sensor metrics = proportion of time asleep, quantity, acceleration, and variability/repeatability of movements[1,2,3] across a full day (average of ~10 hours of data per day).
- outcome = neurodevelopmental status at 12 months (Bayley-III)

Figure 1. Infant wearing sensors on each ankle, in pockets of ankle bands. Inset shows 3 sensors (APDM, Inc.) with a United States quarter for reference.

Results

Preliminary analysis from 43 infants at visit 1, 37 infants at visit 2, and 31 infants at visit 3 are shown in Figure 2. Data are average number of leg movements per hour of awake time, calculated for each infant across a full day at each visit. This allows us to compare across visits as sensors are worn for different lengths of time and infants nap for different amounts of time each day.

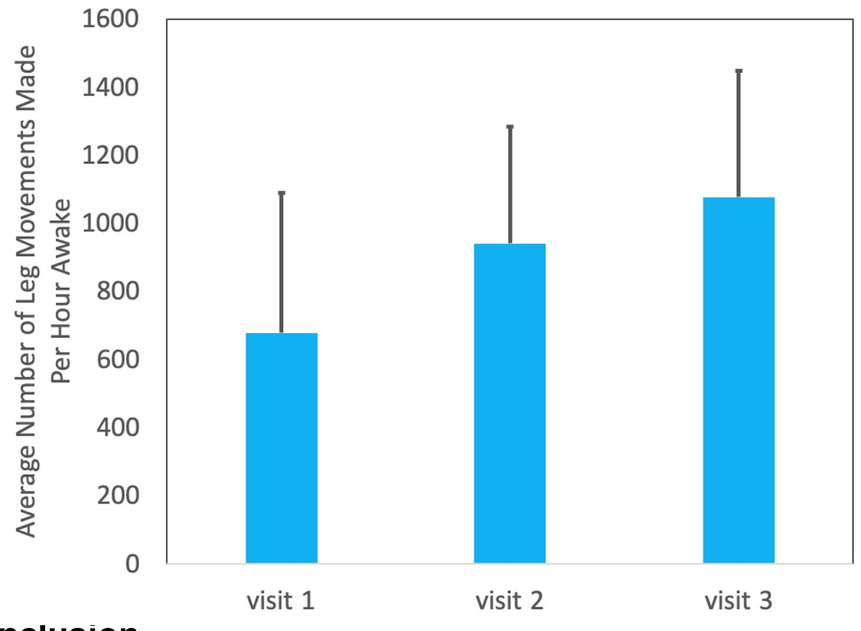

Figure 2. Mean and standard deviation for average number of leg movements made per hour of awake time for all infants at 3 visits.

Conclusion

Infants are moving their legs more as they grow and develop. We do not yet know how leg movement rates relate to developmental outcomes, we will obtain outcome data over the next year. Our novel approach has the potential to improve health outcomes for Guatemalans and other low-and-middle-income country citizens through earlier identification of atypical development, supporting earlier intervention and improved neurodevelopmental outcomes.

References:

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