SJSU SAN JOSÉ STATE UNIVERSITY

SJSU Undergraduate Research Grants

Autonomic Nervous System Activity in Children with Autism Spectrum Disorder

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Abstract

Introduction: Autism Spectrum Disorder (ASD) is a complex neurological disorder that is identified early on in childhood and is one of the fastest growing pediatric disorders. Generally, autonomic imbalance or dysfunction is known to be one of the main pathophysiological characteristics for risk factors and cardio-metabolic diseases. Limited studies have suggested that children with ASD tend to have higher heart rate and blood pressure at rest compared to typically developing children (TDC). This could imply that children with ASD may have differential autonomic responses. Given that individuals with ASD are prone to chronic health problems early in life, we speculate that their poor health outcome could be due to autonomic alterations that exist within the ASD population. **Purpose:** To determine whether ASD children have abnormal autonomic response to a physical stressor (e.g., exercise). **Methods:** We studied a total of 22 children with and without ASD. An electrocardiogram (ECG) was used to measure the electrical activity of the heart, which allowed us to establish the beat to beat heart rate and R-R interval. A mechanical pneumobelt was used to record changes in respiration. Data was collected during the ten minute period of a quiet resting while in the semirecumbent position. Analysis for vagal function using R-R interval was done on LabChart, a computer software that calculates the time and frequency domains of heart rate variability. **Results:** The high frequency (2437±632 TDC vs. 2287±384 ASD, μs²) and low frequency (2441±1422 TDC vs. 1472±232 ASD, μs²) of HR variability at rest were statistically not different among all groups while very low frequency (1424±274 TDC vs. 796±120, μs²) was significantly lower in ASD. rMSSD tends to be greater in ASD children (57.7±5.2 TDC vs. 73.5±9.3 ASD, ms). **Conclusion:** ASD may cause alterations in the brainstem level to imbalance parasympathetic and sympathetic nervous system activities to further regulate cardiovascular system differently.

Findings

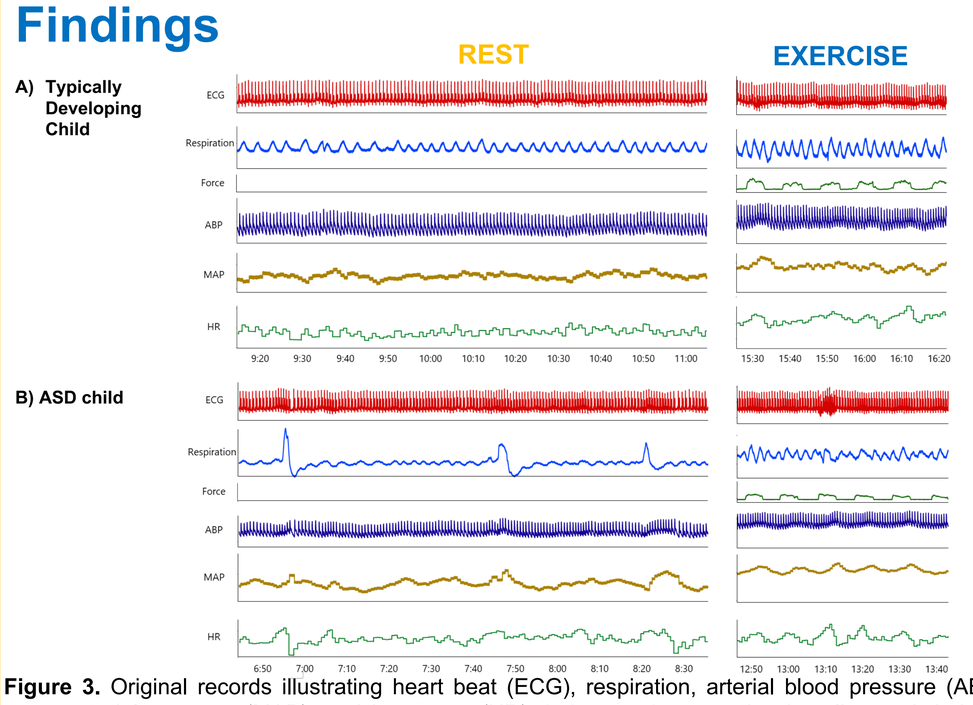

Figure 3. Original records illustrating heart beat (ECG), respiration, arterial blood pressure (ABP), mean arterial pressure (MAP), and heart rate (HR) during 5 minute resting baseline and during 2 minute rhythmic handgrip exercise at 50% MVC in a typically developing child (panel A) and in a child with Autism Spectrum Disorder (panel B).

Methods

Figure 1. Experimental set-up for overall cardiovascular measurements.

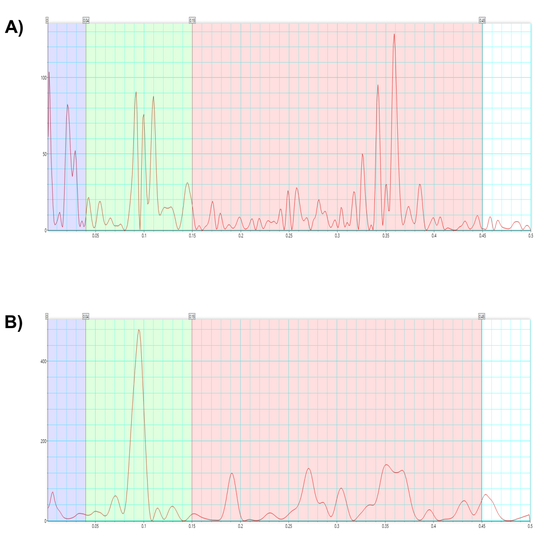

Figure 2. Examples of Power Spectral Density plots from frequency domain Heart Rate Variability analysis during 5 minutes of resting segment (panel A) and during 2 minutes of exercise (panel B) in a child with ASD.

Findings

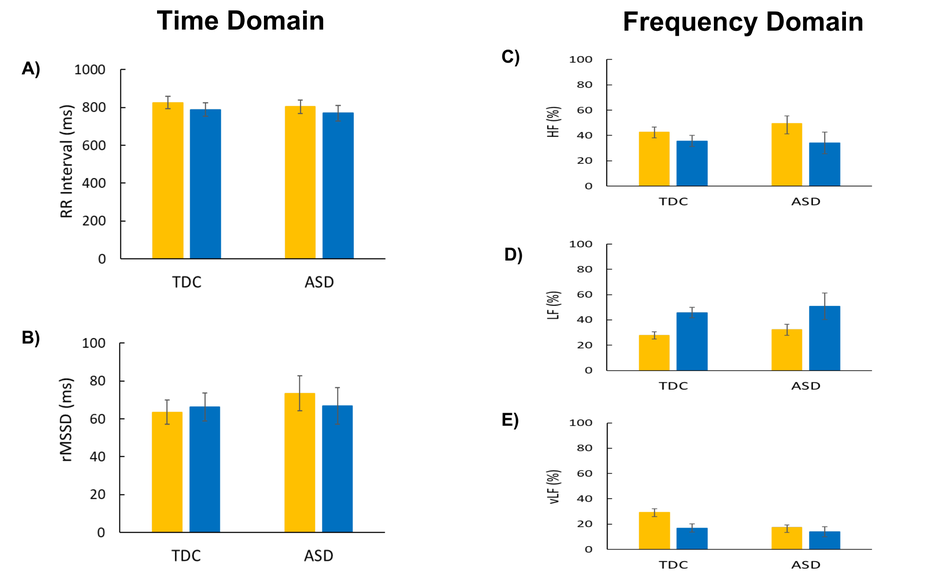

Figure 4. Group summary data showing Time Domain of HR variability with RR interval (panel A) and rMSSD (panel B), Frequency Domain of HR variability with High Frequency Power (HF, panel C), Low Frequency Power (LF, panel D), and Very Low Frequency Power (VLF, panel E) **at Rest (ORANGE)** and **during Exercise (BLUE)** in typically developing children (TDC) and ASD children.

Research Questions

1. Will parasympathetic nervous system activity differently influence heart rate in ASD children?
2. Will exercise training improve autonomic nervous system activity in ASD children?
3. Will sympathetic nervous system activity influence blood pressure response during exercise in ASD children?

Citations

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2. CDC (2016) Facts about Autism Spectrum Disorder. Centers for Disease Control and Prevention.
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4. Croen LA, Zerbo O, Qian Y, Massolo ML, Rich S, Sidney S, and Kripke C (2015) The health status of adults on the autism spectrum. Autism 19 (7): 814-823.
5. Ming X, Julu PO, Brimacombe M, Connor S, and Daniels ML (2005). Reduced cardiac parasympathetic activity in children with autism. Brain & Development, 27(7), 509-516.
6. Ming X, Patel R, Kang V, Chokroverty S, and Julu PO (2016). Respiratory and autonomic dysfunction in children with autism spectrum disorders. Brain & Development, 38(2), 225-232.