Dysfunctional Integration of Frontal and Posterior Brain Regions among Autism Spectrum Disorder (ASD): Quantitative EEG Analysis

Norsiah Fauzan and Nur hurunain Amran
nursiahfauzan@gmail.com, nainamran@gmail.com

Faculty of Cognitive Sciences and Human Development,

University Malaysia Sarawak.

Introduction

Autism Spectrum disorder (ASD) is a neurodevelopmental disorder associated with deficits in executive function, language, emotions and social communication (Coben et al, 2008). In this current investigation, the main purpose was to analyse the brain electrically activity frequency in children with ASD and normal individual (without evident neurological disorders) and compare the recurring patterns in ASD and normal individuals. The specific objective is to investigate the difference in quantitative EEG findings in ten individual diagnosed with ASD and ten normal individuals. Robert Coben and his colleagues have been able to distinguish autistic children from neurotypical children by looking at the quantitative electroencephalogram (qEEG) *alone*, with a success rate of 88%**.**4 (Rondeau, 2005-2010). Through qEEG, or brain mapping, we are able to measure (quantify) the electrical activity summation in a given region of the brain to localize the area of dysfunction.

Methods

Procedures

The process begins when the EEG data were recorded by means of the Mitsar amplifier from 19 electrodes (Fp1, Fp2, F7, F3, Fz, F4, F8, T3, C3, Cz, C4, T4, T5, P3, Pz, P4, T6, O1, O2 sites in the International 10-20 system) with 250 Hz sampling rate in 0.3 – 70 Hz frequency range in the resting eyes opened (EO) conditions. During the recording, participants sat comfortably on a reclining leather sofa. The duration of the recording session was approximately from 10-30 minutes.

The EEG is then stored on a computer. The qEEG process is first to remove artifact (movement, interference,noise, etc) and convert the waveforms into a quantitative measurement,which is very often displayed as a topographical “map”. Topographical differences in cerebral functioning were examined using estimates of absolute, and total power, as well as intrahemispheric and interhemispheric connectivity.

Participants

10 participants diagnosed with ASD and 10 normal participants were selected for the present study. The ASD group composed of 10 male participants recruited from Kuching Autism Association Sarawak ASD; 6 male participants and 4 female were normal. The normal individual had no history of neurological disorders such as epileptic seizures or encephalitis and reduced mental capacity.

Results

Findings included group difference in power, and presence of excessive slow wave activity (delta and theta) at the preFrontal lobe and Frontal lobe or roughly regions Fp1, Fp2, F7 and F8, and O2 or right posterior regions. The findings showed insufficient range of theta and alpha brainwaves that might explain the associated attention and anxiety state of the ASD children. There was insufficient presence of beta in most of the regions such as T3, T4, O1 and O2 which indicated no connections of frontal and posterior regions

Figure 1 Absolute Delta

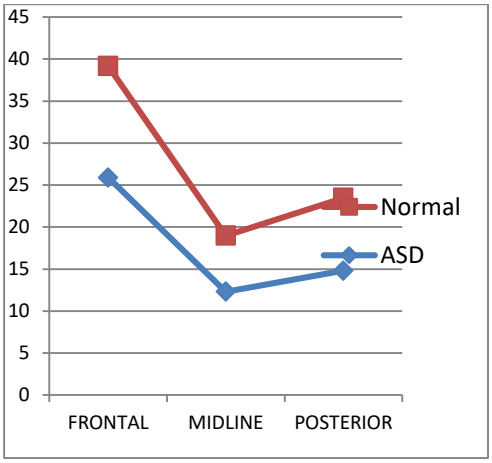


Figure 2 Absolute Theta

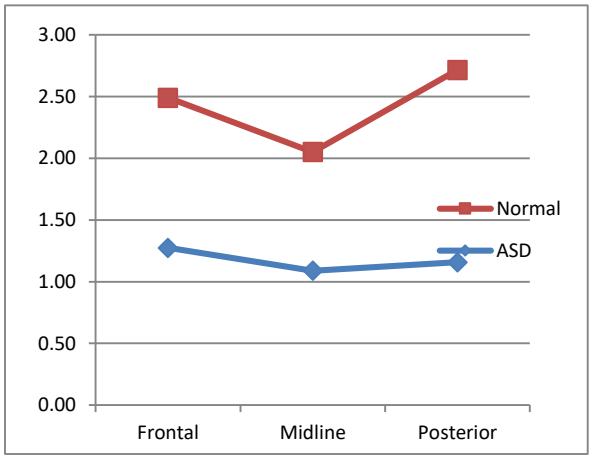


Figure 3 Absolute Alpha

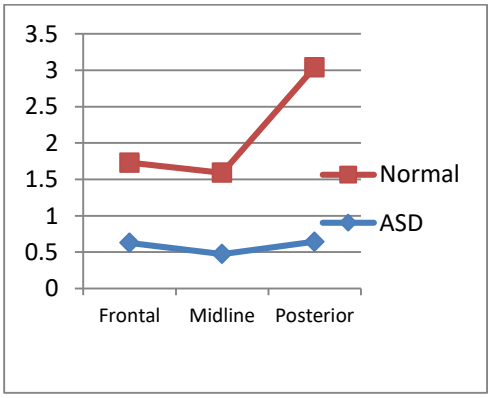
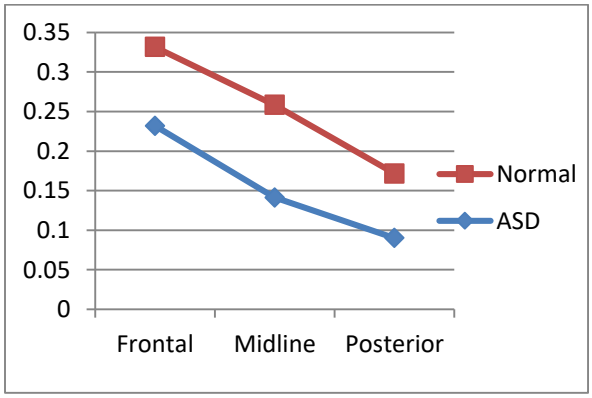


Figure 4 Absolute Beta



Notes: Frontal (Fp1,Fp2,F7, F3,F2,F4,F8),
Midline (T3,C3,Cz,C4,T4),
Posterior (T5, P3, Pz, P4, T6, O1,O2)

More significantly, there was a pattern of underconnectivity in autistics compared to normal participants. Finally, there were low presence of delta, theta ,alpha and beta waves across posterior regions. Results from paired sample t-test were converted into Effect sizes (*d*) and the effect sizes *d*=1.69 (Between ASD Frontal-Normal Frontal), *d*=0.20 (ASD Midline-Normal Midline) and *d*=-1.041 suggesting group difference in power interhemispherically (Frontal and Posterior) but higher values for alpha and theta bands in normal individuals compared to autistics.

Conclusions

These results suggest faulty neural integration of frontal and posterior brain regions in autistics along with a pattern of neural underconnectivity. This is consistent with other research in EEG, such as Coben and Mckeon (20090, Coben and Padolsky (2007) and Coben et.al (2008) suggesting that neural connectivity anomalies are a major deficit leading to autistic symptomatology.

Significance

This paper reports consistencies in the study of EEG power and connectivity or coherence during a resting state Eyes opened (EO) conditions in children suffering autism spectrum disorder.

Keywords; Autism Children; EEG, Diagnosis

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