Department of Medical Studies

Clinico-electrophysiologic correlation with Cognitive Function in children with Attention Deficit Hyperactivity Disorder

THESIS

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(Child health and Nutrition)

PREPARED BY

Noha Fawzy Seaf
M.B., B.Ch., M.Sc. Pediatrics
Cairo University

UNDER SUPERVISION OF

Prof. Dr. Hamed Ahmed El-khayat
Professor of Pediatrics
Faculty of Medicine
Ain-Shams University

Prof. Dr. Samia Sami Aziz
Professor of Public Health
Medical Studies Department
Institute of Postgraduate Childhood Studies
Ain-Shams University

Dr. Nabil Kitchener
Consultant Pediatrics Neuropsychiatrist
GOTHI
Regional Director of World Stroke Organization

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Abstract

Attention Deficit Hyperactivity Disorder (ADHD) is the most common emotional, cognitive and behavioral disorder in children. ADHD has been hypothesized to be results from structural defects in brain networks influencing cognitive and motor behavior or dysfunction of the central nervous system. EEG is a useful source of information on the background state of the brain, indexing the substrate of cognition and behavior, so it appears to be an appropriate tool for assessing this disorder. This study evaluates cognitive function in children with different types of ADHD; detect the EEG changes in different aspects of ADHD and study the correlation between cognitive function and EEG changes among different subtypes of attention deficit hyperactivity disorder children. The study group (٦٠ children) was divided into three subgroups according to the ٣ subtypes of ADHD. All children were between the ages of ٥ and ١٤ years. Neuropsychiatric assessment, electroencephalographic (EEG) study and intelligence quotient (IQ) testing were done to all ADHD subtypes. The study showed that the majority in all subtypes of ADHD had average IQ with no significant difference between different types of ADHD regarding their visual and auditory short term memories. Also revealed that ٤٧٪ of all ADHD groups has electroencephalographic changes. There were significant differences among ADHD subtypes regarding intensity of LT frontal alpha wave, which was significantly increased in combined ADHD group more than in inattention and hyperactive-impulsive ADHD groups, but there were no significant differences between ADHD groups regarding intensity of other EEG waves. The study showed that RT frontal beta wave changes is significantly increased in low average and high average IQ than in average IQ in ADHD children and that LT occipital alpha wave changes is significantly increased in high average IQ than in low average, average IQ and superior IQ in ADHD children. There was no significant correlation between EEG changes and visual short term memory deficit in ADHD children. On the other hand the study demonstrated a significant increase in LT frontal delta and LT temporal beta &delta waves changes in ADHD children with auditory short term memory deficit. The study concluded that there were correlation between some EEG changes and some cognitive function indicators.

Keywords:

Attention Deficit Hyperactivity Disorder (ADHD) – Children – Subtypes – Electroencephalography (EEG) – Intelligence quotient (IQ) – Visual short term memory– Auditory short term memory.

TO THE SPIRIT OF MY FATHER

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List of Abbreviations

AACAP	The American Academy of Child and Adolescent Psychiatry
AAP	American Academy of Pediatrics
APA	American Psychiatric Academy
ACH	Acetylcholine
ADD	Attention Deficit Disorder
ADHD	Attention Deficit Hyperactivity Disorder
ADHD-Com	Attention Deficit Hyperactivity Disorder- Combined subtype
ADHD-HI	Attention Deficit Hyperactivity Disorder- Hyperactive Impulsive subtype
ADHD-In	Attention Deficit Hyperactivity Disorder- Inattentive subtype
ANT	Attention Network Test
APA	American Psychiatric Association
APRS	Academic Performance Rating Scale
b.i.d	Twice daily(from Latin bis in die)
Cap	Capsule
CBCL	Child Behavior Checklist
CD	Conduct Disorder
CDC	Centers for Disease Control and Prevention
CNN	Cable News Network
CNS	Central Nervous System
COMT	Catechol-*O*-methyltransferase
CPRS-R	Conners Parent Rating Scale-Revised
CPT	Continuous Performance Test.
CSF	Cerebrospinal Fluid
CT	Computed Tomography
CTRS-R	Conners Teacher Rating Scale-Revised
D٢	Dopamine receptor D٢
DA	Dopamine
DAT١	Dopamine transporter
DBH	Dopamine β-hydroxylase
DEX	Dextroamphetamine
DRD٤	Dopamine receptor D٤
DSM-II	Diagnostic and Statistical Manual of Mental Disorders ٢nd Edition.
DSM-III	Diagnostic and Statistical Manual of Mental Disorders ٣rd Edition.
DSM-III-R	Diagnostic and Statistical Manual of Mental Disorders ٣rd Edition, Revised.

DSM-IV	Diagnostic and Statistical Manual of Mental Disorders ٤th edition.
DSM-IV-TR.	Diagnostic and Statistical Manual of Mental Disorders, ٤th Edition, Text Revision.
EEG	Electroencephalography
EF	Executive Function
FDA	Food and Drug Administration
fMRI	functional Magnetic Resonance Imaging
FSA	Food Standards Agency
GABA	Gamma aminobutyric acid
GLU	Glutamate
GPe	external portions of the Globus Pallidus
GPi	internal portions of the Globus Pallidus
GRIN٢B	Glutamate receptor, ionotropic, N-methyl D-aspartate ٢B
HSQ-R	Home Situations Questionnaire-Revised
٥HT	Serotonine
Hz	Hertz
ICD-١٠	Intrnational Statistical Classification of Diseases - ١٠th edition
ICF	International Classification of Functioning, Disability and Health
IOWA	Inattention/Overactivity With Aggression
IQ	Intelligence Quotient
Kg	Kilogram
LD	learning Disability
LT	Left
Mg	Milligram
M+MPT	Methylphenidate + Multimodal Psychosocial Treatment
MPH	Methylphenidate
MPT	Multimodal Psychosocial Treatment
MRI	Magnetic Resonance Imaging
MRS	Magnetic Resonance Spectroscopy
MTA	Multimodal Treatment Study of Children With ADHD
Mv	Millivolt
n	Number
NIMH	National Institute of Mental Health
NPP	Negative Predictive Power
NS	Non significant
OCD	Obsessive Compulsive Disorder
ODD	Oppositional Defiant Disorder
PANDAS	Pediatric autoimmune neuropsychiatric disorder associated with streptococcus
PET	Positron Emission Tomography
PFC	Prefrontal cortex

PPP	Positive Predictive Power
q.a.m.	Every day before noon (from Latin quaque die ante meridiem)
q.d	Four times each day (from Latin quater die sumendus)
RT	Right
S	Significant
S.D.	Standard Deviation
S-ADHD	Secondary development of ADHD
SCT	Sluggish Cognitive Tempo
SKAMP	SKAMP Internet site
SNAP-IV	Swanson, Nolan, and Pelham
SNpc	Substantia Nigra pars compacta
SNpr	Substantia Nigra pars reticulata
SPECT	Single Photon Emission Computerized Tomography
SPSS	Statistical Package for Social Science
SSQ-R	School Situations Questionnaire-Revised
TCV	Total Cerebral Volume
TEACh	Test of Everyday Attention for Children
TRF	Teacher Report Form
TX	Texas state (United States postal abbreviation)
U.S.	United State
UK	United Kingdom
Val	Val allele
VNTR	Variable Number Tandem Repeat
WCST	Wisconsin Card Sorting Test
WHO	World Health Organization
Y	Year

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Introduction

Attention deficit hyperactivity disorder (ADHD) is the most common emotional, cognitive and behavioral disorder in children ***(Spencer et al., ٢٠٠٧)***, affecting about ٣ to ٥٪ of children globally ***(Nair et al., ٢٠٠٦)*** and diagnosed in about ٢ to ١٦٪ of school aged children ***(Rader et al., [illegible])***.

ADHD is characterized primarily by behavioral symptoms of inattention, hyperactivity, and impulsivity beginning in childhood and often persisting across the life cycle ***(Biederman, [illegible])***.

The diagnosis of ADHD required the identification of specific behaviors that met the criteria of the Diagnostic and Statistical Manual of Mental Disorders, ٤th edition, Text Revised *(DSM-IV-TR)* ***(APA, [illegible])***.

Although its etiology remains unclear, its strong familial nature and high levels of heritability ***(Faraone et al., [illegible])*** supported a genetic etiology. Importantly, the neurobiological abnormalities found in children with ADHD were also identified in adults ***(Makris et al., ٢٠٠٧)***.

ADHD had been hypothesized to be due, in part, to structural defects in brain networks influencing cognitive and motor behavior ***(Barkley, ١٩٩٧; Makris et al., ٢٠٠٧)***.

A growing literature of magnetic resonance imaging (MRI) based volumetric ***(Valera et al., ٢٠٠٧)*** and cortical thickness ***(Makris et al., ٢٠٠٧)*** studies identified abnormalities in the dorsolateral prefrontal cortex (DLPFC), the frontoorbital cortex, the anterior cingulate cortex (ACC), the inferior parietal lobule (IPL), and the corticostriatal system, which were structures sub-serving attention and executive functions (EFs). The presence of this array of abnormalities raises a critical question as to whether ADHD is a syndrome that may involve disordered white matter (WM) connections.

At the level of body functions, ADHD affected several global and specific mental functions: intellectual function; impulse control; sustaining and shifting attention; memory; control of psychomotor functions; emotion regulation; higher level cognition, including