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Department of Home Economic**

**"Effect of Supplementation with Omega-3 Long Chain
Polyunsaturated Fatty Acids and Zinc on Behavior Problems
Associated with Child ADHD"**

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**Thesis Submitted for Partial Fulfillment
of Master Degree in Home Economic
Dept, (Nutrition and Food Science)**

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2015

قرار لجنة المناقشة والحكم

بناء على موافقة السيد الأستاذ الدكتور / نائب رئيس الجامعة للدراسات العليا والبحوث بتاريخ ٢١ / ٦ / ٢٠١٥ على تشكيل لجنة المناقشة والحكم لرسالة الماجستير المقترحة من الباحثة سهيلة احمد فتحي حسن بقسم الاقتصاد المنزلي - كلية التربية النوعية - جامعة عين شمس بعنوان :

تأثير المكملات الغذائية بالأوميغا ٣ والزنك على سلوك الأطفال المرتبط بفرط النشاط ونقص الانتباه

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وقد اجتمعت اللجنة بالتشكيل عاليه في تمام الساعة الحادية عشر ص من يوم الاثنين الموافق ٢١ / ٨ / ٢٠١٥ م بقاعة أ.د/ مجدي عدوي - كلية التربية النوعية - جامعة عين شمس وناقشت اللجنة الباحثة مناقشة علانية فيما ورد في الرسالة استمرت حتى الساعة الواحدة ليتم من نتائج اليوم وبعد مداولة اللجنة فيما بينها قررت اللجنة باجماع الآراء قبول الرسالة ومنح الباحثة سهيلة احمد فتحي حسن درجة ماجستير في التربية النوعية بقسم الاقتصاد المنزلي تخصص (تغذية وعلوم أطعمة)

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Date: / /2015

Acknowledgment

First of all my obedience, devotion, deepest thanks and praise are due and fully extended-as always to Allah, who has created us and bestowed upon us a lot of blessings which we cannot enumerate and thank enough .

I like to express my great appreciation to: **Dr. Abd El-Rahman Mohamed Attia**, Professor of Nutrition and Ex-Dean of Faculty of Home Economics, Helwan University for his continuous encouragement, highly supervision, sincere advice, scientific help, co-operation in all steps of this work and support throughout this investigation.

I would like to express my deepest gratitude and respect to **Dr. Azza Ahmed ElBakry** Prof of Psychiatry, ,Head of Child Psychiatry Unit, Faculty of Medicine, Cairo University .who devoted her time, effort, scientific advice, endless help, highly supervision and experience to achieve this work.

I would like to express my great thanks to **Dr. Nahed Mohamed Hussein** Assistant Professor of Nutrition and Food Science, Faculty of Specific Education, Ain Shams University, for her valuable guidance, encouragement, highly supervision and great help throughout the work.

I wish also to express my sincere thanks and deepest grateful to **Dr. Maisa Elmallah** Assistant Professor of Nutrition and Food Science, Faculty of Home Economics, Helwan University, for her highly supervision, encouragement, and great help throughout the work.

Finally I would like to express my deepest thanks and gratitude to my family for their continuous encouragement and support during this work.

Sohila Ahmed Fathy Hassan

Effect of Supplementation with Omega-3 Long Chain Polyunsaturated Fatty Acids and Zinc on Behavior Problems Associated with Child ADHD

Sohila Ahmed Fathy Hassan

Thesis submitted for fulfillment of MSc. degree in (Nutrition and Food Science)

ABSTRACT

This study aimed to investigate the effect of omega-3 long-chain polyunsaturated fatty acids (PUFA) and omega-3+ zinc supplementation on behavior and in children with Attention Deficit Hyperactivity Disorder (ADHD). In addition, the changes in PUFA levels and their correlation with changes in behavior and will be examined over 3 month. Subjected sample were about 30 children and divided into 3 groups 10 children with ADHD as (a control) group, 10 children with ADHD were given omega 3 only , 10 children with ADHD were given omega3+zinc. This sample was selected from Abo Elrish pediatric hospital Cairo university and their age ranged between 6-11 years old, All the three groups of children were subjected to following personal data, 24 hour record for three days and its charge this data, Auther take sample of blood from children for biochemical analysis for fatty acids and zinc before and after supplementation, and we applied conner's test to determine the behavior of children. The result showed that : Compared with RNI we found deficient in magnesium , zinc , copper and fiber, vitamin C and B1, Beside increased intake of cab. The mean of conner's scores was significantly high in Omega-3 treatment group compared with mean in the Omega-3 + zinc treatment group and control group.

Fatty acids were increased after omega-3 supplementation . zinc were increased after taken zinc supplementation. The study recommended giving Omega-3 supplementation and Omega-3+ Zinc to children with ADHD .

Keywords:

Attention Deficit Hyperactive Disorder - long-chain polyunsaturated fatty acids
– Zinc - Conner's test.

List of Contents

Subject	Page
List of Contents	I
List of Table	II
List of Figures	III
List of Appendix	III
List of Abbreviation	III
1-Introduction	1
2-Aim of the study	4
3- Review of literature	5
Chapter one	
The History of the diagnosis of ADHD	5
The criteria for each subtype	5
Gender difference	8
Environmental contributions	8
Pharmacological treatment	9
Behavior management	10
Chapter two	
Dietary influence	12
Fatty acids	12
Fatty acids in diet	13
The importance of Essential Fatty Acids in the brain	16
Mechanism of action of EFA in the brain	17
Main EFA metabolism	18
Open-label EFA supplementation trials in ADHD	28
Randomized controlled EFA supplementation trials in ADHD	29
Subgroup analyses of EFA supplementation trials	36
Chapter three	
Zinc deficiency and ADHD	36
Healthy diet pattern in prevention and treatment of ADHD	40
Foods to avoid and foods preferred in children	40
Elimination diets	41
4-Materials and Method	42
5-Results and discussion	47
Description of the sample	48
Demographic data	48
ADHD subtypes	49
ADHD severity	50
Profile of Nutrients	51
Mean intake of nutrients	52
Mean intake of nutrients	53
Mean intake of vitamins	55

Subject	Page
Comparison of Conner's test scores	55
In group 2 pre-test and post-test	56
In group 3 pre-test and post-test	57
Between group 1 and group 2	58
Between group 1 and group 3	60
Between three groups	61
Comparison of plasma levels of total Free FA	64
In group 2 pre-test and post-test	64
In group 3 pre-test and post-test	65
Comparison of plasma levels of total zinc in group 3 pre-test and post-test	66
6-Recommendation	68
7-English summary	69
8-References	74
9-Appendix	96
10-Arabic summary	v

List of Tables

No	TITLE	Page
I	Summary of open-label Essential Fatty Acids supplementation trials in children with Attention Deficit Hyperactivity Disorder	29
II	Foods to avoid and foods preferred in children with ADHD	40
1	Demographic and clinical characteristics of the sample	48
2	ADHD subtypes	49
3	ADHD severity	50
4	Mean intake of nutrients / day for all children	51
5	Mean intake of nutrients / day for all children	52
6	Mean intake of vitamins / day for all children	53
7	Comparison of Conner's test scores in group 2 pre-test and post-test	55
8	Comparison of Conner's test scores in group 3 pre-test and post-test	57
9	Comparison of Conner's test scores between group 1 and group 2	58
10	Comparison of Conner's test scores between group 1 and group 3	60
11	Comparison of Conner's test scores between three groups	61
12	Comparison of plasma levels of total Free FA in group 2 pre-test and post-test	64
13	Comparison of plasma levels of total Free FA in group 3 pre-test and post-test	65
14	Comparison of plasma levels of total Zinc in group 3 pre-test and post-test	66

List of Figures

No	TITLE	Page
1	Biosynthesis of the principal polyunsaturated fatty acids and their metabolism	15
2	Main Essential Fatty Acids metabolites	19
3	ADHD subtypes	49
4	ADHD subtypes and severity	50
5	Mean intake of nutrients / day for all children	52
6	Mean intake of minerals / day for all children	53
7	Mean intake of vitamins / day for all children	55
8	Means of Conner's scores in group 2 (Omega-3) pre-post test	56
9	Means of Conner's scores in group 3 (Omega-3+Zinc) pre-post test	58
10	Means of Conner's scores in group 1 and group 2	59
11	Means of Conner's scores in group 1 and group 3	61
12	Means of Conner's scores in group 1 and group 2 and group 3	63
13	Plasma levels of total Free FA in group 2	65
14	Plasma levels of total Zinc in group 3	67

List of Appendix

TITLE	Page
Appendix 1	96
Appendix 2	97
Appendix 3	98
Appendix4	99

List of Abbreviation

Abbreviation	TITLE / Idioms
AA	Arachidonic Acid
ADHD	Attention Deficit Hyperactivity Disorder
AL	Adequate Intake
ALA	Linolenic Acid
APA	American Psychiatric Association
CHQ	Child Health Questionnaire
COX	Cyclooxy Genase
CTQ	Conner's Teacher Questionnaire
DGLA	Dihomogamma-Linolenic Acid
DHA	Docosahexaenoic Acid

Abbreviation	TITLE / Idioms
DPA	Docosapentaenoic Acid
DSM-IV	Diagnostic and Statistical Manual of Mental Disorders
EFAS	Essential fatty Acids
EPA	Eicosapentaenoic Acid
ETA	Eicosatetraenoic Acid
FDA	Food and Drug Administration
Fig.	Figure
GLA	Gamma-Linolenic Acid
GM	Gram
HUFA	Highly- Unsaturated Fatty Acid
IU	International unit
LA	Linolenic Acid
LC	Long Chain
LC-PUFAS	Long Chain Polyunsaturated Fatty Acids
LOX	Lypooxy Genase
LT	Leukatriene
Mg	Mailgram
MPH	Methylphenidate
MUFA	Monounsaturated Fatty Acids
MVM	Multivitamin Mineral
NUTR.	Nutrition
PG	Prosta Glandin
PS	Phosphatidylserine
PUFAS	Polyunsaturated Fatty Acids
RBC	Red Blood Cell
RCTS	Randonized Controlled Trials
RDA	Recommended Dietary Allowance
SA	Stearidonic Acid
SDQ	Strengths and Difficulties Auestionnaire
SFA	Saturated Fatty Acid
Sig.	Significant
TOVA	Test of Variables of Attewtian
TX	Thromboxane

Introduction

Introduction

According to the Diagnostic and Statistical Manual of Mental Disorders (*DSM-IV-TR, APA, 2000*), Attention Deficit Hyperactivity Disorder (ADHD) “is a persistent pattern of inattention and/or hyperactivity-impulsivity that is more frequent and severe than is typically observed in individuals at a comparable level of development.” There are three subtypes of ADHD that are used to diagnose individuals based on the predominant symptom pattern that has existed for at least the past 6 months (*APA, 2000*). Although most individuals have symptoms of both inattention and hyperactivity-impulsivity, there are some individuals have symptoms of both inattention and hyperactivity-impulsivity, there are some individuals in whom one or the other pattern is predominant.

The number of children diagnosed with ADHD has grown markedly since being recognised as a specific disorder in the 1970s. The prevalence rate of ADHD within Western cultures is approximately 5%, and remains the most common psychiatric illness among young children, with an estimated 50% of these children retaining ADHD symptoms for the rest of their lives. (*Sarris et al., 2011*). In an article reviews epidemiological studies on ADHD in all the Arab countries conducted from 1966 through 2009. It was concluded that ADHD rates in Arab populations were similar to those in other cultures (*Farah et al., 2009*).

There are no available data on the prevalence of ADHD in Egypt (to the best of our knowledge) except for in Alexandria; a study was conducted among 1,350 primary school children in grades 3 through 5; the results revealed that the prevalence of ADHD symptoms was 7.48% (11.67% for boys and 3.58% for girls)(*Attia, et al. 2000*). In a study conducted in Dammam city, Saudi Arabia, and sample size of 1287 students aged 6-13 years, it was found that the overall prevalence of combined ADHD was 16.4%, with a prevalence of 12.4% for

Introduction

hyperactivity-impulsivity and 16.3% for inattention disorders respectively (*Al Hamed et al., 2008*).

Diagnostic tools used to establish a diagnosis of attention deficit hyperactivity/impulsivity disorder involve the clear understanding that symptoms have been present and persistent for a minimum of six months prior to the age of seven, are considered maladaptive, not consistent with the child's developmental level, and cannot be explained by other psychiatric or medical disorders. Symptoms relating to ADHD include inattentiveness in the classroom or at home; or an inability to carry out simple instructions or sustain task attention which can result in careless mistakes in school work and reduce motivation for subsequent participation. Hyperactivity and/or impulsivity diagnosis include symptoms of restlessness that exist in the hands or feet during times of sitting or sleeping and running, moving erratically or talking excessively which cause disruption in an otherwise calm environment (*Sarris et al. 2011*). In addition, there must be clear evidence of clinically significant impairment in social, academic, or occupational functioning. Moreover, the symptoms cannot be a result of another disorder (e.g., Pervasive Development Disorder, Schizophrenia, Personality, Mood Disorder, Anxiety Disorder, Dissociative Disorder or other Psychotic Disorder; (*APA, 2000*). At least one-fourth of children with ADHD also have a learning disorder resulting in difficulties with reading, spelling, and writing (*Mayes et al., 2000*).

The aetiology of ADHD is generally acknowledged to be complex and multifactorial, involving both biological and environmental influence; and there has been extensive research into the causes of ADHD including its high heritability and genetic influences that predispose a child to deficits in dopamine and serotonin transmission (*Wallis et al., 2008*). Other causes have been attributed to harmful exposure to the foetus/child in the prenatal, perinatal, postnatal and early childhood phases (*Swanson et al., 2007*). In utero exposure

Introduction

to excess alcohol, tobacco and lead have been linked to an increased risk of ADHD (*Curtis & Patel, 2008*).

PUFA comprises 15–30% of the brain dry weight (*Hallahan and Garland, 2005*), and are considered essential for normal brain development. AA and DHA are the main fatty acids in the cell membrane phospholipids especially in the grey matter comprising 6% of its dry weight while LA, ALA and EPA are present in very low concentration in nerve tissue. Both ω -3 and ω -6 are essential for growth and function of the developing and mature brain.

Lower levels of long-chain polyunsaturated fatty acids, particularly omega-3 fatty acids, in blood have repeatedly been associated with a variety of behavioral disorders including ADHD. The exact nature of this relationship is not yet clear. A number of the physical and behavioural symptoms of essential fatty acid deficiency mimic some of the symptoms described in typical ADHD patients; therefore it is conceivable, that either dietary deficiency of omega-3 fatty acids, or altered metabolic handling of these fatty acids, could contribute to the abnormalities observed in those affected by ADHD. Several studies have examined fatty acid status in patients with ADHD, but only recently have researchers begun to examine efficacy of high dose supplementation on ADHD behaviours (*Antalis et al., 2006; McNamara and Carlson, 2006; Germano et al., 2007; Sorgi et al., 2007*).

Zinc is an important cofactor for metabolism relevant to neurotransmitters, prostaglandins, and melatonin, and indirectly affects dopamine metabolism. It is necessary for 100 different metalloenzymes and metal–enzyme complexes (*Toren et al. 1996*), many of them in the central nervous system. It contributes to structure and function of brain , Specific to ADHD, the dopamine transporter has a zinc binding site that blocks transport (*Lepping and Huber 2010*). Both animal data (*Halas and Sandstead 1975; Sandstead et al. 1995; Golub et al. 1996*) and human findings suggest

Introduction

involvement of zinc deficiency in hyperactivity. Human zinc deficiency syndrome includes concentration impairment and jitters (*Aggett and Harries 1979*).

Bilici et al. (2004) reported a trial of zinc supplementation alone as treatment for ADHD; participants received zinc sulfate 150 mg/day (containing about 40 mg elemental zinc) for 12 weeks, a rather high dose. After 12 weeks' treatment, the 46-item clinician-rated ADHD Scale showed that the supplemented group improved by 25.4 ± 9.7 compared with the placebo group, which improved by only 12.7 ± 5.4 ($P = 0.002$).

Objective:

The principle purpose of this study is to investigate the changes in PUFA and zinc levels and their correlation with changes in behavior and the effects of PUFA or PUFA + zinc supplementation on behavior in children with ADHD symptoms.

The Aim of the study is to investigate effects of omega-3 PUFA supplementation on behavior in children 6 to 11 y old with ADHD. In addition, the changes in PUFA levels and their correlation with changes in behavior .

Hypothesis:

The oral supplementation of omega-3 fatty acids and zinc will improve behavior of ADHD children

Review of literature