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Polyunsaturated fatty acids supplementation can improve specific language impairment in preschool children: a pilot study

Dalia G. Yasseen¹, Nermien E. Waly² and Khaled O. Abdulghani^{3*} 

Abstract

Background: Speech and language are one of the higher cognitive brain functions. Language delay is one of the major concerns of child health in Egypt. Speech therapy is the standard management in language delay.

Objective: We aimed to investigate the potential role of dietary supplementation with polyunsaturated fatty acids (PUFAs) in improving specific language impairment.

Subjects and methods: A total of 220 children (ages 3–4) were included in this study at the Phonetics Department, Helwan School of Medicine, Egypt, during the period from 2015 to 2018. Children received comprehensive neurological examination and intelligence quotient (IQ) test to exclude the other causes of language delay. Language evaluation was performed using the Arabic language test. They either received family counseling, speech therapy (45 min; 3 times a week for 16 weeks), and PUFA supplementation 500 mg twice daily (group A) or only counseling and speech therapy (group B). Language quotient (LQ) was calculated before and after treatment.

Results: Our results show that LQ significantly improved in group A compared with group B ($p < 0.004$).

Conclusion: Dietary supplementation with PUFA has a beneficial role in the management of specific language impairment along with speech therapy.

Keywords: PUFA, Language impairment, Preschool children

Introduction

Speech and language are one of the higher cognitive brain functions [1]. There is a great socioeconomic impact for cognitive disability. In fact, this impact has exceeded the impact of both cancer and cardiovascular diseases [2, 3]. Language delay is one of the major concerns of parents in Egypt as it may lead to learning and social disabilities.

Cognition refers to several higher neurological functions as memory, learning, language, and comprehension [4]. Speech and language acquisition starts at the first 3 years of life. During this period, the human brain is maturing, which makes it the most critical period for developing language skills. Several factors pose a risk of language and cognitive

delays via the impairments of brain development [1, 5]. Nutritional deficiencies are among those risk factors especially in developing countries [6]. Among those deficiencies are polyunsaturated fatty acids (PUFAs) deficiencies. Growing evidence indicates the impact of deficiency in dietary intake of omega-3 PUFAs to human mental and neurological disorders [7].

Omega-3 PUFA is a family of polyunsaturated fatty acids that is predominantly found in fish oils. The most important fatty acids in human physiology contained in the fish oil supplement are the long chain members of the omega-3 family, known as α -linolenic acid, eicosapentaenoic acid (EPA), and docosahexaenoic acid (DHA). These major fatty acids are known as n-3 PUFAs [8]. Omega-3 PUFA was found to possess cardio-, hepato-, and neuro-protective properties [9–11]. The availability of omega-3 PUFAs in diet has decreased during the last decades.

* Correspondence: Khaled.abdulghani@med.helwan.edu.eg

³Departemnt of Neurology and Psychiatry, Helwan University School of Medicine, Cairo, Egypt

Full list of author information is available at the end of the article

Dietary supplies of these fatty acids are not able to fulfill the needs of the nervous system proper development. A shortage of these fatty acids during the pre- and postnatal periods usually results from the shortage of maternally provided PUFAs in the placenta and breast milk [2, 12]. Despite lacking statistics, a study has shown decreased PUFAs levels in the blood of autistic Egyptian children [13]. Moreover, the cost of enough omega-3-rich foods is beyond the financial capabilities of average Egyptian families; therefore, they are not a part of traditional Egyptian regular food.

Cognition, as a brain function, has been greatly studied in relation to omega-3 PUFA. Deficiency of omega-3 PUFA has a serious impact on cognitive brain development, while its dietary supplementation may be beneficial [2–5, 14]. Several clinical studies have shown that nutritional deficiencies of n-3 PUFAs/omega 3 are associated with autism and attention deficit hyperkinetic disorder (ADHD), and their supplementations was often useful in such cases [15].

The role of n-3 PUFAs in the brain function is not well understood. A study reported that n-3 PUFAs regulate membrane fluidity and consequently neuronal functions [16]. The n-3 PUFAs are important in the regulation of many biochemical functions as neurotransmitter release, uptake, and receptor functions in the central nervous system [17]. On the other hand, postnatal DHA status has been found to correlate with neurodevelopment [18]. Deficiencies of n-3 PUFA lead to loss of DHA from the brain causing memory loss, learning disabilities, and impaired visual acuity [19]. The aim of this study was to evaluate the potential role of dietary supplementation with n-3 PUFAs in managing specific language impairment in children at Helwan University Hospital.

Subjects and methods

This is a randomized case-control study, included a total of 220 children whose parents were seeking medical advice for delayed language development at Phonetic Unit, Helwan University Hospital from September 2015 to January 2018.

All children have normal hearing sensitivity and normal intelligence (IQ score ≥ 90) based on the Stanford-Binet Intelligence Scale, Arabic version [20]. None of them had any history of cognitive or neurological impairments nor any psychological or behavioral disorders.

All children were subjected to the protocol of language assessment [21]. It starts with the parent's interview;

Table 2 Age distribution in among study groups

Age	Group A	Group B	<i>p</i> value
Range (years)	3–4	3–4	0.86
Mean \pm SD (months)	36.409 \pm 3.49	36.492 \pm 3.36	

commenting on (a) complaint and analysis of symptoms; (b) age, birth order, parent's job, degree of education, parental consanguinity, and similar condition in the family; (c) developmental history (prenatal, neonatal, and postnatal); (d) developmental milestones; and (e) past history of early childhood illness.

After the parent's interview, all children were subjected to (a) general and neurological examination, (b) vocal tract examination, (c) psychometric evaluation using Arabic version Stanford-Binet Intelligence Scale [20], and (d) language evaluation by a valid and reliable test for the evaluation of language development using language testing of Arabic-speaking children [21]. For each child, the total language quotient was calculated.

Patients were randomly assigned to two equal groups. Group A patients received family counseling, speech therapy sessions (45 min; 3 times a week, for 16 weeks), and omega-3 fatty acid 500 mg twice daily commercial supplements for kids with DHA and EPA. Group B patients only received family counseling and speech therapy sessions (45 min; 3 times a week, for 16 weeks).

Family counseling: The parents were informed about the nature of the problem and how to stimulate language development by using all possible surrounding activities done in the presence of the child or done by the child to comment in simple statements. They were advised to avoid commands, frequent questions, and direct corrections, and to be directed to enhance the cognitive and social abilities, which will facilitate the development of linguistic abilities.

Statistical analysis

The data collected and analyzed by the computer program SPSS, version 21 (IBM, Chicago, USA). The data expressed as mean, standard deviation, and percentage. We used the ANOVA test to determine the significance for numeric variable. Student's *t* test was used for the comparison of parametric data between the independent groups. The level of statistical significance (*p* value) was set at 0.05.

Table 1 Gender distribution in study groups

Sex	Group A <i>n</i> (%)	Group B <i>n</i> (%)	<i>p</i> value
Male	91 (82.7%)	94 (85.5 %)	0.58
Female	19 (17.3%)	16 (14.5 %)	

Table 3 Language quotients in study groups prior to intervention

Language quotient	Group A	Group B	<i>p</i> value
Mean \pm SD	71.99 \pm 9.75	69 \pm 8.49	0.076

Table 4 Comparison of pre- and post-intervention language quotient in both groups

Language quotient	Group A		Group B		p value
	Pre-intervention	Post-intervention	Pre-intervention	Post-intervention	
Mean ± SD	71.99 ± 9.75	79.61 ± 10.08	69 ± 8.49	75.77 ± 8.74	0.004
p value	< 0.0001		< 0.0001		

Results

The included were 185 males and 35 females, whose ages ranged between 3 and 4 years. Age and gender distribution are comparable in our study groups. Tables 1 and 2 show the age distribution between both groups. There was no statistically significant difference in both age and gender among our study groups ($p = 0.58$). Also, there was no statistically significant difference in language quotient between both groups ($p = 0.076$) as shown in Table 3.

On the other hand, there was a statistically significant improvement in language quotient following intervention in both groups ($p < 0.0001$). This improvement was statistically higher in group A compared with group B as shown in Table 4.

Discussion

Language development delay is one of the major concerns of parents in our society and worldwide that may lead to learning and social disabilities. Early diagnosis/intervention is critical for future health benefits [22]. To our knowledge, this is the first study to describe this effect in language development in Egypt. Our study results show that the use of omega-3 PUFAs is beneficial in children diagnosed with specific language impairment. This comes in agreement with other studies that described the beneficial effects of PUFAs in neuronal development and maturation [4, 13, 15].

A total of 220 children were included in this study, with 185 males and 35 females whose ages ranged between 3 and 4 years. The gender distribution in our study sample was 84% males and 16% females. This percentage is similar to another Egyptian study that showed increased prevalence of cognitive delays and disorders in boys. The study showed that 73.5% children diagnosed with developmental delays were boys while 26.5% were girls [22].

Speech therapy and family counseling is usually the standard management of these cases. In our study, this approach has improved the language quotient in children significantly (Tables 3 and 4). This result agrees with previous studies that found the positive effect of speech therapy in cases of language delay in children [23]. However, this effectiveness was debatable in other studies depending on target group, cause of delay, and child's age [24–26].

When we tested the effectiveness of omega-3 supplementation along with speech therapy, the language quotient of tested children (group A) significantly improved

compared with children who received speech therapy only (group B). Although data is limited, this result comes in agreement with another study that found the beneficial effects of dietary supplementation of PUFAs in various cognitive developmental disorders [13]. Moreover, Strain and colleagues, in 2012, found that pre- and postnatal PUFA improved psychomotor performance and communication in children [27].

Conclusion

Polyunsaturated fatty acids supplementation has a beneficial effect in children with specific language impairment. Along with standard speech therapy, we recommend the prenatal and postnatal supplementation of diet with n-3 PUFAs to prevent speech delay. Further larger studies are needed to confirm these results.

Abbreviations

ADHD: Attention deficit hyperkinetic disorder; DHA: Docosahexaenoic acid; EPA: Eicosapentaenoic acid; IQ: Intelligence quotient; LQ: Language quotient; PUFA: Polyunsaturated fatty acids

Acknowledgements

None

Authors' contributions

DY and NW made substantial contributions to the conception and design of the study; DY performed the acquisition of data; DY, NW, and KA participated in the analysis and interpretation of data; NW and KA have been involved in drafting the manuscript or revising it critically for important intellectual content. All authors agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. All authors read and approved the final manuscript.

Funding

None

Availability of data and materials

The datasets generated and analyzed during the current study are not publicly available due to institutional limitations, yet they are available from the corresponding author on reasonable request.

Ethics approval and consent to participate

This study was approved by the ethical committee of Helwan University School of Medicine on the 10th of September 2015. All parent or legal guardian of patients provided an informed written consent prior to participating in any study-related activities.

Consent for publication

Not applicable

Competing interests

The authors declare that they have no competing interests.

Author details

¹Department of Phonetics and Communication, Helwan University School of Medicine, Cairo, Egypt. ²Department of Physiology, Helwan University School of Medicine, Cairo, Egypt. ³Department of Neurology and Psychiatry, Helwan University School of Medicine, Cairo, Egypt.

Received: 5 August 2019 Accepted: 30 January 2020

Published online: 07 February 2020

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