*Salud, Ciencia y Tecnología*. 2026; 6:2532
doi: 10.56294/saludcyt20262532

**REVIEW**

# Essential fatty acid intake in the health and nutrition of schoolchildren

## Ingesta de ácidos grasos esenciales en la salud y nutrición de escolares

Sandra Gabriela Barrazueta Rojas[1], Lorena Patricia Yaulema Brito[1], María José Andrade Albán[1], María de los Angeles Rodríguez Cevallos[1]

[1]Facultad de Salud Pública. Carrera de Nutrición y Dietética. Escuela Superior Politécnica de Chimborazo (ESPOCH), Riobamba. Ecuador.

**Cite as:** Barrazueta Rojas SG, Yaulema Brito LP, Andrade Albán MJ, Rodríguez Cevallos M de los A. Essential fatty acid intake in the health and nutrition of schoolchildren. Salud, Ciencia y Tecnología. 2026; 6:2532. https://doi.org/10.56294/saludcyt20262532

**Submitted:** 07-08-2025 **Revised:** 18-10-2025 **Accepted:** 03-12-2025 **Published:** 01-01-2026

**Editor:** Prof. Dr. William Castillo-González

**Corresponding author:** Sandra Gabriela Barrazueta Rojas

## ABSTRACT

**Introduction:** nutrition is key to both the health and academic performance of students, particularly because a positive correlation has been found between the intake of some foods and health, nutritional status and the development of cognitive functions in children and adolescents. Therefore.
**Objective:** the objective of this research was to determine the relationship between the intake of essential fatty acids and the health and nutrition of schoolchildren.
**Method:** in this sense, a systematic review of 180 articles was carried out in the Scopus, PubMed, SciELO, Latindex, Redalyc and Google Scholar databases, of which 24 were selected that address Essential fatty acid intake in the health and nutrition of schoolchildren from research reported between 2021 and 2025.
**Results:** the results reveal that the intake of essential fatty acids is closely related to the health and nutrition of schoolchildren when it is observed that diets rich in fish and shellfish or fatty acid supplementation from infancy are associated with lower risks of cardiovascular disease and development of cognitive skills, including in children with attention deficit hyperactivity disorder (ADHD) and Down syndrome, so.
**Conclusions:** it is concluded that the inclusion of fatty acid consumption in the dietary regimes of the school-age population should be mandatory, especially if they are in conditions of vulnerability and malnutrition.

**Keywords:** Learning; Schoolchildren; Lipids; Nutrition; Risks; Health.

## RESUMEN

**Introducción:** la alimentación juega un papel fundamental en el bienestar y el rendimiento académico de los alumnos, especialmente porque se ha observado una relación positiva entre la dieta y la salud, el estado nutricional y el desarrollo de habilidades cognitivas en la infancia y la adolescencia.
**Objetivo:** el propósito de este estudio fue investigar la conexión entre el consumo de ácidos grasos esenciales y la salud nutricional de los estudiantes.
**Método:** para ello, se llevó a cabo una revisión exhaustiva de 180 artículos en bases de datos como Scopus, PubMed, SciELO, Latindex, Redalyc y Google Scholar, seleccionándose 24 que tratan sobre el consumo de ácidos grasos esenciales en la salud y nutrición de escolares en investigaciones publicadas entre 2021 y 2025.
**Resultados:** los resultados indican que la ingesta de ácidos grasos esenciales está muy relacionada con la salud y nutrición de los estudiantes, observándose que dietas ricas en pescado y mariscos, así como la suplementación de ácidos grasos desde la lactancia, se vinculan con menores probabilidades de enfermedades cardiovasculares y mejor desarrollo de habilidades cognitivas, incluso en niños con trastorno por déficit de atención e hiperactividad (TDAH) y síndrome de Down.
**Conclusiones:** por lo tanto, se puede afirmar que la incorporación de ácidos grasos en la dieta de los

escolares es fundamental, especialmente en aquellos que se encuentran en situaciones de vulnerabilidad y desnutrición.

**Palabras Claves:** Aprendizaje; Escolares; Lípidos; Nutrición; Riesgos; Salud.

## INTRODUCTION

Nutrition is key at many stages of life for growth, maintaining health, and preventing disease, but it is also important during the school years for improving cognitive function,[1,2] given that the consumption of certain foods promotes the development of brain functions, such as the consumption of essential fatty acids, while others reduce myasthenia, as has been reported in populations with a prevalence of ultra-processed food consumption.

The diet of these schoolchildren is geared towards the intake of carbohydrates, proteins, and amino acids that are essential for the growth of children and adolescents. However, the intake of fatty acids has not been emphasized despite their proven benefits, with the exception of populations in countries that follow the so-called Mediterranean diet, such as Spain, Greece, and Portugal[3,4] where the consumption of seafood and fish is associated with high levels of fatty acids in plasma.

Although fatty acids are key to human health and nutrition, their intake and supplementation has been reported in the elderly, especially in relation to cardiovascular health, and in some cases in pregnant women, whose consumption has been linked to a reduction in cardiovascular risks in obese children by lowering triglyceride and cholesterol levels, especially when consumed by the mother during breastfeeding.[5,6]

Likewise, there is a great deal of research highlighting the importance of fatty acids with cognitive functions, which are key to improving school performance, with a positive correlation reported between their consumption and skills such as memory, verbal reasoning, and mathematics, as a result of a diet that favors the intake of essential fatty acids or where they have been supplemented, which translates into better academic performance.[7,8]

Attention should be paid to the consumption of essential fatty acids in students with attention deficit disorders, hyperactivity, or Down syndrome, where academic performance may be affected by these conditions[9,10] given that many cognitive functions develop late or are limited, but that the consumption of essential fatty acids can be a strategy to improve brain function in students with these conditions and therefore improve their academic performance, in addition to the benefits obtained for their health.

In this regard, correlations have been established between fatty acid intake and school performance, with a significant gap between higher-income and poorer households, given that in populations living in poverty, seafood and fish intake is low and fatty acid supplementation is not common[11,12] therefore, the benefits expected from their intake, from a health, nutritional, and academic point of view, are not possible unless this social and economic problem is addressed.

Considering the above, the objective of this research was to highlight, through a systematic review, the importance of fatty acid intake in the health and performance of schoolchildren, which will serve as a basis for mandatorily including fatty acid consumption in the diets of the population of school age, especially if they are in conditions of vulnerability and malnutrition, with the aim of improving their nutrition, health, and academic performance.

## METHOD


**Figure 1.** Methodological protocol for searching scientific articles on the importance of acid intake for improving the nutrition, health, and academic performance of school-age children and adolescents

To carry out this research, a literature review was conducted using a systematic approach and a PRISMA guideline framework to study the importance of fatty acid intake in improving the nutrition, health, and academic performance of school-age children and adolescents. To this end, we contacted similar research projects in terms of their purposes, scope, and other noteworthy elements. The systematic review was carried out in two phases: the first referred to heuristics, in which the sources of the findings were verified in order to develop the research, and a hermeneutic phase for the analysis of the results (figure 1).

**Eligibility criteria**

Texts containing content related to the topic under investigation were considered, and these publications had to comply with the research parameters regarding the relevance of essential fatty acid intake to the health and nutrition of students. In addition, they had to have been produced within the defined time frame between 2021 and 2025. Attention was paid to the language used in the search for information, limiting the exploration to previous discoveries and results related to the intake of fatty acids in diets.

**Population**

The study included the school-age population (5-15 years old), especially those in vulnerable and malnourished conditions, with the aim of improving their nutrition, health, and academic performance. This population was identified in scientific manuscripts located in databases such as Scopus, PubMed, Google Scholar, Latindex, and Scielo.

**Exclusion criteria**

Articles whose content was not relevant to the main topic of this research on the significance of essential fatty acid intake in the health and nutrition of school-age children, or that lacked logic, were not considered. Publications that were not supported by an adequate scientific basis and data sources to justify the results, or whose findings derived from products could not be traced in reliable databases, were discarded. Abstracts, conference presentations, and academic papers of any level were also excluded, as were studies related to the consumption of fatty acids in the diets of children under five and over fifteen, and studies conducted before 2021 or after 2025.

**Phenomenon of interest**

The scientific analysis was carried out thoroughly and accurately. After locating the documents, each section of the article was reviewed and key aspects were identified to classify each of the components, in order to carry out a clear and thorough evaluation of each source regarding the relevance of consuming essential fatty acids in the health and nutrition of students. The most relevant information was then selected and the necessary comparisons were made using the PICO questioning technique.

P (problem) = What progress has been made in terms of acid intake to improve the nutrition, health, and academic performance of school-age children and adolescents?

I (interventions) = use of health, nutrition, and cognitive skills assessments for school-age children and adolescents.

C (comparison) = between the nutritional status, health, and academic performance of school-age children and adolescents who consume fatty acids and those who do not include them in their diet.

O (outcomes) = establishing the basis for mandatorily including fatty acid consumption in the diets of the population of this age, especially if they are vulnerable and malnourished, with the aim of improving their nutrition, health, and academic performance.

**Results used for the analysis**

Primary results measuring the importance of essential fatty acid intake on the health and nutrition of schoolchildren were analyzed using randomized controlled trials, cohort studies, or qualitative studies.

**Sources of information and search strategy**

The electronic databases used were Scopus, Pubmed, Scielo, Redalyc, and Google Scholar for articles published between 2021 and 2025, searched using keywords such as fatty acids, school performance, and cognitive skills, selected based on titles and abstracts, followed by selection of full texts, whose independence was guaranteed by review by at least two independent reviewers, whose conflicts were resolved through discussion.

**Data extraction process and data elements:**

Information on results, number of patients, statistical parameters, and type of study was collected from each study using a standardized data extraction form previously tested with data on authors, year, study

design, PICOS elements, sample size, key results related to outcomes, and funding sources. The risk of bias was assessed, and the methodological quality of the included studies was evaluated using Cochrane.

**Interpretation of findings**

The evaluation phase of the findings, known as hermeneutics, was carried out by synthesizing data and creating observations based on the underlying theory. This approach facilitates the study of works by various authors and their comparison based on the topic of interest, specifying the different sources that contributed to the collection of information from various perspectives and approaches, as well as the similarities and differences between the various aspects related to the subject of study.

## RESULTS

Of the 180 articles reviewed in relation to the importance of fatty acid intake for improving the nutrition, health, and academic performance of school-age children and adolescents, 24 were selected, of which the first six address the importance of fatty acids in the health of schoolchildren, the results of which are highlighted in table 1.

**Table 1.** Importance of fatty acids in the health of schoolchildren

| Title | Authors | Year |
|---|---|---|
| Omega-3 fatty acid dietary supplements consumed during pregnancy and lactation and child neurodevelopment: a systematic review. | [13] | 2021 |
| Polyunsaturated fatty acids (PUFA) for attention deficit hyperactivity disorder (ADHD) in children and adolescents. | [14] | 2023 |
| Impaired reverse cholesterol transport is associated with changes in fatty acid profile in children and adolescents with abdominal obesity. | [6] | 2024 |
| Association between Human Milk Fatty Acid Esters of Hydroxy Fatty Acids and Maternal Body Mass Index and Early Infant Growth: A Longitudinal Study. | [15] | 2025 |
| Circulating fatty acids associate with metabolic changes in adolescents living with obesity. | [16] | 2024 |
| Disrupted gut harmony in attention-deficit/hyperactivity disorder: Dysbiosis and decreased short-chain fatty acids. Brain, Behavior, & Immunity-Health, 40, 100829. | [17] | 2024 |

According to limited evidence, consuming omega-3 fatty acids during pregnancy may benefit children's cognitive development. There was insufficient data to analyze how supplementation with these fatty acids affects other aspects of growth during pregnancy or breastfeeding.[13]

According to [14] attention deficit hyperactivity disorder is a significant issue in children and adolescents, manifesting itself through excessive inattention, hyperactivity, and impulsivity that are inappropriate for their development, and is associated with long-term social, educational, and mental health difficulties. Stimulant drugs, such as methylphenidate and amphetamine, are the most common treatments for ADHD; however, they are not always effective and may be associated with unwanted effects. These observations suggest that including PUFAs in the diet could help mitigate attention and behavioral problems related to ADHD. This review is an update of a previous Cochrane analysis. Overall, the evidence for improving ADHD symptoms in children and adolescents through PUFA supplementation was limited.

For authors such as [6] abdominal obesity represents a significant risk factor for heart disease. Fatty acids in the blood have a complicated network of both proatherogenic and antiatherogenic effects. High-density lipoproteins play a role in the antiatherogenic pathway known as reverse cholesterol transport, which includes the removal of cholesterol from cells and the functions of lecithin: cholesterol acyltransferase and cholesterol ester transfer protein.

Obesity according to [15] is reflected in an elevated maternal body mass index and is associated with higher levels of two unsaturated fatty acids (5-PAHSA and 9-SAHSA) and lower levels of one polyunsaturated fatty acid (13-LAHLA) in breast milk. Specific isomers of these fatty acids were associated with the growth and development of body composition in infants who were exclusively breastfed during the first few months.

In this regard [16] point out that obesity is a condition characterized by an imbalance in blood lipid regulation and redox status, along with a notable reduction in telomere length. High levels of proatherogenic lipids and lower concentrations of HDL cholesterol were detected, indicating an increased risk of cardiovascular disease in obese individuals. According to [17] this leads to variations in short-chain fatty acids that are linked to

other behavioral and neurological health conditions, in addition to their role in neuronal communication. After describing the first articles, the other six address the importance of fatty acids in the health of schoolchildren, describing the role of fatty acids in schoolchildren's nutrition, the results of which are reported in table 2.

**Table 2**. Importance of fatty acids in the nutrition of schoolchildren

| Title | Authors | Year |
|---|---|---|
| Fish nutritional value as an approach to children's nutrition. | [18] | 2021 |
| Intake of micronutrients and fatty acids of vegetarian, vegan, and omnivorous children (1–3 years) in Germany (VeChi Diet Study). | [19] | 2022 |
| Nutritional quality implications: exploring the impact of a fatty acid-rich diet on central nervous system development. | [20] | 2024 |
| Nutritional status and dietary fatty acid intake among children from low-income households in Sabah: A cross-sectional study. | [21] | 2023 |
| Fatty Acids in Childhood Obesity: A Link Between Nutrition, Metabolic Alterations and Cardiovascular Risk. | [22] | 2025 |
| Effects of Probiotics Supplementation on Short-Chain Fatty Acids: A Systematic Review of Randomized Controlled Trials. | [23] | 2024 |

Among the sources of fatty acids [18] state that fish represents an economical and readily available source of animal protein for human consumption, even in rural areas. It is crucial for ensuring global food security and nutrition, and its consumption continues to grow. Due to its high nutritional value, fish consumption is recommended for children and pregnant women, as it promotes normal development and growth.

Although new eating habits exist in the modern world that limit fish intake during early life and may affect fatty acid levels, as indicated in [19] it has nevertheless been proven that vegetarian (VN) and vegan (VG) can provide most micronutrients in adequate amounts and with a preferable fat profile compared to omnivorous diets (OM), which can be critical, such as vitamin D, iodine, and DHA for all children, regardless of their diet type, as well as vitamin B2, B12, calcium, and iron.

As described in [20] existing knowledge about how fatty acids influence the development of the central nervous system not only provides a solid foundation for future research but also sets an attractive agenda for it. Addressing the gaps identified and responding to the complex questions raised will pave the way for new dietary strategies and public health policies, which is key given that, according to [21] a high incidence of stunting and overweight or obesity has been detected among children from low-income families in Sabah. Most children did not meet the recommendations for saturated fatty acids (SFAs) and n-3 polyunsaturated fatty acids (PUFAs). These results underscore the urgent need to implement nutritional strategies that promote compliance with dietary guidelines related to fatty acids.

**Table 3**. Importance of fatty acids in the development of cognitive skills

| Title | Authors | Year |
|---|---|---|
| New perspectives on the associations between blood fatty acids, growth parameters, and cognitive development in global child populations. | [24] | 2023 |
| Developmental and nutritional changes in children with severe acute malnutrition provided with n-3 fatty acids, improved ready-to-use therapeutic food, and psychosocial support: | [25] | 2024 |
| Effect of dietary fiber on cognitive function and mental health in children and adolescents: a systematic review and meta-analysis | [26] | 2024 |
| Effects of childhood trauma on depression and cognitive function in first-diagnosed, drug-naïve depressed patients: an observational case-control study | [27] | 2025 |
| Seafood and neurocognitive development in children: A systematic review | [28] | 2025 |
| Associations between perinatal biomarkers of maternal dairy fat intake and child cognitive development: results from the EDEN mother-child cohort. | [29] | 2025 |

The condition described above according to [22] is a consequence of childhood obesity, influenced by dietary choices, increasing the risk of cardiovascular disease. Obesity is linked to inflammation and alterations in glucose, iron, and lipid metabolism. This research examines the relationships between eating habits, plasma fatty acid profile, cardiovascular risk factors, and obesity- n children. One of the alternatives to reverse this situation is the administration of probiotics in childhood, which was also identified as the most effective period of intervention to raise short-chain fatty acid levels.[23] After describing the following six articles on the importance of fatty acids in the nutrition of schoolchildren, the importance of fatty acids in the development

of cognitive skills in schoolchildren is described, the results of which are reported in table 3.

Malnutrition is commonly found in low- and middle-income countries, but it is often clinically identified through abnormal anthropometric measurements that are characteristic of protein-energy malnutrition. For this reason, other elements that contribute to or are side effects of malnutrition, especially the lack of essential fatty acids, are overlooked. Previous research, particularly in high-income countries, indicates that a deficiency of essential fatty acids and their derivatives, such as n-3 and n-6 polyunsaturated fatty acids, causes abnormal physical growth and impaired cognitive development, as stated in [24].

Infants with severe acute malnutrition, as stated by [25] face a high risk of developmental impairment. Factors influencing this condition include inadequate intake of key nutrients, such as polyunsaturated fatty acids, along with a lack of adequate stimulation. A preliminary study was conducted to analyze variations in nutrition and development in children with severe acute malnutrition who received modified therapeutic food and a psychosocial intervention adapted to their environment in Mwanza, Tanzania.

Cognitive impairment due to malnutrition and low levels of fatty acids also manifests itself in depressive symptoms. However, according to [26] evidence from observational studies indicates that higher dietary fiber intake, which promotes the absorption of fatty acids, is associated with a reduced likelihood of depressive symptoms during childhood and adolescence. However, the connection between fiber intake and mental and cognitive health in young people still needs further clarification through high-quality intervention studies in the future. In this regard, authors such as [27] point out that it was first reported that patients who were initially diagnosed without pharmacological treatment suffered more severe childhood trauma compared to healthy controls. In addition, depressed individuals with a history of childhood trauma showed more intense clinical features of depression and reduced levels of EPA.

However, according to [28] seafood provides nutrients that are crucial for cognitive development in children and adolescents due to the high amount of fatty acids they contain, although there are concerns about contamination. Evaluating seafood as a food group, rather than considering only its nutritional value or contaminants, could serve as a basis for future dietary guidelines. The purpose of this study was to review and assess the relationship between seafood consumption in childhood and adolescence and cognitive development. In addition to a diet rich in fatty acids, the findings presented by [29] suggest that higher intake of dairy fats by the mother during the perinatal period may be associated with superior cognitive development in her offspring. Finally, after describing the six articles on the importance of fatty acids in the development of cognitive skills in schoolchildren, the findings on the importance of fatty acids in the academic performance of schoolchildren are presented, with the results reported in table 4.

**Table 4**. Relationship between fatty acids and academic performance

| Title | Authors | Year |
|---|---|---|
| Adherence to the Mediterranean diet and academic performance in adolescents: Does BMI status moderate this association? | [30] | 2021 |
| Is higher adherence to the Mediterranean diet associated with greater academic performance in children and adolescents? A systematic review and meta-analysis. | [31] | 2024 |
| Omega-3 consumption and its relationship with academic performance | [32] | 2025 |
| Interconnected pathways link faecal microbiota plasma lipids and brain activity to childhood malnutrition-related cognition. | [33] | 2025 |
| Investigating the relationship between ultra-processed food consumption and academic performance in the adolescent population: | [34] | 2025 |
| Causal links between obesity, lipids, adipokines, and cognition: a bidirectional Mendelian-randomization analysis. | [35] | 2025 |

Adolescence is a crucial stage for neurological development, characterized by the formation of behavioral patterns that can influence young people's physical, mental, and cognitive health in both the short and long term. Adherence to the Mediterranean diet (MD) and academic performance, as pointed out by [30] and confirmed by [31] where they point out that greater adherence to the Mediterranean Diet is moderately linked to a better health-related quality of life (HRQoL) in children and adolescents. These results reinforce the idea that dietary changes can be an essential part of strategies for youth well-being, although more extensive studies over time and with an intervention approach are required.

In addition to the Mediterranean diet according to [32] the administration of fatty acids in amounts equal to or greater than 450 mg shows improvements in the cognitive function of children and adolescents, which may improve memory. Furthermore, a relationship has been found between nutritional status, omega-3 consumption,

and psychomotor development in schoolchildren who eat foods such as fish oils, shellfish, clams, and various species of fish and seafood. Despite these findings, authors such as [33] point out that more than 30 million children suffer from malnutrition each year, which has significant immediate and long-term effects. Those who survive may experience lasting neurocognitive consequences that affect their school performance and socioeconomic status, which is related to an increase in *Rothia mucilaginosa* in feces and *Streptococcus salivarius*, as well as a decrease in *Bacteroides fragilis*, whose alterations in the microbiome create interconnected pathways that suggest a reduction in plasma levels of odd-chain fatty acids.

In addition to low fatty acid consumption, authors such as [34] reveal a negative correlation between the consumption of ultra-processed foods (UPF) and the academic performance of adolescents, which points to it as a modifiable element that could influence academic results, given that adolescents who consume more UPF had consistently lower scores on various academic indicators, which underscores the importance of maintaining a nutritious diet during this crucial stage of development. As a result, according to [35] high levels of BMI, body fat percentage (BFP), and waist-to-hip ratio (WHR) have a direct negative impact on cognitive ability, while high levels of HDL provided by fatty acids have direct positive effects on cognition.

## DISCUSSION

The discussion focused on three fundamental aspects: the importance of fatty acids for disease prevention, their role in schoolchildren's nutrition, and their role in cognitive improvements and, therefore, better academic performance. The results highlight, first of all, that supplementation with fatty acids, especially Omega 3, both during breastfeeding and childhood, is related to the prevention of cardiovascular and mental diseases and the treatment of attention deficit disorder, findings that are demonstrated by [36,37] who, through a meta-analysis, found that fatty acid supplementation in pregnant or breastfeeding women affected the cognitive performance of children, especially long-chain fatty acids.

In terms of nutrition, many studies reveal that fatty acid supplementation has improved the health of schoolchildren, with the disadvantage that low-income populations suffer from poor nutrition and low consumption of fatty acids due to their intake of fish and seafood, as stated by [38,39] when measuring the relationship between child food poverty and cognitive development, especially in poor regions such as Ghana. As a result, vulnerable populations have reported a higher prevalence of diseases, cognitive deficits, and low height and weight, associated with malnutrition problems, especially in the consumption of essential fatty acids.

Contrary to what is reported in the previous paragraph, fatty acid levels are higher in populations that consume large amounts of seafood and fish, especially in people who follow a Mediterranean diet and therefore have better nutritional, health, and cognitive conditions, as observed in statistics on health, height, weight, and cognitive abilities such as memory, mathematical and verbal development in reports on student performance in countries such as Spain and Portugal, as demonstrated by the results presented by [40,41] when evaluating the role of the Mediterranean diet and the promotion of better mental health in adolescents by reducing stress and anxiety levels, as well as a considerable reduction in obesity and its association with cardiovascular disease.

In relation to cognitive abilities, the association between fatty acid levels and the treatment of schoolchildren with attention deficit disorders, whose condition affects academic performance, is addressed first, as reported in case studies in the school population with attention deficit, hyperactivity, Down syndrome, and autism spectrum disorder (ASD), where brain functions develop late or in a limited way, affecting academic performance, as reported [42,43] who observed an improvement in the functions of schoolchildren with ASD who received a diet rich in fatty acids compared to those who did not receive it. These results were confirmed and their validity demonstrated by the findings reported by [43] whose trend was similar to that presented by [42] in an experimental study.

Meanwhile, in schoolchildren without health conditions that affect their cognitive development, it was found that a higher intake of fatty acids has been correlated with higher academic performance due to the role that fatty acids play in brain functions, as stated by [44,45] when evaluating the impact of amaranth, a plant rich in fatty acids, on the nutrition and performance of schoolchildren, which may be correlated with brain connectivity, as proposed by [45]. Therefore, higher levels of fatty acids in schoolchildren will not only be reflected in higher academic performance by improving cognitive skills, but will also improve their health, especially in the obese population, by reducing triglyceride and cholesterol levels in this population.

Based on these findings, strategies should be implemented to promote the consumption of seafood and fish to increase fatty acid levels, even from the breastfeeding stage, as verified by [46,47] when evaluating a diet rich in fatty acids on the health of pregnant mothers and their children, especially due to its impact on parameters associated with neurodevelopment. Therefore, it is essential that the consumption of fatty acids be included in the diets of the population, especially if they are in conditions of vulnerability and malnutrition, with the aim of improving their nutrition, health, and academic performance.

## CONCLUSIONS

The intake of fatty acids significantly improves the nutrition of schoolchildren, which is reflected in better height and weight compared to children and adolescents with low intake of these acids, whose situation is exacerbated by external social and economic factors, as can be seen when comparing the consumption of fatty acids in populations that follow a Mediterranean diet and have higher incomes with the poorest countries in Africa and Latin America.

Higher consumption of fatty acids makes children and young people less vulnerable to disease, reducing rates of malnutrition and infant mortality. Therefore, the consumption of fatty acids should be mandatory in the diets of the school population. Given the observed benefits, their consumption should begin during pregnancy, continue during breastfeeding, and be maintained throughout school age, either through changes in eating habits or through supplementation.

Better nutrition and health in schoolchildren due to the intake of fatty acids is reflected in better cognitive abilities and therefore better school performance, since high levels of these in the blood are associated with the activation of brain functions such as memory, mathematical and verbal reasoning, which improve academic performance even in children and adolescents with attention deficit disorders, hyperactivity, Down syndrome, or autism spectrum disorders.

## REFERENCES

1. Samigullin A, Gählert J, Groß G, Morcos M, Schwertz R, Öste R, et al. A central role of nutrition in cognitive function among primary school children: a cross-sectional analysis. BMC Nutr. 2025;11(1):35. doi:10.1186/s40795-025-01016-2

2. Hakim R, Dahlan D, Lahmi A. The Brain Development and Nutrition. Tofedu The Future Educ J. 2025;4(1):20-9. doi:10.61445/tofedu.v4i1.370

3. Peña-Jorquera H, Martínez-Flores R, Espinoza-Puelles JP, López-Gil JF, Ferrari G, Zapata-Lamana R, et al. Adolescents with a favorable Mediterranean-style-based pattern show higher cognitive and academic achievement: a cluster analysis—the cogni-action project. Nutrients. 2024;16(5):608. doi:10.3390/nu16050608

4. Silva P. Enhancing Adolescent Food Literacy Through Mediterranean Diet Principles: From Evidence to Practice. Nutrients. 2025;17(8):1371. doi:10.3390/nu17081371

5. Calcaterra V, Cena H, Garella V, Loperfido F, Chillemi C, Manuelli M, et al. Assessment of epicardial fat in children: its role as a cardiovascular risk factor and how it is influenced by lifestyle habits. Nutrients. 2024;16(3):420. doi:10.3390/nu16030420

6. Martin M, Condori AI, Davico B, Rosso LG, Gaete L, Tetzlaff W, et al. Impaired reverse cholesterol transport is associated with changes in fatty acid profile in children and adolescents with abdominal obesity. J Nutr. 2024;154(1):12-25. doi:10.1016/j.tjnut.2023.08.037

7. Borasio F, De Cosmi V, D'Oria V, Scaglioni S, Syren MLE, Turolo S, et al. Associations between dietary intake, blood levels of omega-3 and omega-6 fatty acids and reading abilities in children. Biomolecules. 2023;13(2):368. doi:10.3390/biom13020368

8. Roberts M, Tolar-Peterson T, Reynolds A, Wall C, Reeder N, Rico Mendez G. The effects of nutritional interventions on the cognitive development of preschool-age children: a systematic review. Nutrients. 2022;14(3):532. doi:10.3390/nu14030532

9. Muñoz-Zabaleta MJ, Garzón Rodríguez N, Díaz-Barrera LE, Quiroz-Padilla MF. Metabolomic Insights into Attention Deficit Hyperactivity Disorder: A Scoping Review. Metabolites. 2025;15(2):133. doi:10.3390/metabo15020133

10. Shi S, Baranova A, Cao H, Zhang F. Exploring causal associations between plasma metabolites and attention-deficit/hyperactivity disorder. BMC Psychiatry. 2025;25(1):498. doi:10.1186/s12888-025-06951-9

11. Llo J, Kayode O, Jacob T, Oduntan B, Lawal R. Addressing malnutrition in Nigeria: a narrative review of causes, impacts, and pathways to nutritional resilience. J Res Appl Basic Med Sci. 2025;11(2):163-75. doi:10.61186/rabms.11.2.163

12. Zafar S, Shaikh BT. Understanding the determinants of malnutrition among adolescent girls in Pakistan: What needs to be done? Nutr Res Rev. 2025;:1-15. doi:10.1017/S0954422425000095

13. Nevins JE, Donovan SM, Snetselaar L, Dewey KG, Novotny R, Stang J, et al. Omega-3 fatty acid dietary supplements consumed during pregnancy and lactation and child neurodevelopment: a systematic review. J Nutr. 2021;151(11):3483-94. doi:10.1093/jn/nxab238

14. Gillies D, Leach MJ, Algorta GP. Polyunsaturated fatty acids (PUFA) for attention deficit hyperactivity disorder (ADHD) in children and adolescents. Cochrane Database Syst Rev. 2023;(4). doi:10.1002/14651858.cd007986.pub3

15. Dong P, Zhang Y, Liu CX, Yan DY, Xu X, Li AH, et al. Association between Human Milk Fatty Acid Esters of Hydroxy Fatty Acids and Maternal Body Mass Index and Early Infant Growth: A Longitudinal Study. J Nutr. 2025;155(7):2290-9. doi:10.1016/j.tjnut.2025.05.022

16. Subošić B, Kotur-Stevuljević J, Bogavac-Stanojević N, Zdravković V, Ješić M, Kovačević S, et al. Circulating fatty acids associate with metabolic changes in adolescents living with obesity. Biomedicines. 2024;12(4):883. doi:10.3390/biomedicines12040883

17. Steckler R, Magzal F, Kokot M, Walkowiak J, Tamir S. Disrupted gut harmony in attention-deficit/hyperactivity disorder: Dysbiosis and decreased short-chain fatty acids. Brain Behav Immun Health. 2024;40:100829. doi:10.1016/j.bbih.2024.100829

18. Maulu S, Nawanzi K, Abdel-Tawwab M, Khalil HS. Fish nutritional value as an approach to children's nutrition. Front Nutr. 2021;8:780844. doi:10.3389/fnut.2021.780844

19. Weder S, Keller M, Fischer M, Becker K, Alexy U. Intake of micronutrients and fatty acids of vegetarian, vegan, and omnivorous children (1–3 years) in Germany (VeChi Diet Study). Eur J Nutr. 2022;61(3):1507-20. doi:10.1007/s00394-021-02753-3

20. Smolińska K, Szopa A, Sobczyński J, Serefko A, Dobrowolski P. Nutritional quality implications: exploring the impact of a fatty acid-rich diet on central nervous system development. Nutrients. 2024;16(7):1093. doi:10.3390/nu16071093

21. Chen A, Azuan NBR, Harun NAM, Ooi YBH, Khor BH. Nutritional status and dietary fatty acid intake among children from low-income households in Sabah: A cross-sectional study. Hum Nutr Metab. 2024;36:200260. doi:10.1016/j.hnm.2024.200260

22. Davico B, Martin M, Condori AI, Chiappe EL, Gaete L, Tetzlaff WF, et al. Fatty Acids in Childhood Obesity: A Link Between Nutrition, Metabolic Alterations and Cardiovascular Risk. J Lipid Atheroscler. 2025;14(2):200. doi:10.12997/jla.2025.14.2.200

23. Brasiel PGDA, Potente Dutra Luquetti SC. Effects of Probiotics Supplementation on Short-Chain Fatty Acids: A Systematic Review of Randomized Controlled Trials. Nutr Rev. 2025;:nuaf047. doi:10.1093/nutrit/nuaf047

24. Cardino VN, Goeden T, Yakah W, Ezeamama AE, Fenton JI. New perspectives on the associations between blood fatty acids, growth parameters, and cognitive development in global child populations. Nutrients. 2023;15(8):1933. doi:10.3390/nu15081933

25. Mwita FC, PrayGod G, Sanga E, Setebe T, Joseph G, Kunzi H, et al. Developmental and nutritional changes in children with severe acute malnutrition provided with n-3 fatty acids improved ready-to-use therapeutic food and psychosocial support: A pilot study in Tanzania. Nutrients. 2024;16(5):692. doi:10.3390/nu16050692

26. Yang M, Cai C, Yang Z, Wang X, Li G, Li J, et al. Effect of dietary fibre on cognitive function and mental health in children and adolescents: a systematic review and meta-analysis. Food Funct. 2024;15(17):8618-28. doi:10.1039/D4FO02221A

27. O'Connor LE, Spill MK, Saha S, Balalian A, Davis JS, MacFarlane AJ. Seafood and neurocognitive development in children: A systematic review. Adv Nutr. 2025;:100391. doi:10.1016/j.advnut.2025.100391

28. Yuan WL, Armand M, Peyre H, Sarté C, Charles MA, Heude B, et al. Associations between perinatal biomarkers of maternal dairy fat intake and child cognitive development: results from the EDEN mother-child cohort. Eur J Clin Nutr. 2025;79(4):320-8. doi:10.1038/s41430-024-01544-3

29. Zhao N, Tang M, Wang L, Liu T, Zhao T, Xie K, et al. Effects of childhood trauma on depression and cognitive function in first-diagnosed, drug-naïve depressed patients: an observational case-control study. BMC Psychiatry. 2025;25(1):1-10. doi:10.1186/s12888-025-06764-w

30. Tapia-Serrano MA, Esteban-Cornejo I, Rodriguez-Ayllon M, Vaquero-Solís M, Sánchez-Oliva D, Sánchez-Miguel PA. Adherence to the Mediterranean diet and academic performance in adolescents: Does BMI status moderate this association? Clin Nutr. 2021;40(6):4465-72. doi:10.1016/j.clnu.2020.12.036

31. López-Gil JF, Victoria-Montesinos D, García-Hermoso A. Is higher adherence to the mediterranean diet associated with greater academic performance in children and adolescents? A systematic review and meta-analysis. Clin Nutr. 2024;43(8):1702-9. doi:10.1016/j.clnu.2024.05.045

32. Herrera MEP, Lozada ABS, Espinoza KAV, Vilca LBM. El consumo de omega 3 y su relación con el rendimiento académico. Correo Científico Médico. 2025;29. doi:10.56200/mried.v2i5.5648

33. Portlock T, Shama T, Kakon SH, Hartjen B, Pook C, Wilson BC, et al. Interconnected pathways link faecal microbiota plasma lipids and brain activity to childhood malnutrition related cognition. Nat Commun. 2025;16(1):473. doi:10.1038/s41467-024-55798-3

34. López-Gil JF, Cisneros-Vásquez E, Olivares-Arancibia J, Yañéz-Sepúlveda R, Gutiérrez-Espinoza H. Investigating the relationship between ultra-processed food consumption and academic performance in the adolescent population: The EHDLA study. Nutrients. 2025;17(3):524. doi:10.3390/nu17030524

35. Gong M, Liu H, Liu Z, Wang Y, Qi S, Guo H, et al. Causal links between obesity, lipids, adipokines, and cognition: a bidirectional Mendelian-randomization analysis. Front Endocrinol (Lausanne). 2025;16:1439341. doi:10.3389/fendo.2025.1439341

36. Lehner A, Staub K, Aldakak L, Eppenberger P, Rühli F, Martin RD, et al. Impact of omega-3 fatty acid DHA and EPA supplementation in pregnant or breast-feeding women on cognitive performance of children: systematic review and meta-analysis. Nutr Rev. 2021;79(5):585-98. doi:10.1093/nutrit/nuaa060

37. Lim HY, Fadzil MAM, Mustar S, Shukor IHA, Mohamed WAS. The Impact of Long-Chain Omega-3 Polyunsaturated Fatty Acid Supplementation in Pregnant Women Toward the Intelligence Status of Early Childhood: Protocol for a Systematic Review and Meta-Analysis. JMIR Res Protoc. 2025;14(1):e60417. doi:10.2196/60417

38. Vollmer S, Laillou A, Albers N, Nanama S. Measuring child food poverty: understanding the gap to achieving minimum dietary diversity. Public Health Nutr. 2025;28(1):e27. doi:10.1017/S1368980025000023

39. Owusu R, Micah J, Ghartey W. Consumption behavior, preferences, and willingness to pay for fish attributes in Ghana. Discov Food. 2025;5(1):149. doi:10.1007/s44187-025-00424-4

40. Camprodon-Boadas P, Gil-Dominguez A, De la Serna E, Sugranyes G, Lázaro I, Baeza I. Mediterranean diet and mental health in children and adolescents: A systematic review. Nutr Rev. 2025;83(2):e343-e355. doi:10.1093/nutrit/nuae053

41. Casas R, Ruiz-León AM, Argente J, Alasalvar C, Bajoub A, Bertomeu I, et al. A new mediterranean lifestyle pyramid for children and youth: a critical lifestyle tool for preventing obesity and associated cardiometabolic diseases in a sustainable context. Adv Nutr. 2025;16(3):100381. doi:10.1016/j.advnut.2025.100381

42. Sumra B, Kocherry C, Shamim H, Jhakri K, Al-Shudifat M, Mohammed L. Impact of Omega-3 Fatty Acids on Cognitive Outcomes in Children With Autism Spectrum Disorder: A Systematic Review. Cureus. 2025;17(3). doi:10.7759/cureus.80291

43. Jia SJ, Jing JQ, Yi LX, Yang CJ. The effect of omega-3 fatty acid supplementation on autism spectrum disorder: A meta-analysis. Res Autism. 2025;126:202642. doi:10.1016/j.reia.2025.202642

44. Orsango AZ, Dadhi AE, Tigistu M, Yismaw TG, Dinage MB, Engebretsen IMS. Improving school-age nutrition and school performance through amaranth plus flaxseed food product distribution in Sidama, Ethiopia: a study protocol. Glob Health Action. 2025;18(1):2556087. doi:10.1080/16549716.2025.2556087

45. Costello SE, Geiser E, Schneider N. Nutrients for executive function development and related brain connectivity in school-aged children. Nutr Rev. 2021;79(12):1293-306. doi:10.1093/nutrit/nuaa134

46. Kapoor B, Kapoor D, Gautam S, Singh R, Bhardwaj S. Dietary polyunsaturated fatty acids (PUFAs): Uses and potential health benefits. Curr Nutr Rep. 2021;10(3):232-42. doi:10.1007/s13668-021-00363-3

47. Sherzai D, Moness R, Sherzai S, Sherzai A. A systematic review of omega-3 fatty acid consumption and cognitive outcomes in neurodevelopment. Am J Lifestyle Med. 2023;17(5):649-85. doi:10.1177/15598276221116052

## FINANCING

None.

## CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

## AUTHOR CONTRIBUTION

*Conceptualization:* Sandra Gabriela Barrazueta Rojas, Lorena Patricia Yaulema Brito, María José Andrade Albán, María de los Angeles Rodríguez Cevallos.

*Research:* Sandra Gabriela Barrazueta Rojas, Lorena Patricia Yaulema Brito, María José Andrade Albán, María de los Angeles Rodríguez Cevallos.

*Methodology:* Sandra Gabriela Barrazueta Rojas, Lorena Patricia Yaulema Brito, María José Andrade Albán, María de los Angeles Rodríguez Cevallos.

*Writing – original draft:* Sandra Gabriela Barrazueta Rojas, Lorena Patricia Yaulema Brito, María José Andrade Albán, María de los Angeles Rodríguez Cevallos.

*Writing – review and editing:* Sandra Gabriela Barrazueta Rojas, Lorena Patricia Yaulema Brito, María José Andrade Albán, María de los Angeles Rodríguez Cevallos.