International Journal of Nutrition Sciences

Journal Home Page: ijns.sums.ac.ir

Original Article

The Correlation of Eating Fish with Healthy Dietary Habits and Lifestyle Profile among Children and Adolescents in Greece

Konstantinos D Tambalis[1*], Dimitris Tampalis[2], Giannis Arnaoutis[3], Demosthenes B Panagiotakos[3], Labros S Sidossis[4]

1. Department of Physical Education and Sport Science, National and Kapodistrian University of Athens, Greece
2. Department of Physical Education and Sport Sciences, Demokritus University of Thrace, Greece
3. Department of Nutrition and Dietetics, School of Health Science and Education, Harokopio University, Athens, Greece
4. Department of Kinesiology and Health, Rutgers University, New Brunswick, NJ 08901, USA

ARTICLE INFO

Keywords:
Fish
Children
Adolescents
Dietary habits
Lifestyle
Greece

**Corresponding author:*
Konstantinos D. Tambalis, PhD;
Department of Physical Education and Sport Science,
National and Kapodistrian University of Athens,
Greece.
Tel: +302107276185
Email: ktambal@phed.uoa.gr
Received: April 22, 2026
Revised: July 18, 2026
Accepted: July 24, 2026

ABSTRACT

Background: Frequent fish consumption is considered a key component of a healthy diet, highlighting the importance of promoting it from an early age. This study aimed to investigate the prevalence of fish consumption and identify associated lifestyle factors.

Methods: In a cross-sectional observational study, data from a representative sample of 177,091 Greek schoolchildren aged 8-17 years were enrolled. The Mediterranean Diet Quality Index for children and adolescents (KIDMED) was used to assess fish intake and dietary habits; while physical activity, screen time, and sleeping habits were evaluated through self-completed questionnaires. Anthropometric and physical fitness variables were measured by physical education teachers.

Results: More boys than girls (50.1% vs. 46.6%, $p<0.001$) consumed fish at least 2-3 times weekly and had better anthropometric and aerobic fitness measurements, healthier dietary habits, decreased screen time, and slept more than non-consumers (all $p<0.01$). Consuming fish was strongly correlated with eating diets rich in fruits, vegetables, legumes, dairy products, and olive oil. The likelihood of eating fish decreased by 1% for boys and 5% for girls for each year increase of age. Those who were overweight/obese were 14% less likely to eat fish frequently. The odds of consuming fish decreased by 37% and 13%, respectively, with increased screen time and insufficient sleep, while inadequate physical activity level reduced the odds of consuming fish frequently by 23%.

Conclusion: Increased fish consumption was linked to a healthier lifestyle profile in both sexes. A healthy approach to regular fish eating might be devised, such as nutritional school programs.

Please cite this article as: Tambalis KD, Tampalis D, Arnaoutis G, Panagiotakos DB, Sidossis LS. The Correlation of Eating Fish with Healthy Dietary Habits and Lifestyle Profile among Children and Adolescents in Greece . Int J Nutr Sci. 2026;11(3):1-9.

Introduction

School age is critical for educating children to adopt healthy dietary habits, as these habits tend to persist until adulthood. Regular fish consumption is considered a main component of a nutritious diet, emphasizing the importance of promoting it at a young age (1). Fish contains essential nutrients such as protein, omega-3 fatty acids, minerals, vitamin D, and amino acids (2, 3). It is the main dietary source of the long-chain n-3 polyunsaturated fatty acid, docosahexaenoic acid, and a predominant source of eicosahexaenoic acid, which are crucial for cognitive function and development (4). Consuming fish regularly has been linked to decreased risk of heart disease, stroke, inflammation, improved blood lipid levels, and better vascular function (5-7). It also boosts brain health, cognitive function, prevents depression, anxiety, and reduces the risk for autoimmune diseases (8).

The World Health Organization (WHO) Expert Consultation stated the strong benefits of fish intake at all life stages, including childhood (9). It also recommends that children and adolescents consume at least two servings (170 g) of fish per week (10). However, seafood consumption among children and adolescents is generally low due to various factors such as location, familiarity with fish preparation, and cultural practices (11). Based on a recent study by Nel *et al.* (2025), children who consumed little to no seafood by 7 years of age might be less inclined to engage in prosocial behaviours, such as cooperating, sharing, and helping others, as compared to their peers who eat fish regularly (12). A research suggested that fish consumption among school children aged 6-17 years was not associated with metabolic parameters like obesity and physical fitness (13). In contrast, a study among children and adolescents proposed that higher consumption of seafood was associated with a lower risk of obesity, while a review study incorporated that frequent consumption of seafood, as compared with intake of terrestrial meats, decreased energy intake by 4-9%, preventing a positive energy balance and obesity (14, 15).

Socio-demographic and lifestyle factors can play a role in fish consumption among children and adolescents (16-19). Specifically, a study among healthy children of 8-9 years old concluded that oily fish intake altered sleep and physical activity (PA) patterns (16), while another study among adolescents presented a favorable association between fish consumption and PA (17). Furthermore, a cross-sectional study among adults showed that the highest fish consumption was associated with a better perception of life quality and more PA (17). Screen-time viewing has been linked with adverse dietary outcomes, such as fewer fruits, vegetables, and fish intake, and greater consumption of unhealthy foods (19). For instance, findings from this cross-sectional study among schoolchildren indicated that increased screen use was inversely associated with seafood consumption (19).

While the association between sleeping aspects, PA, and screen time with fish consumption has been investigated among schoolchildren, most studies have examined each factor separately and in specific age groups (16-19). Furthermore, the incidence of fish consumption among school children and the factors that may be linked to it have not been examined in representative national research. Consequently, the current study aimed to contribute to the existing scientific literature by providing descriptive information on the association between frequent fish consumption and its benefits among school-aged children, informing health policies to improve fish intake. The specific objectives were to determine the prevalence of frequent fish intake and explore its association with lifestyle factors, considering potential confounders.

Materials and Methods

The study was conducted using an extensive, nationally representative sample of Greek children and adolescents aged 8-17 years old. It utilized population-representative data from a nationwide school-based health survey in Greece, which was conducted under the auspices of the Ministry of Education from March 2015 to May 2015 collecting anthropometric, nutrition, PA, screen time, and physical fitness (PF) data, along with information on age and sex. The study was conducted in accordance with the principles outlined in the Declaration of Helsinki. Ethical approval for the health survey was obtained from the Ethical Review Board of the Ministry of Education and the Ethical Review Committee of Harokopio University (decision No: 37/20-02-2013).

A total of 177,091 children aged 8-17 years old from elementary (8 to 12 years old) and middle (13 to 17 years old) public and private schools were enrolled, with a participation rate of almost 40% of the total population. Of these participants, 51% were boys and 49% were girls. The working sample was representative of the entire Greek population (Chi-square p value when compared with the current sample with the age-sex distribution of all Greek areas of 0.93). Parents were informed written about the school health survey and gave their written consent for their children to participate.

The school principals provided demographic information about the students, including their school, class, gender, and date of birth. Children's body weight, height, and waist circumference were measured in the morning using a standardized procedure. The International Obesity Task Force age- and gender-specific body mass index (BMI) cut-off criteria were used to classify the children's BMI status as normal-weight, overweight, or obese (20). Central obesity was defined as a waist circumference-to-height ratio (WHtR)≥0.5 (21). All anthropometric measurements were performed by Physical Education (PE) professionals.

The Euro-fit PF test battery was used to evaluate the children's PF levels (22). The battery consisted of five tests, including a multi-stage 20 m shuttle run test (20 m SRT) to estimate aerobic performance, a maximum 10×5 m shuttle run test (10×5 m SRT) to evaluate speed and agility, a sit-ups test in 30 s (SUs) to measure the endurance of the abdominal and hip-flexor muscles, a standing long jump (SLJ) to evaluate lower body explosive power, and a sit and reach (SR) test to measure flexibility. All fitness tests were administered during the PE class by PE professionals who were instructed through a detailed operation manual. A standardized procedure of measurements was followed to minimize inter-rater variability among schools. For this study, data from the 20 m SRT were used.

The dietary, PA, and sedentary habits of participating children were recorded through an electronic questionnaire completed at school with the assistance of their teachers and/or information technology professors. The Mediterranean Diet Quality Index for children and adolescents (KIDMED) index was used to assess the dietary habits of the students (23). This index was consisted of 16 yes or no questions that evaluated adherence to the principles of the Mediterranean diet and general dietary guidelines for youth. Negative responses were assigned a value of -1, while positive responses were assigned a value of +1 (23). The total KIDMED score ranged from 0 to 12 and was classified into three levels of ≥8, indicating optimal adherence to the Mediterranean diet (sufficient dietary habits); 4-7, indicating average adherence to the Mediterranean diet and a need for improvement to meet dietary guidelines (relatively sufficient dietary habits); and ≤3, indicating low adherence to the Mediterranean diet and generally low diet quality (insufficient dietary habits) (23).

The main outcome of this study was frequent fish consumption, which was determined by whether participants consumed fish two or more times per week. Participants who did not consume fish were classified as "non-consumers." The question "Consumes fish regularly (at least 2–3/week)?" was used to measure fish consumption, and responses were incorporated for analysis. The assessment of self-reported PA and sedentary time involved a validated questionnaire that included closed-ended questions on the frequency, time, and intensity of children's participation in school-related PA, organized sports activities, and leisure time PA (24).

The reported activities were multiplied by the minutes of moderate to vigorous physical activity (MVPA) and divided by 7 to obtain the mean daily time children engaged in MVPA. Sedentary time was calculated by multiplying the weekly frequency and duration per bout of participation in sedentary activities and dividing by 7. Screen viewing was used as a proxy for sedentary behaviors, and students were classified as sedentary or not based on the threshold of two hours per day (25). Sleep time was assessed through self-reported recordings, and children and adolescents were classified as meeting the recommendations for sufficient sleep if they slept at least 9 and 8 hours daily, respectively (26).

All statistical analyses were carried out using the SPSS software for Windows (SPSS Inc., version 23.0, Chicago, Il, USA). The descriptive statistics were presented as mean±standard deviation or frequency (percentages). The Chi-square test was utilized to examine the associations between categorical variables, while the Student's t-test was employed to evaluate differences in mean values of normally distributed variables. To determine the potential impact of various dietary habits on frequent fish consumption (yes vs. no), binary logistic regression analysis was conducted, and Odds Ratio (OR) with corresponding 95% Confidence Interval (CI) was calculated and adjusted for confounders.

Additionally, hierarchical binary logistic regression analysis was performed to assess the potential effect of several demographic and lifestyle factors on the frequency of fish consumption, and the OR with corresponding 95% CI was calculated to obtain an adjusted association of covariates while controlling for confounding. Hosmer and Lemeshow's goodness-of-fit test was used to evaluate the model's goodness-of-fit, and residual analysis was conducted using the beta, leverage, and Cook's distance D statistics to identify outliers and influential observations. Finally, discriminant analysis was employed to explore the strength of each component concerning the outcome. The statistical significance level from two-sided hypotheses was set at p value <0.05.

Results

The study included a total of 177,091 school children aged between 8 and 17 years. Table 1 displays the basic descriptive statistics of the total sample categorized by sex. Boys reported a higher percentage of consuming fish two or more times per week compared to girls (50.1% vs. 46.6%, $p<0.001$). Significant differences were observed between boys and girls in relation to anthropometric variables, PA, dietary habits, screen time, and aerobic fitness measurements (all p values <0.001). Table 2 shows the behavioral and anthropometric characteristics of the study participants based on their weekly fish consumption (at least 2-3/week). Participants from both sexes classified as frequent fish consumers had better anthropometric measurements, healthier dietary habits, decreased screen time, more sleep, and better aerobic fitness measurements than non-consumers from the same sex (all p values were <0.01).

The unadjusted binary logistic regression analysis revealed that skipping breakfast, and frequent consumption of sweets and fast food reduced the odds of being a fish consumer, while regular consumption of vegetables, fruits, pulses, pasta/rice, olive oil, and dairy products (40 g), daily increased the odds of being a fish consumer in both sexes (Table 3, Model 1). After adjusting for age, BMI, and waist circumference, food habits remained significantly associated with fish consumption in both sexes (Table 3, Model 2). Additional adjustments for screen time, sleep, aerobic fitness, and PA did not significantly alter the results (Table 3, Model 3).

Based on the previous results, which suggested that fish consumers had a better lifestyle profile than non-consumers, stepwise logistic regression analyses

Table 1. Baseline characteristics (means, SD) of participants in the study aged 8-17 years old.

Variable	Total (n=177109)	Boys (n=90821)	Girls (n=86288)	*P* value*
Age (year)	9.88 (2.8)	9.91 (2.8)	9.84 (2.8)	<0.001
Children 8-11 years, n (%)	100 134	51 161 (50.9)	48 973 (49.1)	<0.001
Adolescents 12-17 years, n (%)	76 975	39 660 (52.5)	37 315 (47.5)	<0.001
Height (cm)	149 (13.5)	150 (14.5)	148 (12.3)	<0.001
Weight (kg)	44.5 (14.2)	45.5 (15.2)	43.5 (12.9)	<0.001
Body Mass Index (kg/m^2)	19.7 (3.8)	19.8 (3.8)	19.5 (3.7)	<0.001
Waist circumference (cm)	70.4 (10.7)	71.6 (11.1)	69.2 (10.2)	<0.001
Waist to height ratio	0.30 (0.46)	0.32 (0.47)	0.28 (0.45)	<0.001
KIDMED score (0, 12)†	6.7 (2.4)	6.7 (2.4)	6.8 (2.4)	<0.001
Fish consumption [at least 2-3/week, n (%)]	82,821 (48.4)	43,957 (50.1)	38,864 (46.6)	<0.001
Physical activity (h/wk)	9.4 (5.5)	10.4 (5.9)	8.4 (5.2)	<0.001
Screen time (h/wk)	8.6 (8.5)	9.3 (8.8)	7.8 (7.8)	<0.001
Sleeping time weekdays, (h/d)	9.2 (1.1)	9.2 (1.2)	9.1 (1.2)	<0.001
Aerobic fitness, 20 m shuttle run (laps)	30.5 (16.7)	35.5 (19.5)	25.1 (13.5)	<0.001

†KIDMED score (≤3: insufficient dietary habits, 4-7: relatively sufficient dietary habits, ≥8: sufficient dietary habits. *P values for differences between boys and girls.

Table 2. Anthropometric and behavioral characteristics (mean±SD) according to weekly frequent or no fish consumption, in participants boys and girls (8-17 years old).

Variable	Frequent fish consumption (at least 2-3/wk)		No fish consumption	
Children	**Boys**	**Girls**	**Boys**	**Girls**
Age (years)	11.3 (2.1)	11.1 (2.1)	11.4 (2.3)*	11.4 (2.3)*
Body Mass Index (kg/m^2)	19.7 (3.8)	19.3 (3.7)	19.9 (3.8)*	19.6 (3.7)*
Waist circumference (cm)	71.5 (11.0)	69.0 (10.1)	71.8 (11.1) *	69.5 (10.2)*
WHtR	0.47 (0.06)	0.46 (0.06)	0.48 (0.06)*	0.47 (0.06)*
KIDMED score	7.6 (2.2)	7.7 (2.1)	5.7 (2.3)*	5.9 (2.2)*
Physical activity (h/wk)	10.9 (6.0)	8.8 (5.3)	9.8 (5.7) *	8.0 (5.1)*
Screen time (h/wk)	8.3 (8.2)	6.6 (7.3)	10.3 (9.1)*	8.8 (8.4)*
Sleeping time (h/day)	9.3 (1.2)	9.3 (1.2)	9.0 (1.2)*	9.0 (1.1)*
Aerobic fitness (20m SRT, laps)	35.5 (19.6)	25.9 (13.8)	35.4 (19.3)	24.5 (13.2)

KIDMED: Mediterranean Diet Quality Index for children and adolescents; WHtR: Waist to height ratio; *$p<0.01$ for differences between frequent (at least 2-3/wk) and not consumers of fish from the same sex.

Table 3. Results (OR, 95%CI) from logistic regression models that used to evaluate the association of children's (8-17 years old) dietary habits with frequent fish consumption (no vs. yes).

Variable Predictors	Model 1 OR (95% CI)	Model 2 OR (95% CI)	Model 3 (OR 95% CI)
Boys			
Skips breakfast (no vs. yes); Age (per 1 year)	0.87 (0.84-0.89)	0.86 (0.83-0.89)	0.88 (0.86-0.92)
Has fresh or cooked vegetables more than once a day (no vs. yes)	1.14 (1.11-1.18)	1.13 (1.10-1.17)	1.12 (1.09-1.15)
Has a second fruit every day (no vs. yes)	1.64 (1.60-1.69)	1.64 (1.59-1.68)	1.62 (1.58-1.66)
Eats pulses >1/week (no vs. yes)	1.52 (1.48-1.56)	1.52 (1.48-1.57)	1.50 (1.45-1.54)
Eats pasta or rice almost every day (no vs. yes)	1.45 (1.41-1.48)	1.45 (1.41-1.49)	1.44 (1.40-1.48)
Consumes nuts regularly (at least 2–3/week) (no vs. yes)	1.67 (1.63-1.71)	1.67 (1.63-1.71)	1.60 (1.56-1.64)
Uses olive oil at home (no vs. yes)	0.97 (0.90-1.04)	0.97 (0.91-1.04)	0.96 (0.88-1.03)
Takes two yoghurts and/or some cheese (40 g) daily (no vs. yes)	1.48 (1.43-1.53)	1.48 (1.43-1.53)	1.44 (1.39-1.49)
Fast food consumption (<=1/week vs. >1/week)	0.90 (0.88-0.92)	0.92 (0.89-0.94)	0.93 (0.90-0.96)
Takes sweets/candy several times every day (no v. yes)	0.86 (0.84-0.90)	0.88 (0.85-0.91)	0.90 (0.87-0.94)
Girls			
Skips breakfast (no vs. yes); Age (per 1 year)	0.81 (0.79-0.84)	0.82 (0.79-0.85)	0.86 (0.83-0.89)
Has fresh or cooked vegetables more than once a day (no vs. yes)	1.12 (1.09-1.15)	1.11 (1.08-1.15)	1.10 (1.07-1.14)
Has a second fruit every day (no vs. yes)	1.66 (1.61-1.70)	1.61 (1.57-1.66)	1.59 (1.56-1.63)
Eats pulses >1/week (no vs. yes)	1.51 (1.47-1.55)	1.52 (1.47-1.56)	1.51 (1.47-1.55)
Eats pasta or rice almost every day (no vs. yes)	1.32 (1.29-1.36)	1.32 (1.28-1.36)	1.33 (1.29-1.37)
Consumes nuts regularly (at least 2–3/week) (no vs. yes)	1.69 (1.64-1.74)	1.65 (1.61-1.70)	1.60 (1.55-1.65)
Uses olive oil at home (no vs. yes)	1.02 (0.94-1.11)	1.05 (0.96-1.14)	1.07 (0.98-1.17)
Takes two yoghurts and/or some cheese (40 g/daily) (no vs. yes)	1.50 (1.44-1.51)	1.48 (1.43-1.53)	1.45 (1.40-1.51)
Fast food consumption (<=1/week vs. >1/week)	0.86 (0.83-0.89)	0.89 (0.86-0.92)	0.91 (0.88-0.94)
Takes sweets/candy several times every day (no v. yes)	0.79 (0.786-0.82)	0.82 (0.79-0.84)	0.84 (0.80-0.87)

Model 1: Unadjusted; Model 2: Adjusted for age, Body Mass Index, waist circumference; Model 3: Model 2 + screen time, sleeping hours, and physical activity levels.

(4 Models) were conducted to explore the potential associations of several factors on fish consumption (frequent vs. non) in both sexes (Table 4). The initial analysis (Table 4, Model 1) revealed that for every one-year increase in age, the odds of being a fish consumer decreased by 2% and 6% in boys and girls, respectively. Furthermore, being centrally obese or overweight/obese decreased the odds of being a fish consumer by 12% and 15%, respectively.

Further adjustment for the KIDMED index (Table 4, Model 2) did not alter the results related to the effect of age and obesity status. However, sufficient dietary habits increased the odds of fish intake by almost four times in both sexes. Further adjustment for sleep and screen time (Table 4, Model 3) revealed that inadequate sleeping hours and increased screen time reduced the odds of being a fish consumer by almost 10% and 40%, respectively. Finally, when PA level and aerobic fitness were incorporated into the analysis (Table 4, Model 4), the influence of previous factors remained significant.

It was also shown that insufficient PA level decreased the odds of being a fish consumer, and better aerobic performance was associated with increased odds of being a fish consumer in both sexes. Discriminant analysis was applied to evaluate whether the predictors could better distinguish increased fish consumers from non-fish consumers. Standardized function coefficients suggest that dietary habits (0.97), screen time (-0.31), and PA (0.21) contributed more to distinguishing those who consume fish frequently from non-consumers, in both sexes. The classification results showed that the model correctly predicted 86% of frequent fish consumers and 59% of non-consumers.

Discussion

To our knowledge, this is the first study to examine various lifestyle and anthropometric correlations of fish consumption in a community-representative population. We have included data from 177091 children (ages 8 to 17) to provide consistent, standardized, and comparable results. The following are the most noteworthy findings. (a) almost half of school children frequently ate fish; (b) children of both sexes who ate fish had a

Table 4. Results (OR, 95%CI) from logistic regression models that used to evaluate the association of children's (8-17 years old) characteristics with frequent fish consumption (no vs. yes).

Variable Predictors	Model 1 OR (95% CI)	Model 2 OR (95% CI)	Model 3 OR (95% CI)	Model 4 (OR 95% CI)
Boys				
Age (per 1 year)	0.98 (0.97-0.98) (1.097-1.112)	0.98 (0.97-0.98)	0.99 (0.98-0.99) (1.097-1.112)	0.99 (0.98-0.99)
Body Mass Index group (normal-weight vs. overweight/obese)	0.89 (0.81-0.96)	0.89 (0.82-0.95)	0.90 (0.85-0.95)	0.90 (0.83-0.97)
Abdominal obesity (no vs. yes)	0.88 (0.84-0.92)	0.89 (0.85-0.94)	0.91 (0.87-0.95)	0.91 (0.88-0.94)
KIDMED index (insufficient vs. relatively/ sufficient dietary habits)		4.12 (3.98-4.32)	3.89 (3.70-4.09)	3.70 (3.54-3.88)
Sleeping hours (sufficient vs. insufficient)			0.87 (0.84-0.90)	0.89 (0.86-0.92)
Screen time (acceptable vs. increased)			0.64 (0.62-0.66)	0.66 (0.63-0.69)
Physical activity (adequate vs. inadequate)				0.72 (0.68-0.75)
20 m shuttle run (per 1 lap)				1.01 (1.00-1.02)
Girls				
Age (per 1 year)	0.94 (0.93-0.95)	0.94 (0.93-0.95)	0.95 (0.94-0.96)	0.95 (0.94-0.95)
BMI group (normal-weight vs. overweight/ obese)	0.81 (0.77-0.86)	0.81 (0.76-0.88)	0.83 (0.77-0.88)	0.83 (0.78-0.88)
Abdominal obesity (no vs. yes)	0.89 (0.85-0.93)	0.90 (0.86-0.93)	0.91 (0.89-0.93)	0.91 (0.90-0.94)
KIDMED index (relatively/sufficient vs. insufficient		4.28 (4.08-4.48)	4.13 (3.89-4.34)	3.90 (3.70-4.12)
Sleeping hours (sufficient vs. insufficient)			0.84 (0.79-0.87)	0.86 (0.82-0.89)
Screen time (acceptable vs. increased)			0.57 (0.55-0.59)	0.60 (0.56-0.64)
Physical activity (adequate vs. inadequate)				0.82 (0.79-0.85)
20 m shuttle run (per 1 lap)				1.01 (1.00-1.02)

KIDMED: Mediterranean Diet Quality Index for children and adolescents; Model 1: Age and Body Mass Index group and abdominal obesity; Model 2: Model 1 + KIDMED index; Model 3: Model 2 + Screen time and sleeping hours; Model 4: Model 3 + Physical activity levels and aerobic fitness measurements.

healthier lifestyle profile; and (c) regular eating of fish was strongly linked to healthy eating habits, decreased screen time, and longer sleep and PA.

Nearly 50% of the participants consumed fish two or more times per week. Fish consumption varies noticeably among and within countries. According to the World Population Review, seafood intake varies from almost 50 to 3 kg per capita per year, worldwide (27), while there is scarce representative data for school children. For example, in an international comparison of dietary patterns including almost 7200 children from 12 countries situated in all main world regions, the weekly consumption of fish was 2.1±2.6 times (28).

Regarding the age effect in frequent fish consumption, our data showed that for every one-year increase in age, the odds of being a fish consumer decreased by 1% in boys and 5% in girls. The Dietary Guidelines for Americans recommended a gradual increase in fish intake, starting from 2 ounces at age of 4-7 years to 4 ounces at age 11 years, and ending up in 8 ounces in adulthood (29). Our results are probably attributed to the fact that older children had more autonomy in their dietary choices, so fish consumption was less preferred than younger children, who were more likely to be under their parents' influence.

After controlling for several confounders, frequent fish eating was substantially linked to lower chances for central obesity and overweight/ obesity in the current sample of schoolchildren by roughly 10%, in both sexes. According to scientific data, schoolchildren's regular fish consumption is not linked to obesity (13). On the other hand, a study conducted on children and adolescents suggested that eating more seafood was linked to a lower risk of obesity (14), while a review study proposed that eating seafood frequently reduced energy intake by 4-9% when compared to eating meat, which prevented obesity and a positive energy balance (15). International health organizations, such as the Food and Drug Administration (FDA) and WHO contend that promoting healthy food choices, such as fish intake, could decrease the risk of overweight or obesity (29).

According to the current study findings, students who consumed more fish were almost four times more likely to have adequate eating habits. It was also found that eating fish frequently was negatively correlated with unhealthy eating habits, such as consuming sweets and fast food. Children should eat enough fish as part of a balanced diet, according to the WHO and several national dietary guidelines, since it contains many vital elements and may help prevent several illnesses (8-10, 29-31). Our results suggest that screen and sleeping time were significantly associated with frequent fish consumption. In detail, the participants with increased screen time (>2 h/d) had lower odds by 37% of being fish consumers, in both sexes. Negative dietary outcomes, such as eating less fish and consuming more unhealthy foods, have been associated with screen time (19). For example, results from a cross-sectional study of schoolchildren showed that seafood consumption was negatively correlated with increased screen time (19).

Additionally, the available data suggested that both sexes' likelihood of consuming fish was 13% lower when they got less than 8- 9 hours of sleep per day. In particular, a study included healthy youngsters aged 8-9 years found that eating fatty fish improved their sleep habits (16). It appears that inadequate PA level reduced the likelihood of consuming fish by 23%, suggesting a possible link between fish consumption and PA. A cross-sectional study of adults revealed that the highest fish consumption was linked to a better perception of life quality and more PA (18), while another study in Brazilian adolescents found a positive correlation between fish consumption and healthy behaviors like PA and breakfast consumption (OR=1.16; 95%CI 1.10-1.22) and PA (1.14; 95%CI 1.02-1.28) (17).

The current results suggested a trend that as aerobic fitness performance improved, the odds of consuming fish increased, even though the likelihood ratio of aerobic fitness performance to predict fish consumers was small (for every one lap increase in the 20 m shuttle run test, there is an increase per 1% of being a fish consumer, 95% CI 1.01-1.02, $p<0.001$). These results are consistent with earlier research on kids that found a positive correlation between PF and eating habits, and that eating fish frequently was linked to higher probabilities of having a good level of aerobic fitness (32, 33). In contrast, another study conducted among schoolchildren aged 6-17 years concluded that fish consumption was not associated with PF (13). More research is needed to validate our findings. A healthy lifestyle was linked to increased aerobic fitness, and these kids were more likely to prefer wholesome dietary habits like eating fish. The present work was performed in a wide range of ages (8 to 17 years old) and explored numerous covariates. In Greece, primary and secondary education is mandatory and, as a result, the study included a significant portion of this population. The methodology applied allows the comparison of these results with others from similar and representative studies.

Limitations consist of methodological issues and the fact that possible confounding factors, such as the availability of fish that were probably associated with fish consumption and socio-economic status, have not been assessed. Nevertheless, Greece is a Mediterranean country, fish is relatively cheap, at least for the middle-upper socioeconomic status people, and there is high availability throughout the country. Moreover, this is a cross-sectional study, so causality cannot be assigned. Furthermore, the record of dietary habits, PA, sleep, and sedentary time was self-reported, thus subject to desirable reporting bias. However, participant responses were anonymous; therefore they had no reason to misreport. Finally, due to the huge sample size, statistical significance can be easily achieved.

Healthy approaches, such as implementing dietary school programs, to encourage regular fish intake could be established with a focus on preventing detrimental health effects later in life. Given the available data, it is concerning that public health programs should address persistent issues with the availability and cost of fish, as well as deficiencies in nutrition understanding and avoidance to eat (34-36). Specifically, to prevent negative health impacts in the future, it is important to establish frequent fish consumption habits in children and create circumstances that encourage fish consumption at home, at school, and in the community. Moreover, these findings can also be used by politicians to support and create policies that encourage training and economic initiatives to increase access to nutrient-dense foods (37). The social and financial difficulties that school children from low socio-economic groups may face could also be lessened by strengthening school-based support networks and integrating them into current health care frameworks.

Conclusion

The study found that nearly half of Greek school children consumed fish regularly. Frequent fish consumption was strongly correlated with healthy dietary habits, such as eating fruits and vegetables, consuming pulses and dairy products, and using olive oil at home, as well as with a healthier lifestyle profile (e.g., increased PA, acceptable screen time, adequate sleeping time, and better aerobic fitness).

Acknowledgment

This study was supported by the Hellenic Ministry of Education and Religious Affairs and the Department of Nutrition and Dietetics Graduate Program, Harokopio University of Athens.

Funding

None.

Authors' Contribution

All authors contributed equally to the study design and analysis. KDT and DT wrote the paper. DBP and LSS drafted the initial form of the manuscript. All authors commented on the manuscript draft. All authors are in agreement with the manuscript and declare that the content has not been published elsewhere.

Conflict of Interest

The authors have not stated any conflicts of interest.

References

1 Craigie AM, Lake AA, Kelly SA, et al. Tracking of obesity-related behaviours from childhood to adulthood: A systematic review. *Maturitas*. 2011;70:266-284. DOI: 10.1016/j.maturitas.2011.08.005. PMID: 21920682.

2 Hassanshahi N, Masoumi SJ. The Effect of Omega-3 Fatty Acids in Ulcerative Colitis: A Systematic Review. *Int J Nutr Sci*. 2018;3:58-64.

3 Mendivil CO. Fish consumption: a review of its effects on metabolic and hormonal health. *Nutr Metab Insights*. 2021;14:11786388211022378. DOI: 10.1177/11786388211022378. PMID: 34158802.

4 Buckland G, de Silva Johnson S, Johnson L, et al. The relationship between dietary intakes and plasma concentrations of PUFA in school-age children from the Avon Longitudinal Study of Parents and Children (ALSPAC) cohort. *Br J Nutr*. 2021:127:1-11. DOI:10.1017/S0007114521002191. PMID: 34134803.

5 Kris-Etherton PM, Harris WS, Appel LJ. Fish consumption, fish oil, omega-3 fatty acids, and cardiovascular disease. *Circulation*. 2002;106:2747-2757. DOI: 10.1161/01.CIR.0000038493.65177.94. PMID: 12438303.

6 Djuricic I, Calder PC. Beneficial outcomes of omega-6 and omega-3 polyunsaturated fatty acids on human health: an update for 2021. *Nutrients*. 2021;13:2421. DOI: 10.3390/nu13072421. PMID: 34371930.

7 Mehrabani D, Masoumi SJ, Masoumi AS, et al. Role of Diet in Mesenchymal Stem Cells' Function: A Review. *Int J Nutr Sci*. 2023;8:9-19. DOI: 10.30476/IJNS.2023.97788.1221.

8 Demelash AB, Alefe AM. Health benefits and health risks of contaminated fish consumption: Current research outputs, research approaches, and perspectives. *Heliyon*. 2024;10:e33905. DOI: 10.1016/j.heliyon.2024.e33905. PMID: 39050454.

9 FAO/WHO (2024) Joint FAO/WHO Expert Consultation in the risks and benefits of fish consumption: Meeting report, 9–13 October 2023. Food Safety and Quality Series, No. 28. Rome. DOI:10.4060/cd2394.

10 Maulu S, Nawanzi K, Abdel-Tawwab M, et al. Fish nutritional value as an approach to children's nutrition. *Front Nutr*. 2021;8:780844. DOI: 10.3389/fnut.2021.780844. PMID: 34977125.

11 National Academies of Sciences, Engineering, and Medicine; Health and Medicine Division; Food and Nutrition Board; Committee on the Role of Seafood Consumption on Child Growth and Development. Washington (DC): National Academies Press (US); 2024 May 28. Accessed April 13, 2025.

12 Nel L, Emmett PM, Golding J, et al. Seafood intake in children at age 7 years and neurodevelopmental outcomes in an observational cohort study (ALSPAC). *Eur J Nutr*. 2025;64:120. DOI:10.1007/s00394-025-03636-7. PMID: 40064696.

13 Courraud J, Quist JS, Kontopodi E, et al. Dietary habits, metabolic health and vitamin D status in Greenlandic children. *Public Health Nutr*. 2020;23:904-913. DOI:10.1017/S1368980019002799. PMID: 31573464.

14 Zhang T, Ye H, Pang X, et al. Seafood intake in childhood/adolescence and the risk of obesity: results from a Nationwide Cohort Study. *Nutr J*. 2024;23:77. DOI:10.1186/s12937-024-00986-6. PMID: 39010085.

15 Liaset B, Øyen J, Jacques H, et al. Seafood intake and the development of obesity, insulin resistance and type 2 diabetes. *Nutr Res Rev*. 2019;32:146-167. DOI:10.1017/S0954422418000240. PMID: 30728086.

16 Vuholm S, Teisen MN, Mølgaard C, et al. Sleep and physical activity in healthy 8-9-year-old children are affected by oily fish consumption in the FiSK Junior randomized trial. *Eur J Nutr*. 2021;60:3095-3106. DOI:10.1007/s00394-021-02490-7. PMID: 33515093.

17 Takey M, Giannini DT, Kuschnir M, ERICA: prevalence of fish consumption and its association with cardiovascular risk factors and healthy behavior in Brazilian adolescents. *J Pediatr (Rio J)*. 2022;98:599-606. DOI:10.1016/j.jped.2022.02.003. PMID: 35381207.

18 Macoel ES, Sdnato JG, Galvad JA, et al. Fish consumption and lifestyle: a cross-sectional study. *Food Sci Technol* (Campinas). 2019;39:141-145. DOI:10.1590/fst.40617.

19 Shqair AQ, Pauli LA, Costa VPP, et al. Screen time, dietary patterns and intake of potentially cariogenic food in children: A systematic review. *J Dent*. 2019;86:17-26. DOI:10.1016/j.jdent.2019.06.004. PMID: 31228564.

20 Cole T, Bellizzi M, Flegal K, et al. Establishing a standard definition for child overweight and obesity worldwide: international survey. *BMJ*. 2000;320:1240-1243. DOI: 10.1136/bmj.320.7244.1240. PMID: 10797032.

21 Browning LM, Hsieh SD, Ashwell M. A systematic review of waist-to-height ratio as a screening tool for the prediction of cardiovascular disease and diabetes: 0.5 could be a suitable global boundary value. *Nutr Res Rev*. 2010;23:247-269. DOI: 10.1017/S0954422410000144. PMID: 20819243.

22 Research CoECoEoS (1993) Eurofit: handbook for the Eurofit tests of Physical fitness. 1993.p.1-75.

23 Serra-Majem L, Ribas L, Ngo J, et al. Food, youth and the Mediterranean diet in Spain. Development of KIDMED, Mediterranean Diet Quality Index in children and adolescents. *Public Health Nutr*. 2004;7:931-935. DOI: 10.1079/phn2004556. PMID: 15482620.

24 Grigorakis DA, Georgoulis M, Psarra G, et al. Prevalence and lifestyle determinants of central obesity in children. *Eur J Nutr*. 2016;55:1923-1931. DOI: 10.1007/s00394-015-1008-9. PMID: 26233883.

25 Colley RC, Wong SL, Garriguet D, et al. Physical activity, sedentary behaviour and sleep in Canadian children: parent-report versus direct measures and relative associations with health risk. *Health Rep*. 2012; 23:45-52. PMID: 22866540.

26 Paruthi S, Brooks LJ, D'Ambrosio C, et al. Consensus Statement of the American Academy of Sleep Medicine on the Recommended Amount of Sleep for Healthy Children: Methodology and Discussion. J *Clin Sleep Med*. 2016;12:1549-1561. DOI: 10.5664/jcsm.6288. PMID: 27707447.

27 https://worldpopulationreview.com/country-rankings/fish-consumption-by-country. Accessed April 13, 2025.

28 Mikkilä V, Vepsäläinen H, Saloheimo T, et al. An international comparison of dietary patterns in 9-11-year-old children. *Int J Obes Suppl*. 2015;5:S17-S21. DOI:10.1038/ijosup.2015.14. PMID: 27152179.

29 https://www.fda.gov/food/consumers/advice-about-eating-fish. Accessed April 13, 2025.

30 U.S. Department of Health and Human Services, U.S. Department of Agriculture. (2020). 2020–2025 Dietary Guidelines for Americans, 9th ed. https://www.dietaryguidelines.gov/sites/default/files/2021-03/Dietary. Guidelines_for_Americans-2020-2025.pdf. Accessed April 13, 2025.

31 World Health Organization European Region. Food based dietary guidelines in the WHO European Region. Copenhagen: WHO, Europe, 2003. Accessed April 13, 2025.

32 Tambalis KD, Panagiotakos DB, Psarra G, et al. Association of cardiorespiratory fitness levels with dietary habits and lifestyle factors in schoolchildren. *Appl Physiol Nutr Metab*. 2019;44:539-545. DOI: 10.1139/apnm-2018-0407. PMID: 30321490.

33 Thivel D, Aucouturier J, Isacco L, et al. Are eating habits associated with physical fitness in primary school children? *Eat Behav*. 2013;14:83-86. DOI: 10.1016/j.eatbeh.2012.11.002. PMID: 23265408.

34 Deroover K, Bucher T, Vandelanotte C, et al. Practical nutrition knowledge mediates the relationship between sociodemographic characteristics and diet quality in adults: A cross-sectional analysis. *Am J Health Promot*. 2020;34:59-62. DOI: 10.1177/0890117119878074. PMID: 31578076.

35 McKinnon L., Giskes K., Turrell G. The contribution of three components of nutrition knowledge to socio-economic differences in food purchasing choices. *Public Health Nutr*. 2014;17:1814-1824. DOI: 10.1017/S1368980013002036. PMID: 23920283.

36 Mehrabani D, Vahedi M, Eftekhari MH, et al. Food avoidance in patients with ulcerative colitis: a review. *Int J Nutr Sci*. 2018;2:189-95.

37 Hedayati A, Homayuon M, Mobaracky A, et al. Lithium chloride, ketogenic diet and stem cell transplantation in treatment of bipolar disorder. *Int J Nutr Sci*. 2024;9:80-82. DOI: 10.30476/IJNS.2024.99601.1250.