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The frequent of fish intake can increase the chance of Child intelligence of aged 9-10 years in Surakarta



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ABSTRACT

Background: Healthy, intelligent, and highly competitive children are the asset of a nation. Indonesia as one of the developing countries which level of fish consumption is still low, including children fish intake. Children fish consumption in Surakarta, Central Java Province has potential to improve. Growth and brain development persist in childhood and adolescence at 9-10 years. That age range is the beginning of the peak growth (growth spurt) that requires the intake of fat and protein to support the growth and development of the brain and fish is a potent food source of protein and omega-3 fatty acids.

Aim: This study aims to analyze the relationship between fish consumption frequency and fish type with children intelligence level at aged 9-10 years.

Method: The design of this study was cross-sectional involving 112 elementary school children grade 4 in Surakarta, Central Java, Indonesia. Data were collected using questionnaires, 1 x 24-hour food recall form, semi-quantitative FFQ (Frequency Food

Questionnaire), anthropometry, and intelligence level using Culture Fair Intelligence Test (CFIT-2A) method. The results were analyzed by multivariate analysis with multiple logistic regression.

Results: Multiple logistic regression analysis on the intelligence level of children aged 9-10 years showed that the frequency of fish consumption has a value of $p = 0.170$ and fish species has a value of $p = 0.259$, while confounding factors in the form of mother education and income of parents have their respective p -value of 0.011 and 0.171.

Conclusion: There is no significant correlation between the frequency of fish consumption and type of fish to the intelligence level of children aged 9-10 years ($p > 0,05$). However, the probability of subjects whose frequency of consumption of fish >3 times/week to have intelligence in the intelligent category greater than 1.81 times the subject consuming fish ≤ 3 times/week, after controlling maternal education factors and income parents.

Keywords: children's intelligence, fish consumption, mother's education, parent's income, type of fish

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INTRODUCTION

Fish consumption is believed to affect child's intelligence. Some research showed there is a relationship between fish-consumption frequency and the intelligence of 9- to 11-year-old children.¹ Other findings also reported that after the adjustment of socio-economic-status intervening factor, children who consumed more than 1 fish/week had higher total intelligence scores than those consuming fewer than 1 fish/ week.² Therefore, regular fish consumption can potentially increase child's intelligence.

The main phase of human-brain growth occurs from birth to age of 2 years. However, the development and growth of certain areas of the brain persist in childhood and adolescence. At the age of 6 months, the myelination of the frontal lobe area continues, which is identified at the age of 2 years, 7 to 9 years, and mid-adolescence.³ A healthy diet pattern of children of 6 to 24 months

old persistently affects IQ (Intelligence Quotient) scores at the age of 8 years.⁴ The same pattern is believed to occur in 9- to 10-year-old children who still depend on their parents regarding nutritional fulfillment, including the selection of fish group.

Affective attitude or the mother's liking of seawater fish is a major predictor of the child's attitude toward seawater-fish consumption.⁵ Fish-consumption patterns can be influenced by mass media, health promotion, family support, preferences of each family member⁶; as well as personal attitudes, norms, and past experiences.^{6,7}

Fish has an important role in the fulfillment of nutritional protein in developing countries.⁸ Indonesia as a developing country still has low fish-consumption level of only 38 kg/capita/year from the availability of 51.8 kg/capita/year.⁹ Based on the data of fish-consumption rate in 2008 – 2012 in Central Java, the rate of fish consumption only 17.56% in Central Java Province.¹⁰

Surakarta as one of the important cities in Central Java Province has the potency to increase the fish consumption level even though it is not a fish-producing area. In addition, the contribution of Indonesian people's spending to buy fish in urban areas is higher than that in rural areas.¹¹ Although some literature has not yielded consistent conclusions about relationship between fish consumption and child cognition, multiple analysis is needed to know the relationship between IQ-test score and fish consumption in mid-childhood. IQ-test score is a good predictor for school achievement in mid-childhood.¹² Therefore, the aim of this study is to find out the relationship between fish-consumption frequency and fish species with the intelligence levels of 8-year-old children.

METHOD

Design, place, and time

The design of this research was cross-sectional. The research was conducted in 4 primary schools in Department of Education of Surakarta City which was decided by using stratified random sampling. The schools chosen are Primary School Number 78 Sabranglor, Primary School Number 42 Wonosaren, Primary School of Muhammadiyah 8 Jagalan and Primary School of Muhammadiyah Program Khusus Kottabarat in Surakarta. This research was being held on July-October, 2017.

Sampling Technique

The population for this research was 4th-grade primary school students (age 9-10 years old) male and female in Surakarta city. The result was 107 students needed as subject (with 10% drop out possibility). This research had fulfilled the requirements and had been granted an agreement by Ethics Commission of Health Research of Medical Faculty in Sebelas Maret University Number. 689/VII/HREC/2017. Students from 4 primary schools who fulfilled the inclusion criteria have chosen as the subject. Inclusion criteria included good nutritional status, live in Surakarta with parents, able to communicate well, age 9-10 years old, willing to be the subject of the research.

Data Collection From Subject

The subject filled and returned the questionnaire on age, sex, parent's education and parents' income information. Later, the researcher with the help of the enumerator will guide the subject to answer the questions in the questionnaires about frequency of fish consumption and types of fish consumed. Besides, the enumerator also interviewed the subject to fill out the semi-quantitative Food Frequency Questionnaire (FFQ) and recall form 1

x 24 hours for three days. The anthropometry data was obtained by measuring the weight and the height with digital body scale with precision 0,1 kg and microtoise with precision 0,1 cm.

CFIT-2A Test (Culture Fair Intelligence Test 2A)

Cognitive test with CFIT-2A method was conducted by "Jasa Psikologi Indonesian" in Surakarta. The test was conducted in classroom with controlled condition, on the same time (9 a.m to 11 a.m) in each school.

Data Processing and Analysis

There were two types of data in this research; primary and secondary data. Primary data included characteristics of the subject (age, sex, mother's education, parent's salary), data on fish consumption (preferences, frequency of fish consumption and types of fish consumed), which was obtained by using questionnaire, semi-quantitative FFQ forms (modified of¹⁴), and food recall form 1 x 24 hours for 3 days. Data of the intelligence level was obtained by using Culture Fair Intelligence Test (CFIT) with scale 2A. Secondary data included the condition on the research location. All the data was obtained by using a validate and reliable interview and questionnaires. Data processing included verification, coding, entry, cleaning and analysis. The data from FFQ and food recall were analyzed by using Nutrisurvey for Windows 2007 software. The data of fish consumption were tabulated and analyzed statistically by using SPSS version 16. Data analysis multiple-logistic regression test for multivariate analysis with the significance of <0.05.

RESULTS

Multiple-logistic-regression analysis was used in this research to find out the independent variables that most influence the intelligence of 9- to 10-year-old children after controlled by the intervening variables. Variable was grouped into frequency of fish consumption (>3 times/week, ≤3 times/week); type of fish (sea water fish, other fish); mother education (high, not high); parent income (high, not high); level of intelligence (intelligent, not smart).

Fish-consumption frequency and fish species affected the intelligence of 9- to 10-year-old children by 15% after controlling the maternal education and parental income. [Table 1](#) shows that fish-consumption-frequency variable is the factor that most influences the intelligence of 9- to 10-year-old children. The chance of the subjects who consumed fish more than 3 times a week to have intelligence in the smart category was 1.81 times greater than the subjects consuming fish less than/ equal to 3 times

Table 1. The Results of Multivariate Analysis Using Multiple Logistic Regression Test

	OR	95%CI	p value	Nagelkerke Factor (%)
Fish-Consumption Frequency (> 3x/week)	1.81	0.78-4.21	0.170	
Type of Fish (seawater fish)	0.40	0.08-1.95	0.259	15
Maternal Education (high)	0.32	0.14-0.77	0.011	
Parental Income (high)	0.46	0.15-1.40	0.171	

a week although it was not statistically significant ($p = 0.170$). The chance of the subjects who consumed another type of fish to have intelligence in the smart category was 0.40 times lesser than that the subjects who consuming seawater-fish although it was not statistically significant ($p = 0.259$).

In this research, there are intervening variables which are also included in multiple logistic regression; they are maternal education and parental income. The probability of the subjects who had uneducated mothers to have intelligence in the smart category was 0.32 times lesser than that of the subjects with highly-educated mothers, and it was statistically significant ($p = 0.011$). The probability of the subjects with high-income parents was 0.46 times lesser than that of the subjects with highly-educated parents to have intelligence in the smart category although it was not statistically significant ($p = 0.171$).

DISCUSSION

Table 1. shows that consuming fish regularly increases the chance of intelligence of 9- to 10-year-old children by 1.81 times (95% CI = 0.78-4.21), although it is not statistically significant ($p = 0.170$). This is in line with the research revealing that there is a relationship between the frequency of fish consumption and the intelligence of 9- to 11-year-old children who always eat fish 1 time a week or 2 to 3 times a month. They have higher IQ scores of 4.80 and 3.31 times respectively than those who rarely eat fish (less than 2 times/month), and it is statistically significant (all $p < 0.05$). Similar findings also show that after the adjustment of socio-economic-status intervening factor, it was found that 15-year-old children who frequently consumed fish more than once per week had higher total intelligence scores than those consuming fish less than 1 time per week.² It means that the increasingly frequent consumption of fish can increase child's intelligence.

The chance of the subjects who consumed other type of fish (a combination of seawater and freshwater fish) to have intelligence in the smart

category was 0.40 times lesser than that of the subjects who chose seawater fish only (95% CI = 0.08-1.95). It showed that the subjects who consume seawater fish have better potential intelligence. The nutritional Polyunsaturated Fatty Acid (PUFA) of fish, especially omega-3 fatty acids are vary in each species of fish. The amount of PUFA in big freshwater fish, such as goldfish and *tilapia*, is relatively lower than the smaller seawater species, such as salted fish and sardines.¹⁵ Fish species in the Mediterranean Sea are rich in omega-3 PUFAs, especially EPA and DHA.¹⁶

Most of the study suggests that fish and another seawater products are rich in omega-3 fatty acids. However, farmed freshwater fish, such as *mujahir* fish and catfish also contain omega-3 fatty acids commonly consumed by children in Sweden.¹⁷ Study conducted by Orhvik et al. confirmed that two freshwater-fish species in African waters contain significant EPA and DHA.¹⁸ African catfish (*Clarias Gariepinus*) contains high protein and medium oil while *mujahir* fish (*Tilapia Zillii*) has high protein and low oil. Both freshwater fishes are good sources of fatty acids and amino acids and are relatively easy to get.

The pattern of fish consumption by the research subjects was influenced by various factors such as socioeconomic and cultural factors in their environment. The pattern of food consumption of 6- to 12-month-old children was associated with their cognitive development. The IQ scores at 4-year-old children were higher (using the test of Wechsler and Primary Scale of Intelligence) and remained significant after the adjustment for various intervening factors such as economic status, maternal education, and maternal IQ.¹⁹ Throughout childhood, children and the elderly have the same diet pattern in which high maternal education is associated with high scores of healthy nutritional diet.²⁰

Table 1 shows that in this research maternal education factors significantly influence the intelligence of 9- to 10-year-old children. The subjects with uneducated mothers had 0.32 times lesser chance (95% CI = 0.14-0.77) than those with highly-educated mothers to have intelligence in the smart category, and it was statistically significant ($p = 0.015$). This shows that the subjects with highly-educated mothers tend to have intelligence in the smart category. Children who often eat fish have a higher intelligence value of about 40% associated with highly-education parents.² This is in line with the report that parental education consistently deals with the child's IQ score.¹

The socioeconomic factor that affects child's intelligence and highly correlated with education is

parental income. Table I shows that the probability of the subjects with low-income parents to have intelligence in smart category was 0.46 times lesser than the subjects with high-income parents although it was not statistically significant ($p = 0.171$; 95% CI = 0.15 to 1.40). It indicates that child's intelligence affected by the total of parental income. High level of income is one of the factors that can influence maternal care in the fulfillment of child nutrition to support optimal development.²² Parents who have high income tend to be freer to choose quality and nutritious food. This is in line with research in Turkey which reported that 38% of consumers believed that fish consumption could increase through social awareness due to the significant relationship between fish-consumption frequency and fish species selected as the income class increased.²³ This result in accordance with study conducted by Dey et al. showed that the proportion of expenditure to consume fish is higher in high-income group than in low-income group.²⁴

High socioeconomic status and factors such as parental education, employment, and income are associated with better cognitive performance in 8- to 10-year-old children in Sout India.²⁵ Research in Santal India measured the cognitive-ability scores of 5- to 12-year-old children through Raven's Coloured Progressive Matrices (RCPM) whose results were significantly correlated with nutritional status and socioeconomic factors. In other words, children with good nutritional, economic, and social status had good cognitive scores.²⁶ Meanwhile, other studies suggest that culture, personal preferences, and socioeconomic status also affect the variation of fish consumption containing omega-3 fatty acids PUFA, including EPA and DHA.²⁷

CONCLUSION

There is no significant correlation between the frequency of fish consumption and type of fish with intelligence level of children aged 9-10 years. However, the probability of subjects whose frequency of fish consumption >3 times/week to have intelligence in the smart category 1.81 times greater than the subject consuming fish ≤ 3 times/week, after controlled by maternal education and parental income factors.

CONFLICT OF INTEREST

Authors in the study state that there is no conflict of interest regards with this research.

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