Journal of Nutrition and Health Care

Vol 2(1) March 2025
https://junic.professorline.com/index.php/journal/index

Utilization of Sea Fish Consumption (As a Source of Nutritional Products) to Improve the Health of Elementary School Students, High School, Vocational Schools and Islamic High Schools (LITERATURE REVIEW)

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Abstract

Indonesia has abundant fishery resources, but the level of fish consumption among school children is still low. This study aims to review the literature related to the utilization of marine fish consumption, especially tuna, in improving the health and learning achievement of students from elementary school to high school/vocational school/Islamic high school. Marine fish, especially tuna, are rich in protein, omega-3, DHA, and EPA which play an important role in brain development and endurance. Studies show that regular fish consumption can improve memory, focus on learning, and prevent stunting in children. However, low education, access to quality fish, and children's preference for fast food are the main challenges. Various government programs such as the Gerakan Memasyarakatkan Makan Ikan (GEMARIKAN) have been implemented to increase fish consumption among students. This study proposes innovative strategies such as diversification of fish processing in a form that is more attractive to children and more intensive education about the benefits of fish consumption for health. The results of this study are expected to provide recommendations for agency/institution policies in increasing fish consumption in educational environments in order to create a healthier and smarter generation.

Keywords: Consumption Of Sea Fish, Nutrition Education Program, GEMARIKAN

1. Background

Indonesia is recorded as an archipelago with 17,499 islands that have the potential for abundant fishery products with its marine economic zone reaching 2.55 million km2 of the total sea area of 3.25 million km2 (Pratama, 2020). This provides an advantage in the form of abundant fishery resources, one of which is tuna. Tuna is a type of marine fish that has high nutritional content, especially protein, omega-3, vitamins, and minerals that play an important role in the growth and development of children.

In the world of education, adequate and balanced nutritional intake is an important factor in supporting student learning achievement. Fish consumption, especially tuna, has been shown to

have a positive correlation with improving children's intelligence and concentration. DHA and EPA contained in fish play a role in the formation of brain tissue and improve memory, which indirectly supports students' academic success.

Food is the most important basic human need. In order to achieve quality human resources, nutritious food consumption is required. Nutritional adequacy is needed by every individual, including school-age children. School-age children (6-12 years old) are one of the nutritionally vulnerable groups. Data from the 2013 Riskesdas showed that the national prevalence of stunting in children aged 5-12 years was 30.7% (12.3% very short and 18.4% short). In addition, data also showed that the national prevalence of wasting (according to IMT/U) in children aged 5-12 years was 11.2%, consisting of 4.0% very wasted and 7.2% wasted.

Despite its great benefits, the level of fish consumption among school children is still relatively low. Some of the factors that influence this include lack of education on the benefits of fish consumption, limited access to quality fish, and the dominance of fast food that is preferred by children. To address this issue, the government has launched various programmes, one of which is the Free Nutritious Meal Programme (MBG). This programme aims to improve the nutritional status of students by providing nutritious food, including marine fish, as part of the daily menu in schools.

In addition to MBG, Gerakan Memasyarakatkan Makan Ikan (GEMARIKAN) is also a strategic step in increasing fish consumption among the public, especially school children. This programme focuses on educating the public about the importance of fish consumption as the main source of protein and diversifying fish products to make them more attractive and suitable for children's tastes.

The benefits of fish consumption are not only related to improving intelligence, but also in preventing stunting, which is a chronic malnutrition condition that can hamper children's physical growth and cognitive development. A study showed that children who consume fish regularly have stronger memory, better focus levels, and higher academic performance compared to those who rarely consume fish. Therefore, increasing fish consumption in the school environment is a strategic step in building a healthier and more competitive generation.

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Furthermore, tuna has an advantage over other types of fish due to its abundant availability and relatively more affordable price compared to other fish such as salmon or tuna. This makes tuna an ideal choice in school nutrition programmes that aim to improve the quality of student health. With its high protein content, tuna plays a role in improving the body's immunity as well as helping the cell regeneration process that supports optimal growth for school-age children.

To increase fish consumption among school children, there is a need for innovation in the diversification of processed fish. Various products such as fish nuggets, fish balls, and shredded fish can be a more attractive alternative for children. In addition, education about the benefits of fish

also needs to be expanded through various media, both in the school environment and at home, so that children get used to consuming fish as part of their healthy diet.

Based on this background, this study aims to review the literature on the use of marine fish consumption, particularly tuna, in improving students' health and learning achievement. It will also explore the linkages between fish consumption and various government programmes aimed at improving the nutritional status of school children, as well as innovative strategies that can be implemented to increase fish consumption among students. This study is expected to provide recommendations that can support policies to increase fish consumption in educational settings to create a healthier and smarter generation.

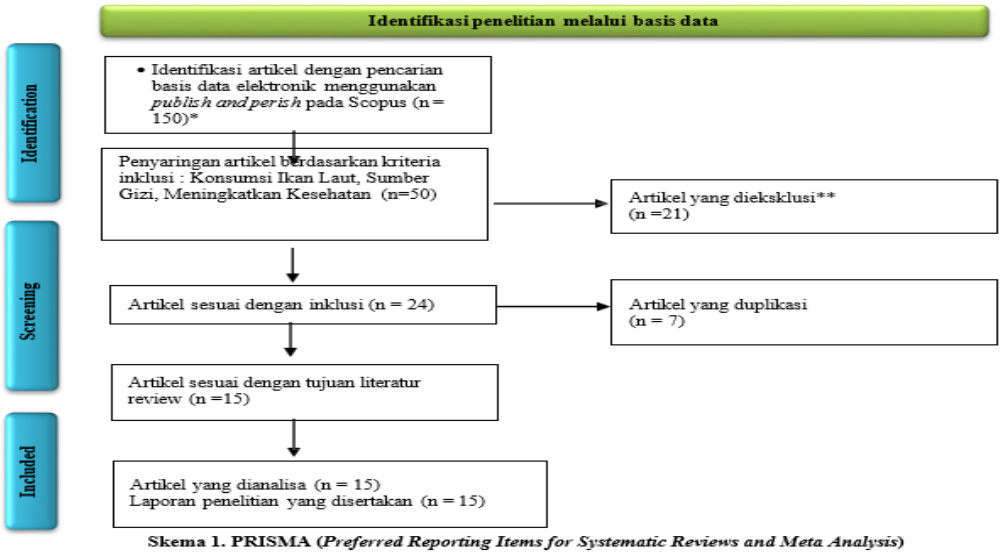
2. Methods

This research uses a literature review with a narrative method. The article search was conducted using national articles and searched with Google Scholar, ScienceDirect, Scopus, DOAJ (Directory of Open Access Journals), Researchgate, AcademiaEdu, ISJD (Indonesian Scientific Journal Database), and SAGE Journals databases.

The total number of articles obtained based on each database was checked to see if there were relevant articles based on the title and then continued screening articles based on the abstract. The article eligibility test was carried out based on the inclusion and exclusion criteria. The inclusion criteria were the results of nutrition education research using the keywords: 'Utilisation of Sea Fish Consumption', "(As a Nutritional Source Product)", "Improving Health", keywords to increase the knowledge of nutrition education targets, the analysis of the results used is a trial study or research article, the articles used are publications in 2016-2024, full text articles and open access articles.

Articles that do not meet the inclusion criteria will be excluded or not included in the next stage. Once the eligibility analysis had been conducted, the next step was to look at the similarity of the interventions in each of the selected articles. The author chose nutrition education interventions using media (as a nutritional source product), to increase knowledge in the archipelago as the main topic and based on search results with inclusion criteria, 15 relevant articles were obtained based on publications over the past 10 years with full text articles and open access articles. The selection of locations focused on the archipelago with the aim of knowing how much nutrition education using media (as a nutrition resource product), to increase knowledge has been done and how far the effectiveness of the education.

3. Results



Skema 1. PRISMA (*Preferred Reporting Items for Systematic Reviews and Meta Analysis*)

Scheme 1 shows the flowchart of the article search process until the exclusion of articles using the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta Analysis) method. Figure 1 shows the results of article searches that have been filtered based on the research inclusion criteria. There are 15 articles that will be analysed in this study that discuss various spatial analyses of how much nutrition education uses media (as a nutritional source product). The results of article identification using a search engine called publish or perish on the Boolean Operator found as many as 50 articles that entered according to the keywords. The results of filtering articles obtained articles that match the inclusion criteria of nutrition education research using the keywords: 'Utilisation of Marine Fish Consumption', "(As a Nutritional Source Product)", "Improving Health",. Fifteen articles discussed the factors to improve knowledge in the archipelago as the main topic and based on the search results with the inclusion criteria using spatial analysis The digest of 15 articles will be described in table 1.

During the first stage of this research, articles or other research results were collected based on search engines on the site, namely: *Academia.edu, SpringerOpen, Google Schoolar and SINTA database.*

Table 1 List of Articles Search Results of Online Journal Sites

No	**Author**	**Title**	**Source**	Year
1	Yana Sambeka, Meityn Disye Kasaluhe, Astri Mahihody	Education on the Utilization of Modern Fishery Products as an Effort to Improve Adolescent Nutrition at SMK Negeri 1 Tabukan Tengah	https://edumediasolution.Com/Index.php/Society	2024
2	Tri Yusufi Mardiana, Linayati	Education on the Importance of Fish Nutritional Value and Enhancement of Fish Processing Skills for Students at Mas Fatkhul Qowim, Api-Api Village, Wonokerto Subdistrict, Pekalongan Regency	J-Adimas (Jurnal Pengabdian Kepada Masyarakat)	2024
3	Emma Suri Yanti Siregar, Tengku Muhammad Ghazali	Encouraging Fish Consumption for School Children's Intelligence at MTs Al-Maidar Pandan, Central Tapanuli Regency	http://jurnal.unmer.Ac.Id/Index.Php/Jpkm	2021

4	Emmy Sri Mahreda	Factors Influencing Fish Consumption Preferences Among School-Age Children (Case Study: SMPN 1 Astambul, Banjar Regency)	Enviro Scienteae	2022
5	*Frengki Umbu Pati, Herwanti Baha, Lilik Sri Hartati*	The Relationship Between Marine Fish Consumption and Academic Achievement of Elementary School Students at SD Inpres Pantai Rua in Waikabubak, West Sumba, East Nusa Tenggara	Https://Digilib.Esaunggul.Ac.Id	2017
6	Galuh Nita Prameswari	Nutrition Promotion on the Habit of Eating Fish Among School-Age Children	https://Journal.Unnes.Ac.Id/Sju/Index.Php/Jhealthedu	2018
7	*Maulida Nurapipah, Aprilia Lestari*	Education on the Benefits of Fish Consumption for Health to Prevent Stunting Early	Jurnal Pengabdian Kepada Masyarakat: Kesehatan (JPKMK)	2023
8	Nanda Diniarti, Nunik Cokrowati,	Education on Fish Nutritional Value Through Training in Processing Fish-Based Foods Using Mackerel Tuna	Jurnal Abdi Insani Universitas Mataram	2020
9	Cerria Inara	The Benefits of Marine Fish Nutritional Intake for Disease Prevention and Maintaining Health Among Coastal Communities	*Jurnal Kalwedo Sains (Kasa)*	2020
10	Teguh	Nutrition Education on Fish	Http://Jurnal.Utu.Ac.Id/Mkreatif	2022

	Raharja , Nabila Ukthy, Yasrizal	Consumption for Children Aged 12-15 as a Stunting Prevention Effort in Alue Ambang Village, Aceh Jaya Regency		
11	Trisna Agung Pambud, Lutfi Danuwari	Utilization of Mackerel Tuna (Euthynnus Sp.) in Noodle Production as an Effort to Enhance the Creative Economy	JMM (Jurnal Masyarakat Mandiri)	2022
12	Eva Dewi1 , Dian Hasni1 , Rasdiansyah	Utilization of Tofu Residue and Mackerel Tuna as Protein Substitutes with the Addition of Cornstarch in Nugget Production	Jurnal Ilmiah Mahasiswa Pertanian Unsyiah	2016
13	Raden Syaifuddin , Rosifatul Umamah, Jamaluddin	Utilization of Fishermen's Catch into Fish Crackers in Sidogedungbatu Village, Sangkapura Subdistrict, Gresik Regency	Jurnal ilmu kelautan kepulauan	2022
14	Annisa Rahmawati1, Tri Adi Wibowo, Desy Sasri Untar	Production of Mackerel Tuna (Euthynnus affinis) Nuggets with the Addition of Moringa Flour (Moringa oleifera) to Increase Nutritional Value	Jurnal Pengolahan Perikanan Tropis (JPPT)	2024
15	Neneng Sumarni	Effect of Adding Moringa Leaves (Moringa oleifera L.) to Mackerel Tuna (Euthynnus affinis) Nuggets on Organoleptic Quality and Nutrient Content as an Alternative High-Iron Food	STIKes Perintis Padang, Prodi S1 Gizi	2020

Community service activities regarding education on the use of contemporary fishery products as an effort to improve adolescent nutrition at SMK Negeri 1 Tabukan Tengah were carried out on 21 July 2023.

This community service activity began with measuring students' height and weight. After completing the measurement, the students continued the activity by filling out the pre-test before entering the opening ceremony. The pre-test was carried out with the intention of assessing students' initial understanding of fish and the benefits of fish for the body, adolescent nutrition, and the use of current fishery products before being given education. After the pre-test activity, the community service activity was officially opened by the school, in this case the Principal of SMK Negeri 1 Tabukan Tengah. The school welcomed this activity because it is important for students in choosing nutritious food intake both at home and at school which is separated from parental supervision. Poor nutritional quality of food or snacks at school and at home is associated with low academic performance at school and intention to continue to higher education (Burrows et al., 2017). After providing these materials, students were given the opportunity to discuss, and take a quiz which can be an instant feedback in this educational activity. Furthermore, the team conducted post-test activities. This is done as an evaluation material to measure the students' final level of understanding of the material that has been given. Pre-test, post-test, and N-Gain data can be seen in Table 2.

Based on the comparison between the pre-test and post-test results, it can be said that educational activities can improve student understanding. Furthermore, the average increase in student understanding or N-Gain is 0.49; so it can be said that the increase in student understanding has a moderate category. This service activity ended with the provision of tools to measure students' BW and TB, as well as Packaged Nutrition Discs to help students control their body health. Furthermore, this activity was closed by the Principal of SMK Negeri 1 Tabukan Tengah. The Principal stated that the implementation of activities like this is necessary to increase knowledge for school community, especially students.[1]

Api-api Village has an area of 223.053 ha, 21 km from the centre of Pekalongan Regency and geographically, as recorded administratively, borders several villages such as Sijambe and Wonokerto Wetan villages to the south and west and borders Pecakaran village to the south and to the north is directly adjacent to the Java sea. Api-api Village is a land of settlements, rice fields and pond areas that stand between 3 hamlets: Api-api, Pagedangan, and Dadaptulak which are divided into 16 neighbourhoods and 9 hamlets. Currently, the majority of superior resource utilisation is in milkfish ponds with a total of 114,370 ha of ponds whose products are exported to several other districts.

Educational Training on the Importance of Fish Nutritional Value Increasing Fish Processed Skills in MAS Fatkhul Qowim Students was attended by 8 students, as for the names of the names as follows: Erin Bagus Prasetyo, Dava Shofanul Hakim, Gigit Prasetio, Meta Dwi Santika, Eka Diava, M. Zuqni Mulnazim, M. Khaninul Khasan, Vina Khoirotun Khisan (Figure 1). At the time of the training, the participants were very active, this was shown when the practice took place, students participated in the training process, both male and female. This service activity involved lecturers from the Faculty of Fisheries, Pekalongan University and lecturers from the Fishery Product Technology Study Program, FPIK Diponegoro University as a form of follow-up to the MoA that had been implemented and involved Unikal students. The material provided is in the form of making presto milkfish, fried milkfish, liquid smoked fish, fish roll.[2]

The implementation of PKM follows the stages that have been prepared because it is a reference and as technical instructions. The implementation of activities well and smoothly cannot

be separated from good planning. Good planning will produce maximum output. In general, the partners chosen in this community service activity were very enthusiastic about the ideas conveyed by the service team. Community Service Activities (PKM) with the theme of fond of eating fish are carried out based on the stages planned by the service team.[3]

Activity preparation

Prior to the implementation of community service activities, a survey was first conducted to the location of the service. The location where the activity will be carried out is at MTS Al-Maidar Pandan, Pandan District, Central Tapanuli Regency. The purpose of the survey is as a form of initial step whether the school has the willingness to be used as a location for activities. Survey activities are carried out to ensure conditions and situations due to the spread of COVID-19. During the pandemic, students have not carried out teaching and learning as usual, therefore it is necessary to discuss with the school so that the service can be carried out. The survey begins by submitting a request for permission to the principal and school management. [3]

The school and the PKM implementers determine the schedule for implementing the activity. After going through the discussion process, a schedule for implementing activities was obtained. The survey also took care of the administration for the implementation of this PKM activity, as shown in Figure 1.

After conducting the survey, the next step is to prepare the tools and materials for PKM activities. Among them are masks, socialisation materials, infokus, rooms and equipped with chairs and other devices that can support the implementation of PKM activities properly. PKM activities are carried out in one of the student study rooms. During the pandemic, the implementers of activities and the school still adhere to health protocols. Health protocols are provided by the organising committee such as masks, body temperature checks, and hand sanitisers. Health protocols are provided to minimise the occurrence of COVID-19 transmission during the activities later. The service team still heeds the call from the government to maintain health when carrying out activities that invite many people. It is hoped that by complying with the rules the participants and the service team will avoid the virus.[3]

The results of testing the similarity of the estimator model analysed using observations obtained a chi squared value of 1.306 at a significance value of 0.995 (Table 1). With a significance value greater than 0.05, it means that there is no difference between the data of the estimated logistic regression model using observation data. This shows that the model is correct so that model modification does not need to be done. To clarify the picture of the accuracy of the logistic regression example using observational data, it can be shown using a description table in the form of a cross tabulation table between the output or prediction results using the results.

Tabel 1. *Hosmer Lameshow test*

Chi-square	df	Sig.
1.306	8	.995

Uji Cox & Snell's R2 dan Nagelkerke R2

The results of the test of the effect of independent variables on the dependent variable simultaneously are shown by the Nagelkerke R 2 value. The Nagelkerke R square value is 55.7% (Table 2), which means that the influence of socioeconomic status, mother's education, energy sufficiency level, infection and nutritional status of children on fish consumption in school children

at SMPN 1 Astambul is 55.7%. 4.

Tabel 2. Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	7.506[a]	.208	.557

SD Inpres Pantai Rua is located in Wanukaka sub-district, Waikabubak - West Sumba, the distance between SD Inpres Pantai Rua and Pantai Rua is approximately 200 metres. The vision of SD Inpres Pantai Rua is to excel in science, imtaq and culture and the mission is to develop knowledge in the fields of science and technology, language, sports, arts and culture according to the talents and potential of students, foster belief and faith through the experience of religious teachings, optimise learning and guidance, establish and develop harmonious cooperation between school and community members.[5]

Most of the respondents were female, 67.3%. The age range in this study was 9 to 16 years old and most of them were in the 9-12 years old category, 79.6%. Most of the respondents had low father's education 89.8%, low mother's education 85.7%, father's farmer/fisherman occupation 95.9%, mother's farmer/fisherman occupation 98.0%, low parental income 95.9%.[5]

This research has been conducted at SD Ummul Quro Semarang. The subjects of this study were students of grade 2 and 3 of SD Ummul Quro Semarang. The number of students in grade 2 was 23 students and grade 3 was 31 students, so the total number of students who were the subjects of this study was 54 students. The age range of students varied from 7 to 9 years old, while the gender of the students were 25 males (46.3%) and 29 females (53.7%). Before the delivery of promotional material for eating fish, a pre-test was conducted to determine students' attitudes towards eating fish. The results of the pretest showed that 50 students (92.6%) stated that they liked to eat fish, but there were 4 students (7.4%) who stated that they did not like to eat fish because it smelled fishy and had many thorns. After the pretest, then the intervention was carried out in the form of promotion of fond of eating fish. [6]

The results of the work programme carried out by Aprilia Lestari from the Nursing Science Study Program are education about the benefits of eating fish for health to prevent stunting from an early age. Before conducting education, the first thing to do is prepare the material and then socialise it to students of SDN Cikaracak 1.

jThis activity was carried out at SDN Cikaracak 1 located in Cikaracak Village, Argapura District, Majalengka Regency. Participants who participated in this activity were 2 teachers and 52 students. The method used was lecture by educating students about the benefits of eating fish. The activity was continued by distributing leaflets to all participants and explaining the benefits of eating fish for health, development and growth in children.[7]

4. Discussion

Fish oil is rich in vitamins A, D, and E, and a lack of vitamin D can cause osteoporosis, tissue weakness, and decreased immune system function (Larsen et al., 2011). Community service activities often utilize cultivated fish from the Apia pi Village community, including milkfish. Milkfish is a fish that can live in areas with a wide range of salinity because it is euryhaline. According to Halifudin (2015), milkfish is very rich in amino acids, with the highest composition being glutamate, reaching 1.386% in freshwater and 1.268% in brackish water. Milkfish meat contains macro minerals such as Ca, Mg, Na, and K, and micro minerals such as Iron, Zinc, Copper, and Manganese. Its

vitamins include A, B1, and B12. Oleic acid is the highest unsaturated fatty acid at 31-32% (Tri Yusufi Mardiana, Linayati, 2024).

The implementation of PKM activities is carried out according to the schedule determined by the school principal. After all the tools and materials are prepared by the service team, the service activities are carried out. The service activities begin with an opening ceremony. The opening ceremony is initiated by one of the teachers at MTS Al-Maidar Pandan, and the execution of the activities is then fully entrusted to the service team. The service team introduces themselves first to the students before providing socialization materials or community service, which is very necessary.

Therefore, an evaluation of the completed service activities is needed. The evaluation is conducted by assessing how well the participants have absorbed the knowledge presented by the speakers. In addition, the evaluation is also based on the preparation of tools and materials, as well as the technical implementation. The implementation of this PKM has been successful, as evidenced by the enthusiastic participation of students in the Q&A session, their active participation throughout the event, and the hope for sustained advocacy for enjoying fish as part of their diet. As an evaluation material to improve the results of future activities, the service team will plan more optimally for the next activities (Emma Suri, Tengku, 2021).

Choices or determining snacks are manifestations of behavior. Meanwhile, factors influencing the formation of conduct/behavior include internal and external factors. Knowledge is an internal factor that influences the selection of various snacks. This knowledge includes knowledge of the nutritional content of the food to be eaten, intelligence, perception, emotions, and external motivation. Supporting factors for food selection are divided into 3 factors: food-related factors, exclusive/personal factors related to decision-making in food selection, and socio-economic factors.

The selection or determination of snacks is a manifestation of behavior. The factors influencing the formation of conduct/behavior consist of internal and external factors. Knowledge is an internal factor that influences the selection of various types of snacks. This knowledge includes nutritional awareness of food, intelligence, perception, emotions, and external motivation.

The factors supporting food choices are categorized into three: factors related to the food itself, exclusive/personal factors influencing decision-making in food selection, and socio-economic factors. Research findings indicate that socio-economic status significantly influences children's dislike of fish-based snacks, with a significance value of 0.019 ($p < 0.05$). Therefore, socio-economic status plays a crucial role in fish consumption among school children in Indonesia, specifically at SMPN 1 Astambul. Improved socio-economic status encourages children to increase their fish intake.

Household economic status is determined by the total family income per month, including both primary and supplementary income, divided by the number of family members to obtain per capita monthly income. A diverse fish consumption pattern should be supported by all family members to enhance household food security by incorporating fish into breakfast, lunch, and dinner. This contributes to fulfilling the protein needs of family members, which is highly significant. (Emmy Sri Mahreda, 2022).

The Relationship Between Fish Consumption and Academic Achievement

Based on research, the frequency of consuming marine fish correlates with academic performance. Most respondents who frequently consumed marine fish demonstrated good academic achievement, with 28 students (57.1%) achieving high performance and 21 students (42.9%) achieving moderate performance. Statistical analysis showed a significant relationship

between fish consumption frequency and academic achievement ($p = 0.025 < 0.05$). This supports the theory that fish consumption enhances children's intelligence and academic abilities (Padit, 2009). Various studies have indicated that adequate DHA intake (0.5% of total energy) improves children's concentration and academic performance in school (Pari, 2001). (Frengki Umbu Pati, Herwanti Baha, 2017).

Following the completion of the "Love Eating Fish" promotional intervention, a post-test was conducted to measure children's attitudes toward fish consumption. The study found that 53 students (98.1%) exhibited a positive attitude toward eating fish, a significant increase from the pre-test result of 92.6%.

Table 1 presents cross-tabulated research results, showing that 50 students maintained a positive attitude toward fish consumption before and after the intervention. Notably, no students exhibited a positive attitude before the intervention and a negative attitude afterward. (Galuh Nita Prameswari, 2018).

During the intervention, students attended the sessions until completion, accompanied by their homeroom teachers from grades 3 and 4. The presence of teachers aimed to ensure knowledge transfer and continuous motivation for students to consume fish regularly. The educational sessions engaged students effectively, as demonstrated by their active responses to questions, comments on images in leaflets, and discussions on the information provided. (Maulida Nurapipah, Aprilia Lestari, 2023).

The Health Benefits of Tuna Fish

Due to its high nutritional value, tuna fish provides numerous health benefits, including:

1. **Maintaining Stable Blood Pressure**
   Rich in omega-3, tuna helps prevent blood vessel blockages, ensuring smooth blood flow and stable blood pressure.

2. **Supporting Organ Function and Health**
   Tuna is a high-protein food essential for forming new cells and tissues while repairing damaged ones. This contributes to the health of organs such as the eyes, brain, and liver.

3. **Boosting the Immune System**
   Tuna is rich in omega-3, vitamin A, and vitamin B12. These nutrients, along with protein, enhance immunity and help protect against infections and diseases.

4. **Strengthening Bones**
   Tuna contains high levels of vitamin D and calcium, which are essential for bone strength and health.

5. **Weight Management**
   The protein in tuna promotes satiety, delaying hunger and aiding in maintaining an ideal body weight.

6. **Maintaining Heart Health**
   Regular consumption of tuna has positive effects on heart health. Its protein and omega-3 content help regulate cholesterol levels and blood pressure, reducing the risk of cardiovascular diseases.

   Despite its health benefits, excessive consumption of tuna is not recommended due to its high mercury content. jIt is advisable to limit intake to 2–3 servings per week.Individuals

allergic to seafood should also exercise caution when consuming tuna, as it may trigger allergic reactions.

7. The Role of Tuna Fish in Children's Cognitive Development

Tuna is recommended for children's diets due to its numerous benefits. According to the U.S. National Institutes of Health, tuna enhances brain function in children due to its high content of omega-3 fatty acids and niacin.

For elderly individuals, niacin helps reduce the risk of Alzheimer's and dementia. Meanwhile, omega-3 fatty acids support brain function and mental health, reducing the risk of depression.

Tuna's protein content makes it a suitable alternative to red meat. It strengthens children's immune systems, supports growth, and helps increase muscle mass while preventing obesity.

Regular fish consumption is also linked to a lower risk of asthma in children. Asthma, a chronic inflammatory condition of the airways, was found to be 24% less prevalent among children who consumed fish regularly, according to a study published in *PubMed Central*. However, no significant effects were observed in adults.

Given the proven benefits of fatty fish for adults, researchers have begun studying its effects on children. A study published in the *American Journal of Clinical Nutrition* found that fatty fish consumption positively impacted children's development and overall health.

A study involving nearly 200 children aged 8 to 9 years revealed that consuming fatty fish increased triglyceride and HDL cholesterol levels without negatively affecting blood pressure, heart rate variability, or glucose homeostasis.

5. Conclusion

Increasing the consumption of marine fish as a source of essential nutrients (protein, omega-3 fatty acids, DHA, and EPA) has great potential for improving health, academic performance, and the overall quality of life of students from elementary to high school levels. Empirical studies at SD Inpres Pantai Rua found a significant relationship between marine fish consumption and academic achievement ($p = 0.025$), supported by the benefits of omega-3 in enhancing cognitive function, emotional stability, and immune health.

This aligns with findings from SMKN 1 Tabukan Tengah and MTS Al-Maidar Pandan, where educational programs and innovative fish-based meals (such as nuggets, fish balls, and fishcakes) increased students' interest in consuming fish by 98.1%.

The government's *Free Nutritious Meals Program (MBG)* plays a strategic role in integrating processed marine fish into students' daily menus, addressing malnutrition, and improving overall resilience. When combined with appealing food presentations and continuous education, MBG can foster healthy eating habits from an early age, as demonstrated by the success of the program at MTS Al-Maidar Pandan, where systematic and ongoing socialization is recommended.

However, research by Nurmildawaty (2013), which found no correlation between fish consumption and academic performance, should be considered. This suggests that marine fish is only one of many contributing factors, alongside environmental aspects (accessibility, family economy), parental education, and integrated government policies. For instance, MBG should align

with support from healthcare centers, agricultural agencies, and marine fisheries to ensure the availability of fresh, affordable fish, particularly in remote areas.

References

1. Yana Sambeka, Meityn Disye Kasaluhe, Astri Mahihody (2024). Education on the Utilization of Modern Fishery Products as an Effort to Improve Adolescent Nutrition at SMK Negeri 1 Tabukan Tengah. [Online] Available at: https://edumediasolution.com/index.php/Society. pp. 161-168.
2. Tri Yusufi Mardiana, Linayati Linayati (2024). Education on the Importance of Fish Nutritional Value and Enhancement of Fish Processing Skills for Students at Mas Fatkhul Qowim, Api-Api Village, Wonokerto Subdistrict, Pekalongan Regency. J-Adimas (Community Service Journal), pp. 43-48.
3. Emma Suri Yanti Siregar, Tengku Muhammad Ghazali (2021). Encouraging Fish Consumption for School Children's Intelligence at MTs Al-Maidar Pandan, Central Tapanuli Regency. [Online] Available at: http://jurnal.unmer.ac.id/index.php/JPKM. pp. 455-464.
4. Emmy Sri Mahreda (2022). Factors Influencing Fish Consumption Preferences Among School-Age Children (Case Study: SMPN 1 Astambul, Banjar Regency). Enviro Scienteae, pp. 106-114.
5. Frengki Umbu Pati, Herwanti Baha, Lilik Sri Hartati (2017). The Relationship Between Marine Fish Consumption and Academic Achievement of Elementary School Students at SD Inpres Pantai Rua in Waikabubak, West Sumba, East Nusa Tenggara. [Online] Available at: https://digilib.esaunggul.ac.id. pp. 1-6.
6. Galuh Nita Prameswari (2018). Nutrition Promotion on the Habit of Eating Fish Among School-Age Children. [Online] Available at: https://journal.unnes.ac.id/sju/index.php/jhealthedu. pp. 1-6.
7. Nanda Diniarti, Nunik Cokrowati (2020). Education on Fish Nutritional Value Through Training in Processing Fish-Based Foods Using Mackerel Tuna. Jurnal Abdi Insani, Universitas Mataram.
8. Cerria Inara (2020). The Benefits of Marine Fish Nutritional Intake for Disease Prevention and Maintaining Health Among Coastal Communities. Jurnal Kalwedo Sains (Kasa).
9. Teguh Raharja, Nabila Ukthy, Yasrizal (2022). Nutrition Education on Fish Consumption for Children Aged 12-15 as a Stunting Prevention Effort in Alue Ambang Village, Aceh Jaya Regency. [Online] Available at: http://jurnal.utu.ac.id/mkreatif.
10. Trisna Agung Pambud, Lutfi Danuwari (2022). Utilization of Mackerel Tuna (Euthynnus sp.) in Noodle Production as an Effort to Enhance the Creative Economy. JMM (Jurnal Masyarakat Mandiri).
11. Eva Dewi, Dian Hasni, Rasdiansyah (2016). Utilization of Tofu Residue and Mackerel Tuna as Protein Substitutes with the Addition of Cornstarch in Nugget Production. Jurnal Ilmiah Mahasiswa Pertanian Unsyiah.
12. Raden Syaifuddin, Rosifatul Umamah, Jamaluddin (2022). Utilization of Fishermen's Catch into Fish Crackers in Sidogedungbatu Village, Sangkapura Subdistrict, Gresik Regency. Jurnal Ilmu Kelautan Kepulauan.

13. Annisa Rahmawati, Tri Adi Wibowo, Desy Sasri Untar (2024). Production of Mackerel Tuna (Euthynnus affinis) Nuggets with the Addition of Moringa Flour (Moringa oleifera) to Increase Nutritional Value. Jurnal Pengolahan Perikanan Tropis (JPPT).
14. Neneng Sumarni (2020). Effect of Adding Moringa Leaves (Moringa oleifera L.) to Mackerel Tuna (Euthynnus affinis) Nuggets on Organoleptic Quality and Nutrient Content as an Alternative High-Iron Food. STIKes Perintis Padang, S1 Nutrition Program.
15. Nanda Diniarti, Nunik Cokrowati (2020). Education of Fish Nutrition Value Through Food Processing Training Using Mackerel Tuna as Raw Material. Jurnal Abdi Insani, Universitas Mataram, Vol. 7, No. 1, April 2020, pp. 49-58.
16. Kusmiyati, Dewa Ayu (2023). Let's Meet Protein Nutritional Needs by Consuming Fish. pp. 1349-1352.
17. https://www.alodokter.com/jangan-lewatkan-6-manfaat-ikan-tongkol-untuk-kesehatan-anda?utm_source=chatgpt.com
18. https://www.fatsecret.co.id/kalorigizi/search?q=Ikan+Tongkol&utm_source=chatgpt.com
19. https://www.orami.co.id/magazine/manfaat-ikan-tongkol?utm_source=chatgpt.com
20. https://www.bola.com/ragam/read/4110081/5-manfaat-ikan-tongkol-bagi-kesehatan-dan-kecantikan?utm_source=chatgpt.com