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Nutritional Significance of Fish in Combating Malnutrition

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Review Article

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ABSTRACT

The nutritional importance of fish in the context of combating malnutrition holds significant potential as a strategic avenue for addressing global health issues. Malnutrition, characterized by deficiencies in vital nutrients, remains a critical concern affecting diverse populations. Fish is a nutrient-dense food source and investigates its potential contributions to alleviating malnutrition. Wild-caught and aquaculture-derived fish are rich sources of essential nutrients crucial for human health. Abundant in high-quality proteins, fish provides ample amino acids necessary for growth, immune function, and cellular repair. Moreover, fish is renowned for its content of omega-3 fatty acids, along with eicosapentaenoic acid (EPA) also docosahexaenoic acid (DHA), which confer cardiovascular advantages, neurological development, and anti-inflammatory properties. The

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importance of fish's micronutrients, such as vitamins D and B_{12}, iodine, selenium, and zinc. These micronutrients play integral roles in maintaining bone health, supporting cognitive functions, regulating thyroid activity, and enhancing immune responses. Notably, the bioavailability of these nutrients from fish exceeds that of many plant-based sources, highlighting its potential to address nutrient deficiencies effectively. The versatility of fish consumption across cultural diets and its potential to bridge nutritional gaps for vulnerable populations, particularly in regions with limited access to diverse nutrient sources. As malnutrition is influenced by various socio-economic, cultural, and environmental factors, adopting a holistic approach incorporating fish's nutritional attributes could significantly address this challenge. This study aims to highlight the potential of fish as a strategic path for addressing global health issues.

Keywords: Nutritional significance; fish; essential nutrients; combating malnutrition; Omega-3 fatty acids

1. INTRODUCTION

Malnutrition continues to be a prevailing worldwide health issue that impacts diverse socio-economic groups, significantly impacting personal health and societal progress. This encompasses a range of nutritional insufficiencies, encompassing disparities in both macronutrient and micronutrient levels, resulting in detrimental health consequences [1]. Fisheries play a crucial role in addressing malnutrition, as they provide a source of high-quality protein and vital micronutrients [2]. The primary emphasis in addressing malnutrition has largely centered on staple foods and dietary variation. Nevertheless, further investigation into the potential of fish, a nutrient-rich reservoir of vital nutrients, is merited for its role in mitigating malnutrition [3]. The capacity of nutrients from fish to alleviate malnutrition and enhance public health is considerable. Malnutrition, distinguished by insufficient consumption or uneven assimilation of nutrients, persists as a significant worldwide issue. Approximately 2 billion individuals are believed to experience micronutrient insufficiencies, severely impacting health, advancement, and efficiency [4]. Malnutrition, often observed as stunting, wasting, and underweight, predominantly affects children and expectant mothers in economies with lower to middle incomes. Concurrently, the increasing prevalence of overweight and obesity exacerbates malnutrition, leading to a double burden [5].

Fish, including finfish and shellfish, occupy a distinct and remarkable role within the spectrum of food resources owing to their abundant array of vital nutrients [6]. It is an outstanding reservoir of protein, bioaccessible micronutrients, and beneficial fats, thus holding promise as a nutritional remedy for addressing malnutrition. Fish protein is characterized by its completeness, encompassing all indispensable amino acids. Furthermore, it demonstrated enhanced digestibility and absorption rates compared to protein from plant sources [7]. For example, soy protein is a plant source of protein that is less digestible and absorbed less efficiently [8].

Moreover, fish is complete with long-chain polyunsaturated fatty acids (LC-PUFAs) such as omega-3 fatty acids, eicosapentaenoic acid (EPA) along with docosahexaenoic acid (DHA), which have been associated with cognitive development, cardiovascular health and immune modulation [9]. Some examples of the best sources of marine omega-3s comprise salmon, mackerel, tuna, herring and sardines [10]. These fish are all rich in EPA and DHA, which can provide a number of health benefits, including reducing the risk of heart disease, stroke, anti-inflammatory benefits and Alzheimer disease. Regular fish consumption has been linked to enhanced vitamin D levels, especially in areas with reduced sunlight exposure. Furthermore, fish is a significant provider of bioavailable minerals like iodine, selenium, and zinc. These minerals are crucial for thyroid activity, antioxidant protection, and immune modulation [9,10]. It is very important to know that malnutrition is a complicated issue with a number of source causes, such as poverty, a lack of access to healthcare and education and other variables. In order to overcome malnutrition, we need to follow several strategies to add the nutritional benefits of fish to the diet.

The primary objective of this review is to emphasize the persistent issue of malnutrition, marked by deficiencies in essential nutrients, which continues to pose a significant challenge to various demographic clusters. Subsequently, the review examines the nutritional merits of fish,

emphasizing its rich content of high-quality proteins, omega-3 fatty acids and essential micronutrients. Furthermore, it highlights the versatility of fish consumption and its capacity to serve as a viable means of addressing nutritional deficiencies within vulnerable populations.

2. CONTRIBUTION OF FISH TO THE PROVISION OF ANIMAL-DERIVED PROTEIN DURING 2013-15

The impact on seafood production climate change is anticipated to influence target species within capture fisheries significantly. The variations in oxygen levels, temperature, acidification and the presence of toxic pollutants in aquatic environments [11,12]. Climate change is poised to exert effects at the individual species level and on the intricate interplay between species and their habitats, thereby instigating shifts in geographical species composition. Furthermore, these changes will result in shifts in productivity and the resilience of ecosystems in both spatial and temporal dimensions, such as earlier spring blooms [13,14].

A comprehensive modeling exercise that assessed the global capture potential of 1,066 commercially exploited marine fish and invertebrate species under various climate change scenarios revealed that climate change could lead to a substantial redistribution of overall catch potential. This redistribution implies that high-latitude regions could experience an average increase in catch potential ranging from 30% to 70%, while tropical areas are likely to witness decreased catches of up to 40%. This shift corresponds to a reduced catch potential in regions that currently rely heavily on marine protein resources (Fig. 1).

3. NUTRITIONAL STATUS OF FISH

The nutritional composition of fish is essential for addressing global hunger and malnutrition, particularly among rural populations in developing [15]. Fish commodity is also increasingly assuming a significant role in promoting healthful diet in developing nations. Across its diverse species, fish inherently symbolizes a substantial protein content alongside varying proportions of fats and micronutrients (Fig. 1). Fatty and moderately fatty fish, in particular, represent primary dietary sources of omega-3 fatty acids, presenting a distinct fatty acid profile compared to terrestrial food sources. Nevertheless, the concentrations of polyunsaturated fatty acids (PUFAs), such as eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), exhibit disparities among different fish species [15] Fig. 2). PUFAs cannot be produced by humans; they are called

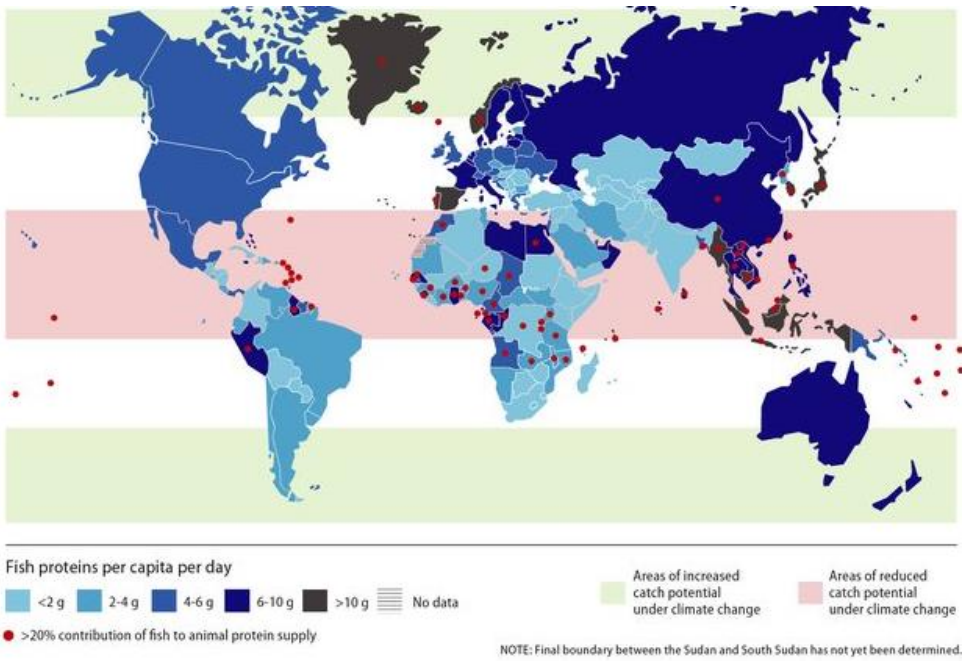

Fig. 1. Illustrating the global provision of animal protein, the map delineates the role of seafood in the supply chain [13]

essential fatty acids. They need to be added to the diet to fulfill the requirements for better growth and development. [16]. Lean fish, such as cod, haddock and pike, contain relatively lower levels of these compounds compared to moderately fatty fish like halibut, catfish and tuna, as well as fatty fish such as herring, mackerel, trout, salmon, and eel [17].

The commendable nutritional profile of fish excels in its protein and healthy fat content and extends to an array of essential micronutrients. Notably, fish is particularly abundant in iodine, selenium, calcium, iron, zinc, vitamin D, A and B12 (Fig. 3). However, the nutrient composition varies among distinct fish species and even within the same species, nutritional quality fluctuates depending on factors such as environment and seasons [18].

4. ADDRESSING MALNUTRITION THROUGH FISH NUTRITION

Malnutrition, a considerable worldwide health concern, can be proficiently tackled by including fish in dietary regimens. Fish, being a nutrient-rich dietary option, offers indispensable proteins, vitamins, minerals, and omega-3 fatty acids. These components are pivotal for fostering optimal growth, cognitive maturation and fortifying the immune system in children [19,20] The fish should be added to the diet in a cooked state to ensure nutrient retention for undernourished children. It has the potential to alleviate protein and nutrient insufficiencies, leading to enhanced weight gain and improved holistic health [21]. The Odisha state government launched a pilot program to introduce fish and fish-based products into the Supplementary Nutrition Programme (SNP) in Anganwadi centers for children, nursing, pregnant women, and adolescent girls to reduce malnutrition among vulnerable populations [22] Moreover, the exceptional digestibility of fish protein renders it well-suited for the delicate digestive systems of children. Omega-3 fatty acids, notably DHA and EPA, are linked to improved cognitive performance and visual aspects of considerable significance in the initial stages of childhood [23,24].

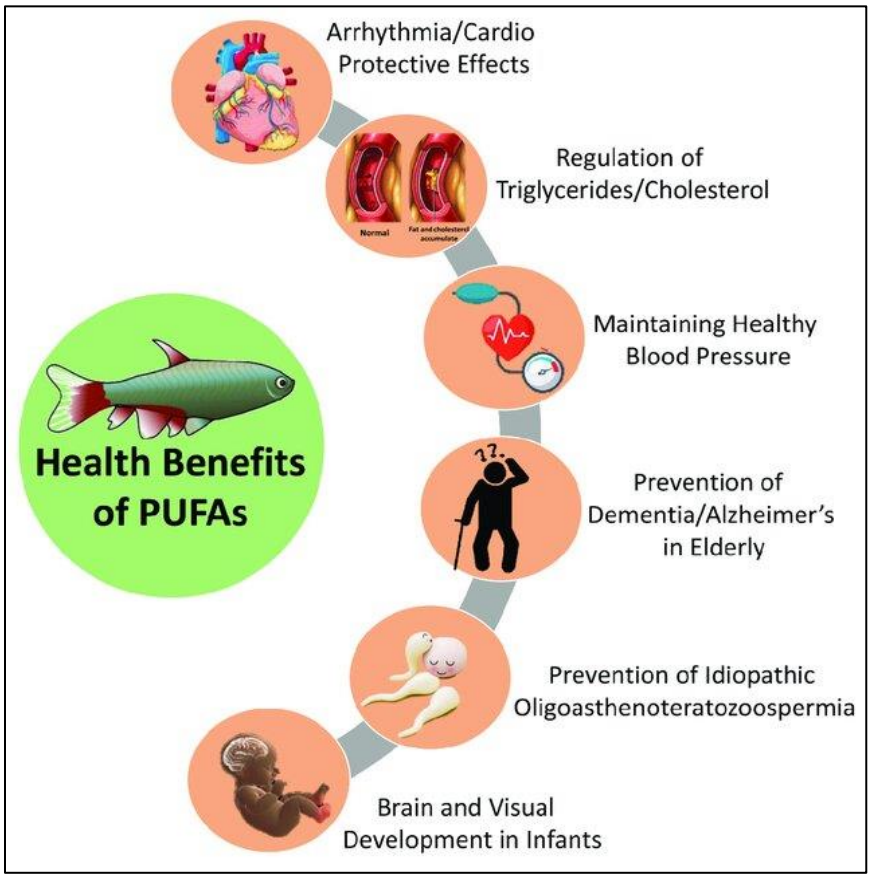

Fig. 2. General PUFAs health benefits [25]

Pregnant and lactating mothers necessitate augmented nutrient consumption to facilitate the growth and maturation of their children (Fig. 4) [26]. Fish like mackerel, salmon, and sardines are rich sources of vital nutrients such as docosahexaenoic acid (DHA), contributing to the advancement of fetal brain and visual growth [27]. Furthermore, the fish protein facilitates tissue regeneration and augmentation, catering to the escalated demands of gestation and lactation [28].

Adding fish to dietary patterns can have a profound impact in areas with high malnutrition rates. The inclusion of fish in diets has the potential to mitigate undernutrition by supplying essential nutrients that are frequently deficient. This, in turn, can contribute to enhanced maternal well-being and improved birthing results. Nevertheless, ensuring the safety of fish consumption is crucial due to the potential presence of detrimental levels of mercury and pollutants in certain fish species. To overcome this, avoid eating banned species, which are typically cultured or harvested from wastewater and have a high chances of accumulating heavy metals in their bodies, such as the African catfish, *Clarias gariepinus* [29].

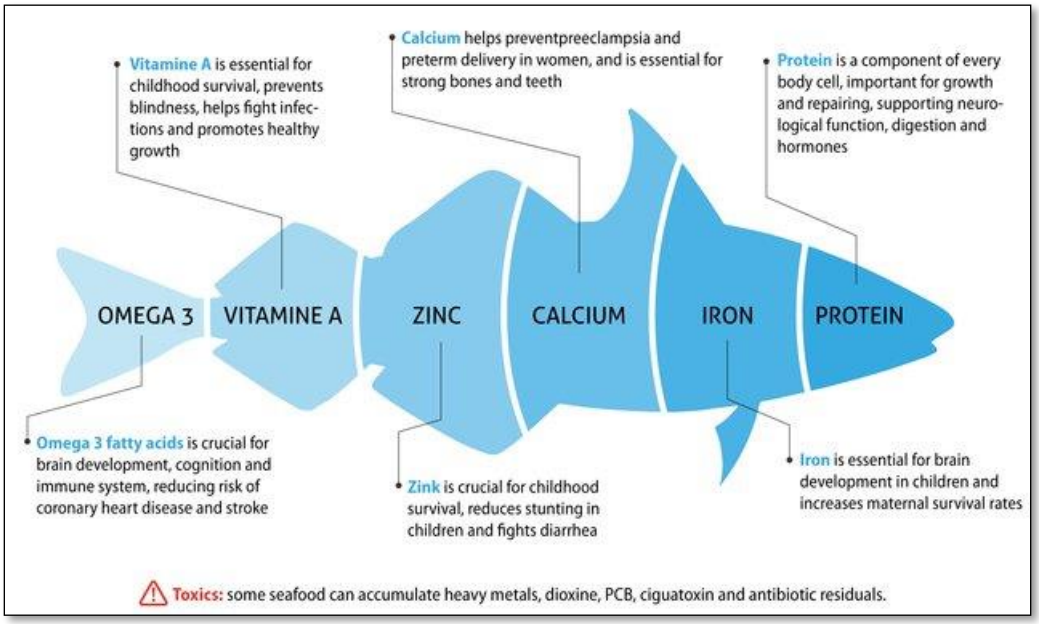

Fig. 3. Illustrating benefits of fish in human nutrition [30]

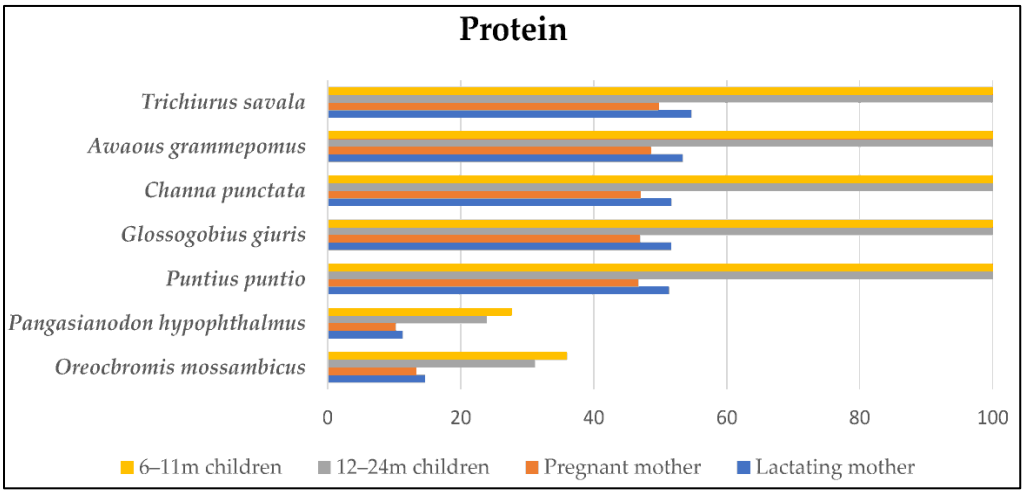

Fig. 4. Potential contribution (%) of dry fishes to the recommended nutrient intake (RNI) of protein for children and pregnant and lactating women [31]

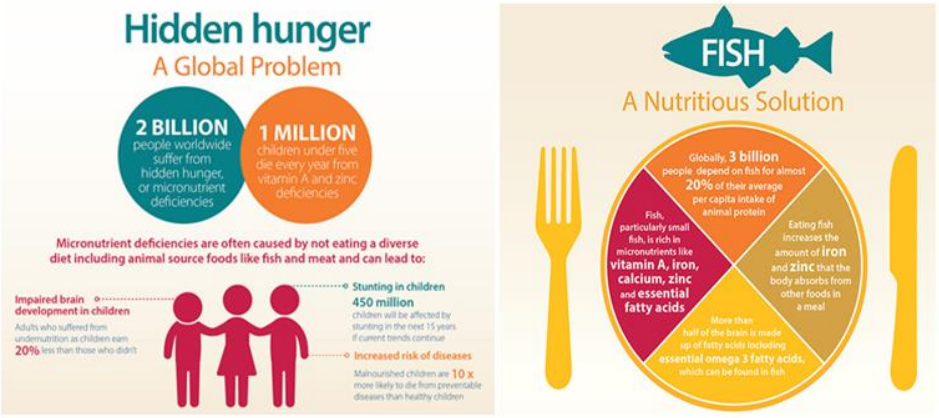

Fig. 5. Challenges and considerations
(Source: Worldfishcenter)

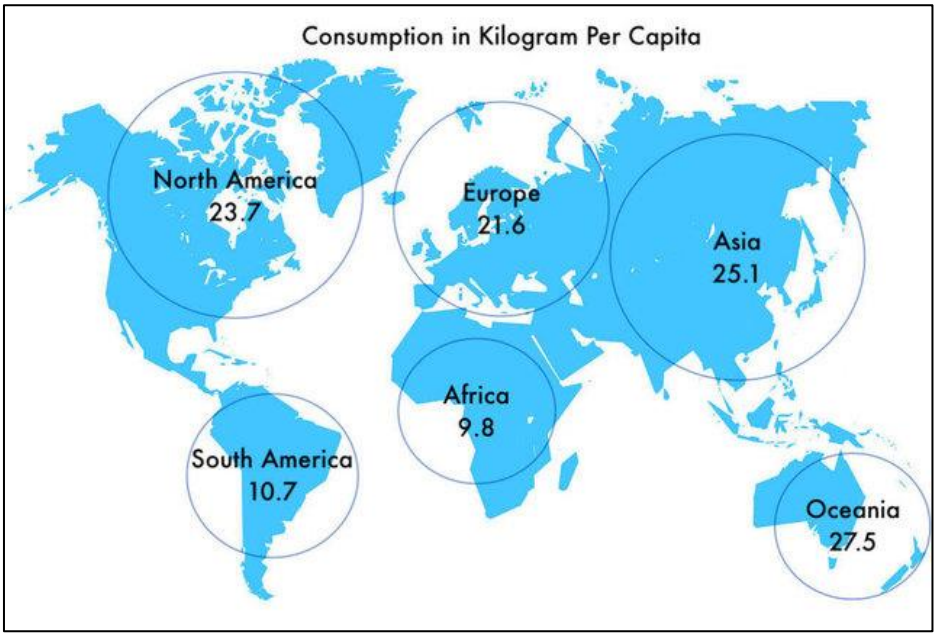

Fig. 6. World per capita fish consumption [32]

5. NUTRITIONAL SECURITY AND SUSTAINABILITY

Acknowledging the nutritional potential of fish in mitigating malnutrition necessitates a comprehensive assessment of the wider ramifications associated with heightened fish consumption. The imperative lies in upholding sustainable fishing methodologies and effective aquaculture administration to guarantee the enduring accessibility of fish as a vital nutritional source (Tacon et al., 2009; Colombo et al., 2022). The depletion of fish populations, vanishing of habitats and pollution of the environment constitute challenges to the availability of fish and, consequently, to nutritional stability. Hence, a comprehensive strategy integrating sensible fisheries management and aquaculture methodologies is vital to attain nutritional objectives while conserving aquatic ecosystems effectively [33-36].

The consumption of fish provides significant nutritional advantages; the American Heart Association (2020), Strategic Impact Goals identified consumption of at least two 3.5-ounce servings per week of fish, preferably oily fish, as one of five key dietary metrics that characterize ideal cardiovascular health [37] Also, it is crucial

to recognize obstacles such as overfishing, environmental pollutants and problems related to accessibility. Ensuring the enduring availability of fish as a nutritional need the implementation of sustainable fishing methodologies and robust regulatory measures [38,39] Furthermore, it is imperative to undertake activities to enhance the affordability and availability of fish for marginalized populations. These initiatives are crucial in optimizing its effectiveness in addressing malnutrition [40]. Cultural inclinations and eating patterns exert notable influence. In areas where fish consumption lacks occurrence, advocating for its integration into diets mandates informative initiatives elucidating its nutritional advantages. Furthermore, the imperative to meticulously select and oversee sources arises due to potential heavy metal and pollutant infiltration in fish, notably prominent in specific larger species. The fish consumption per capita is lowest in Africa (9.08), which is the least-developed countries in the world and Asia is considered as the highest (25.1) fish consumption (Fig. 5) [41].

6. CONCLUSION

In summary, fish is valuable in tackling malnutrition due to its nutrient-dense constitution and concomitant physiological advantages. Investigating the inclusion of fish in dietary interventions and policy frameworks presents a propitious pathway for addressing worldwide malnutrition. Nevertheless, embracing a comprehensive methodology that incorporates principles of sustainability, attainability, and impartial dispensation is imperative to fully exploit the nutritional import of fish in enhancing collective well-being. Additional research is indispensable to elucidate the most advantageous amalgamation of piscine-cantered interventions into intricate programs designed to curtail malnutrition from various angles.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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