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# Nutritional Value and Associated Potentials Risks of Seafood Consumption

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## Short Communication

Seafood provides essential nutrients to the body. A study funded by CDC found that eating seafood for essential Omega-3 fatty acids can prevent 84,000 deaths each year [1-3]. According to a Harvard study [4], 3-ounce servings of fatty fish a week reduces the risk of dying from heart disease by nearly 40%. Eating 8 two servings of fish per week during pregnancy can improve baby's IQ, cognitive development, and eye health [5,6]. Older adults with the highest fish consumption live and average of 2.2 years longer [7]. But all these statements possess another side of the coin. Food-born poisoning, mercury-lead-arsenic-cadmium poisoning, exposure to polycyclic aromatic hydrocarbons (PAHs) raised the issue of safety with aberrant consumption of seafoods. Seafood choices that are very low in mercury include: salmon, sardines, pollock, flounders, cod, tilapia, shrimp, oysters, clams, scallops and crab. The U.S. Food and Drug Administration (FDA) and Environmental Protection Agency (EPA) have developed directions to help consumers minimize risks that could be associated with several pollutants (specially mercury) in seafood.

Global seafood trade nearly doubled in recent decades with demand steadily increasing, fueled by decreasing transportation costs, advances in preservation and processing technologies, and open trade policies and is now among the most highly traded commodities [8]. A nearly 40% of seafood consumed in the US is of domestic origin [9]. Fried seafood accounted for 1 in 5 seafood meals and 30% of total seafood calories in the US in 2005-14 [10]. The top species consumed in Mexico were: canned tuna, sunfish, shrimp, mullet, carp and school shark (constituted 60% of seafood intake) [11]. Seafood consumption is rising above 20.0 kilo per capita per year on a global average and over 22.0 kilo Europe [12]. Habitual intake of marine fish and seafood, such as microalgae, which are very rich in some chemical compounds, has been strongly associated with several benefits in human health [13]. Encouraging people to eat more seafood can offer a direct, cost-effective way of improving overall health outcomes [14]. Seafood contains functional components that are not present in terrestrial organisms. Seafood, such as fish, crustacean and molluscan shellfish, and echinoderms, provides in the edible part (*e.g.* filet, abdominal muscle) many nutritional components beneficial for the human diet like n-3 polyunsaturated long chain fatty acids (PUFAs), namely eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), essential elements such as selenium and iodine, high potassium and low sodium concentrations, and the vitamins D, A, E, and B(12), as well as taurine (2-aminoethanesulfonic

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acid) among others [15,16]. The Recommended Intake (RI) for EPA+DHA and was associated with a healthier lifestyle [17]. Furthermore, in a recent Norwegian epidemiological study, lean-fish consumption once a week or more was associated with decreased postprandial triacylglycerol (TAG) and increased high-density lipoprotein cholesterol (HDL-C) levels, and in men a decreased waist circumference and blood pressure were identified [18].

Øyen et al. [19] reported that intake of lean fish was associated with decreased risk of T2DM. Selenium (Se) content of sea fish reduces methylmercury (MeHg) toxicity [20]. Rimm et al. [21] concluded that 1 to 2 seafood meals per week be included to reduce the risk of congestive heart failure, coronary heart disease, ischemic stroke, and sudden cardiac death, especially when seafood replaces the intake of less healthy foods. Also, Zhao et al. [22] concluded that fish consumption was associated with a decreased risk of stroke. The PUFAs particularly concentrate in the nervous system, alter immune system function reduce serum triglyceride levels and have been reported to reduce the risk of sudden death after a myocardial infarction [23]. Several meta-analyses have evaluated the beneficial role of LC ω-3 PUFA supplementation in several mental disorders such as bipolar disorder, schizophrenia, or depression [24]. Yang et al. [25] further stated a modest inverse association between fish or omega-3 fatty acid intake and risk of depression, especially in women. Greater consumption of fish is associated with a lower risk of dementia [26]. Weight-loss diet including oily fish resulted in greater TG reduction than did a diet without fish or fish oil [27]. A high intake of fatty seafood increases circulating levels of the insulin-sensitizing hormone adiponectin, whose blood concentration is reduced in obesity and T2DM [28,29]. Increased intake of protein from meats, chicken with skin and regular cheese was associated with weight gain but increased intake of seafood together with peanut butter, walnuts, other nuts, chicken without skin, yogurt and low-fat cheese was associated with weight reduction [30]. A frequent intake of lean seafood, as compared with intake of terrestrial meats, reduces energy intake typically in the range of 4-9% [29]. Bodybuilders traditionally have chosen many types of seafood (scallops, shrimp, crab, haddock, cod, pollack, snapper, halibut and white tuna) as their prime sources of fairly-digesting protein [31,32]. Adding more seafood to the diet could help get couples' sex lives, and even their fertility. Research suggests that seafood intake might affect semen quality, ovulation or embryo quality [33]. Greater male and female seafood intake were associated with a higher sexual intercourse frequency (SIF) and fecundity among a large prospective cohort of couples attempting pregnancy [34]. In the Norwegian Mother and Child Cohort Study, seafood intake was positively associated with birth weight [35]. However, with the increase in the demand for fish and seafood, aquaculture production is increasing, which could lead to new risks that will need to be addressed in the future to control foodborne pathogens. Fresh fish and seafood are highly perishable, and microbiological spoilage is one of the important factors that limit their shelf life and safety. Fresh seafood can be contaminated at any point from rearing or harvesting to processing to transport or due to cross-contamination by consumer mishandling at home [36].

In response to the BP oil spill of 2010, US FDA warranted risk criteria to protect vulnerable populations from exposure to PAHs through seafood consumption (FDA 2010a) [37]. Most fish have at least some degree of chemical contamination with methylmercury, (which binds to muscle) and/or with persistent organic pollutants such as dioxins, polychlorinated biphenyls, polybrominated diphenyl ethers, chlorinated pesticides (which concentrate in fish fat) [23]. Higher MeHg risk was associated with blue shark and boiled and grilled tuna consumption. For tuna, however, high Se content after boiling and grilling may mitigate MeHg risk [20]. It was suggested that the most at risk group are women of childbearing age and children who should keep mercury intake below 0.2 ug/kg body weight per day [38]. Rahmani et al. [39] concluded canned tuna fish consumed in Iran has not at non-carcinogenic risk but has a carcinogenic risk due to arsenic (As). In North Sea and Port Açu (Brazil) coastal areas, high arsenic (As) concentrations were observed in water, soil and sediments. Lifetime Cancer Risk values at the actual global seafood consumption rate of 54 g day-1 are above 10-4 for whelks, scallops, dogfish, ray and lemon sole

[40]. A 2-fold increase in fecal trimethylamine (trimethylamine N-oxide, TMAO, a canonical metabolite from gut flora, has been related to the risk of cardiovascular disorders) excretion was observed after the lean-seafood diet period [41]. TMAO levels were highly associated with diabetes in CHD patients [42]. Data for 2015 estimate EU mollusc production at approximately 879,000 tones with 629,000 tones (72%) farmed and the remaining 250,000 tones (28%) wild-caught. Molluscs comprise approximately 11% of EU seafood consumption. Mussels are the most consumed mollusc species by EU consumers, followed by scallops and then clams. The EU provides comprehensive regulations covering various general food safety aspects to manage the risk of contamination in shellfish farms [43]. Microalgal species growing in marine and aquaculture environments can be responsible for harmful events because of their ability to produce potent natural toxins that can accumulate in edible mollusc species. Their consumption can cause severe illness and even be lethal [44]. A paralytic shellfish poisoning (PSP) event in New England caused estimated losses of $12 to $20 million in Massachusetts alone, with additional losses in New Hampshire and Maine. Continual PSP intoxication in Alaskan shellfish was estimated to be worth $6 million annually [45]. Okadaic acid, azaspiracid, pectenotoxin, gymnodimine, and spirolide - all these toxins were present in most coastal areas of China at almost all times of the year, which shows that they are a major potential threat to human health [46]. In general, hydrophilic toxins (domoic acid, paralytic shellfish poisoning toxins and tetrodotoxins) showed higher bio-accessibility than lipophilic ones (okadaic acid and azaspiracids). The bio-accessibility of toxins from the okadaic acid group ranged from 69% (raw European razor clams) to 74% (raw donax clams). Regarding azaspiracids, 47% of the initial content was bio-accessible in steamed blue mussel. As for hydrophilic toxins, 100% of the initial content was bio-accessible after digestion in raw shellfish and puffer fish gonads [47]. There is, however, a rising concern over the vulnerability of seafood supply chains to species mis-labelling and fraud. DNA methods have been widely used to detect species mis-labelling and a recent meta-analysis of 4500 seafood product tests from 51 publications found an average of 30% were not the species stated on the label or menu [48]. Although, studies are concentrated in North America, Europe, and Asia. Elsewhere, including countries in the Middle East and North Africa, studies of this sort are scarce [49]. Over time, plastic particles contaminate the marine ecosystem and the food chain, including foodstuffs intended for human consumption [50]. Global seafood trade in 2016 was $132.6 billion, and over 90% of US seafood was imported from geographic regions with significant waste leakage and pelagic plastic pollution [51]. Humans can be exposed to microplastics through the consumption of seafood, can cause histopathological changes and may affect growth, the reproduction system, and behavior [52]. Ergonomic and safety solutions should be implemented to prevent musculoskeletal injuries/illnesses in seafood processing [53]. In the UK, pregnant women are recommended to consume no more than two 140 g portions of fatty fish per week [54]. Although, Amezcua et al. [55] concluded that an average seafood intake of at least 29 g/day during pregnancy, equivalent to 2-3 servings/week, reduced the risk of n small for gestational age (SGA) newborn, compared with an average seafood intake of less than 8 g/day. The carcinogenic risk (CR) index indicated that Cd and Pb in the muscles of selected shellfish (*Portunus reticulatus, Portunus segnis, Portunus sanguinolentus, Scylla olivaceae, Penaeus monodon,* and *Penaeus indicus*) species caused the greatest cancer risk [56]. Anisakiasis (fish-borne parasitic disease caused by consumption of raw or undercooked fish) from herring, cod, squid, mackerel consumption is common in countries with high-fish consumption, such as Japan (20,000 cases are reported annually) [57]. Ciguatera Fish Poisoning (CFP) is the most frequently reported seafood-toxin illness in the world. CFP is not due to the mishandling of fish and is not prevented by any particular storage, preparation, or cooking methods [58]. So many issues of the same is discussed in many articles in PubMed, ALTAVISTA, Embase, Scopus, Web of Science, and the Cochrane Central Register. At the end, lean fish should be included in the diet when targeting the modifiable risk factors that are comprised in metabolic syndrome [59]. Seafood is an easily perishable food due to its chemical

composition. Immediately after harvest, changes in odor, taste, and texture in fishery products can be noticed. For this reason, measures to protect the product must be taken immediately after harvest or catching [60]. Ocean acidification and warming may threaten future seafood production, safety and quality by negatively impacting the fitness of marine species. Identifying changes in nutritional quality, as well as species most at risk, is crucial if societies are to secure food production [61].

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