

Disorders caused by contaminated fish meat consumption: Literature review

Doenças causadas por consumo de carne de peixe contaminada: Revisão de literatura

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Sônia dos Santos Toriani

Post-graduation Program in Health and Environment, University of Joinville Region – UNIVILLE, Joinville, SC, Brazil.
E-mail: soniatorani.nutri@gmail.com

Eduardo Manoel Pereira

Department of Pharmacy, University of Joinville Region – UNIVILLE, Joinville, SC, Brazil.

Daniela Delwing-de Lima

Post-graduation Program in Health and Environment, University of Joinville Region – UNIVILLE, Joinville, SC, Brazil.

Therezinha Maria Novais de Oliveira

Post-graduation Program in Health and Environment, University of Joinville Region – UNIVILLE, Joinville, SC, Brazil.

ABSTRACT

Between 2007 and 2017, Brazil registered 99,826 outbreaks of foodborne diseases and 0.84% of those were associated with fish meat intake. It is estimated that approximately 56 million infection cases occur worldwide due to raw or undercooked fish meat containing several disease-causing parasites. Hence, this study aimed to review the literature concerning diseases caused by ingestion of contaminated fish meat. Reviews, case reports and epidemiologic studies were searched in Portuguese, Spanish and English in the databases LILACS, Pubmed, Science Direct, SciElo and Scholar Google using as keywords: transmissible diseases, contaminated fish and human infections were used to retrieve papers from 2014 to 2020. Nine papers, including seven reviews, one case report and one case-control study fulfilled inclusion criteria and presented several consequences of contaminated raw or undercooked fish meat ingestion, which ranged from nematode, bacterial and toxin diseases that may cause gastrointestinal problems to allergic reactions, lung infection, endemic acute myalgia, bacteremia, meningitis and death. Growing fish meat intake in several dishes presents significant health risk due to the pathogenic potential of toxins and parasites that remain when food is consumed raw or undercooked. Tighter sanitary surveillance, population health education, training and sensitization of health professionals in recognizing and notifying cases might contribute to minimize risk.

Keywords: fish, fish meat, infectious diseases, transmissible diseases, food and nutrition safety, food safety.

RESUMO

Entre 2007 a 2017, foram notificados 99.826 mil surtos de doenças transmitidas por alimentos no Brasil. Destas, 0,84% foi associado à ingestão de pescados. Estima-se que, aproximadamente, 56 milhões de casos no mundo de infecções por consumo de pescados, crus ou mal cozidos, contendo vários parasitas capazes de provocar doenças. Por isso, o presente estudo objetivou revisar a literatura acerca dos dados notificados sobre doenças alimentares causadas por ingestão de carne de peixe contaminada. Foram utilizados os bancos de dados LILACS, MEDLINE, Science direct, Google acadêmico e Pubmed para busca de artigos publicados partir de 2014 utilizando com palavras-chave: doenças transmitidas, peixes contaminados e infecções humanas em português, inglês e espanhol, sendo incluídos relatos de caso, revisões e estudos epidemiológicos. Nove artigos foram incluídos, sendo sete revisões, um relato de caso e um estudo caso-controle, que apresentaram as consequências do consumo de carne de peixe crua ou mal cozida no que tange a causalidade de várias infecções por nematódeos, bactérias e toxinas passíveis de provocar problemas gastrintestinais agudos, reações alérgicas, infecções pulmonares, mialgia aguda endêmica, bacteremia, meningite e óbito. O consumo crescente de carne de peixe crua ou mal cozida em diversas preparações oferece risco não desprezível para a saúde, devido ao potencial patogênico dos parasitas e toxinas encontrados neste alimento. Atuação mais incisiva da vigilância sanitária, educação em saúde da população para os riscos, capacitação dos profissionais de saúde e sensibilização para notificação dos casos podem contribuir para minimizar esses riscos.

Palavras-chave: peixe, doenças infecciosas, doenças transmissíveis, segurança alimentar e nutricional, inocuidade dos alimentos.

1 INTRODUCTION

Fish meat is an especially important food for health and should be included in people's daily meals at least twice a week. It is a food rich in A, E, D, B1, B2, B5, B6 and B9 vitamins; minerals such as calcium, phosphorus, sodium, potassium, manganese, copper, cobalt, zinc, iron, iodine and all the essential amino acids in balance (Food and Agriculture Organization of the United Nations, FAO, 2018).

However, for the nutritional contribution to be within the appropriate safety parameters, such source of animal protein must meet the consumers' food safety standards with the desired quality. Thereby, the sites where fishes breed and are grown must be free from contaminations, since they can be transferred to the human organism after ingestion in different degrees, depending on the quantity, consumption time and contamination level of such food, which may cause significant health problems such as predisposition to cancer, cardiovascular diseases and neurotoxicity (Fernandes *et al.*, 2012; Silva, Santos, 2016).

Because fish meat presents greater possibility for microbial growth, chemical changes and breakdown by endogenous enzymes, this food is subject to rapid

deterioration. Therefore, the way of conservation, handling, processing, preserving, storage and transportation, when not carried out in the appropriate manner, following the guidelines of food safety, may cause damaging effects for the consumer's health, and it justifies measures of quality control and respective special care (FAO, 2016).

Pathologies resulting from fish meat consumption may be caused by toxins produced by the fish itself, by toxic substances or microorganisms contained in contaminated water in which fish breed, deriving from degraded areas, and waste and garbage dump sites. Contaminants may be mainly bacteria of genus *Vibrio*, *Listeria*, *Clostridium*, also A type hepatitis virus A (HAV), adenovirus, Norwalk or norovirus (Magalhães, 2012).

In order to avoid consumers' exposure to diseases arising from ingested fish, food safety must be focused on the guaranty of the commercialized fish integrity, by means of systematic practice of the best procedures on handling employed by the fishing industry, thereby ensuring the product quality from catching to handling. However, once consumed raw, semi-raw or partially smoked, and when the appropriate measures of control and prevention are not taken, the consumption of this type of food may become a problem for public health (FAO, 2016). Aiming to know the main diseases transmitted by the consumption of contaminated fish, a literary review was performed on the cases of notified diseases caused by the consumption of fish meat.

2 METHODOLOGY

In this review, articles indexed in the following data bases were searched: Latin American and Caribbean Health Sciences Literature (LILACS), Science direct, Google scholar and Pubmed. The search was performed between May and June 2020 in the Portuguese, English and Spanish languages, using the keywords: transmitted diseases, contaminated fish and human infections. Articles which got off the subject and publications preceding 2014 were excluded. Type of studies included were: reviews, epidemiological studies, and confirmed notified case reports on diseases transmitted by the consumption of contaminated fish found in the indicated bases published from January 2014 to December 2020.

3 RESULTS

A total of 28 articles were found. Nonetheless, only nine fulfilled the inclusion criteria. The remaining articles were excluded for they did not match the issue of the review, for not providing information proving the infections by means of medical diagnosis with notification of disease caused by the consumption of contaminated fish, and a mycobacterial infection case

report was excluded because it was not a disease caused by ingestion, but by contact with contaminated fish. Among the works included, there are seven literature review, a case report, and a case-control study.

The review of Oliveira *et al.* (2017) focused on cases of diphyllbothriasis resulting from consumption of raw fish meat in preparations such as sushi and sashimi and reported 92 notified cases (68 in São Paulo state). The disease most prevalent symptoms were abdominal cramps, diarrhea and weakness. The epidemiological inquiry showed that salmon imported from Chile and consumed raw (sushi and sashimi) were the species responsible for the outbreak. Dias *et al.* (2016) described the condition of a 25-year-old female patient weighting 49 kg who reported nausea, abdominal pain, weight loss, epigastric pain, and continuous diarrhea due to consumption of semi-raw fish two month before the symptom's onset. The diagnosis of diphyllbothriasis was achieved two days after the first symptoms appeared due to evidence of *Diphyllbothrium latum* eggs.

The study of Serrano-Moliner, Noralez-Suares-Varela, Valero (2018) reviewed the cases of nematodiasis registered from 2000 to 2016 in countries of the European Union and found 1523 cases, which were 1493 autochthonous and 30 imported. Several parasites were detected, namely: *Toxocara* spp (34.7%), *Ascaris lumbricoides* (27.1%), *Trichinella* spp (21.9%), *Anisakis* spp (15.5%) and *Angiostrongylus cantonensis* (0.8%).

Guardone *et al.* (2018) reviewed the occurrence of anisakiasis in Italy and 73 cases were found. The parasite was detected by endoscopy (51.4%) and laparotomy (48.6%). Intestinal (42.5%), stomach (43.8%), esophageal (1.4%) and ectopic (peritoneum and spleen – 12.3%) infection sites were observed. In most of the patients the source of infection was raw or undercooked anchovy (65.7%), followed by sardine (15.1%) and generic raw seafood (15.1%). Dominant symptoms were acute or chronic abdominal pain, nausea and diarrhea (less frequent) within a week after the consumption of fish meat. Ten cases of allergic reaction were confirmed.

The review of Eiras *et al.* (2018) analyzed cases of nematodiasis notified in travelers returning to 22 countries and found 100 cases, involving *Gnathostoma* sp. as the most frequent (85 cases), *Capillaria philippinensis* (8), *Anisakis simplex* (6 cases) and *Angiostrongylus cantonensis* (1 case). Bravo and Gontijo (2018) reviewed the clinical characteristics of the presentation of gnathostomiasis, parasitosis associated to the consumption of raw or marinated fish meat in the form of sushi, sashimi or ceviche, which, although being endemic in Southeast Asia, Japan and Latin America, increased number of cases has been observed in travelers who returned to non-endemic areas (USA

and Europe), and increase of reports of autochthonous cases in non-endemic countries (Brazil and Colombia), suggesting that the distribution of the parasite may be broader than it is known. However, this study did not bring data on the prevalence of the cases.

Souza *et al.* (2015) reviewed scombrototoxicosis cases (severe case of histamine intoxication) and highlight the relevance of quality control of histamine concentration in the fish. Since 1970, countries with the greatest rates of cases are Japan, the United States, and the United Kingdom (Food and Drug Administration, FDA, 2011), however there were reports of outbreaks in several other countries such as France, Denmark, and Canada. Asia is the continent with the greatest number of cases described. In the continent, histamine intoxication was the biggest cause of diseases in the 1950's and, to this day, it is the largest cause of intoxications (Cinquina *et al.*, 2004). According to FDA (2011), from 1960 to 1980, there were 42 outbreaks described in Japan, totaling 4,122 intoxicated individuals.

Tan *et al.* (2016) conducted a case-control study in Singapore to investigate the association of the consumption of yusheng, a raw fish-based dish (bighead carp and snakehead) with an outbreak of group B streptococcal bacteremia serotype III ST-283 in 2015. In the comparison of 40 cases with 58 controls, odds ratio of 5.1 was found to this relation, suggesting close involvement with the consumption. Age older than 65, diabetes, and cardiovascular disease were also risk factor with significant odds ratio.

Marques, Costa, Bentes (2017) reviewed the clinical presentation of acute epidemic myalgia with a view to alert the medical community after an outbreak in Salvador (BA), Brazil in December 2016, in which, nine patients from three different families presented in hospital reporting widespread severe muscular pain which evolved to rhabdomyolysis. The outbreak spread rapidly and by January 24th, 2017 there were 64 suspected cases notified and two deaths. The intoxication after fish meat intake (Haff disease) was considered the most probable source of the outbreak.

4 DISCUSSION

Considering the increase in the consumption of fish meat worldwide and the range of diseases susceptible to be contracted by means of raw or undercooked fish meat consumption, few articles on the risks were found. However, they emphasize the importance of a more prudent look at such practice, considered the pathogenic potential of the parasites found in fish meat.

Diphyllobothriasis was a non-existing disease in Brazil, but in 2004 it caused an outbreak in São Paulo state due to consumption of salmon in the form of sushi and sashimi (Oliveira *et al.*, 2017). Diphyllobothriasis is also known as “fish tapeworm” disease, and it is a parasite zoonosis of broad geographical distribution, caused by the ingestion of fish infected with the *Diphyllobothrium spp* parasite larvae and consumed raw, undercooked, smoked in inappropriate temperatures or submitted to insufficient freezing, causing long-term intestinal parasitosis in human beings (Arrais *et al.*, 2017).

Toxocarosis was the most frequent parasitosis indicated in the Serrano-Moliner, Noralez-Suares-Varela, Valero (2018) study. It is an infection more common in pediatric population, occasioned by the intake of eggs present in the soil, contaminating most frequently children living in areas with poor sanitation system, who live together with pets and who practice geophagy (Mota *et al.*, 2016). The human being is, in fact, an accidental host and the contamination may also take place by intaking undercooked food. Since maturation of the larvae is not possible in the human gastrointestinal system, it provokes its migration to several tissues, bringing to local inflammation of variable severity caused by the disease (Mota *et al.*, 2016).

The occurrence of ascariasis was also relevant in the previous review, which is a parasitosis related to poor hygiene, and the most frequent human geohelminthiasis in countries in which there is no adequate sanitation. The main disease carriers are children aging from 1 to 12 year, who can be asymptomatic or present abdominal pain, nausea, anorexia and, when the infection is more intense, intestinal obstruction (Marquetti, Carlotto, 2019). The parasite larvae may infect the lungs and cause bronchospasm, pneumonitis, and hemoptysis (Marquetti, Carlotto, 2019).

Serrano-Moliner, Noralez-Suares-Varela, Valero (2018) and Guardone *et al.* (2018) identified several cases of anisakiasis, disease caused by the ingestion of larvae of Anisakidae family nematode present in raw, marinated or undercooked fish meat. The human being is an accidental host and the infection courses with clinical picture marked by acute gastrointestinal symptomatology, though allergic reactions have also been observed (Aibinu, Smooker, Lopata, 2019). The authors emphasize high risk for those parasitoses and corresponding impact on public health and emphasize that the low number of notified cases conflicts with the frequent occurrence of such parasite in a broad range of Mediterranean fish, including those consumed marinated or raw, suggesting the human infections are underestimated, partly due to the fact that they are self-limited,

underreported, and diagnosed inappropriately because of little knowledge on human parasitology linked to seafood by the physicians.

However, in terms of impact on public health, *Trichinella* spp was the most important parasite found in the Serrano-Moliner, Noralez-Suares-Varela, Valero (2018) review because it may cause overly aggressive clinical picture liable to cause death. Trichinellosis is acquired by the ingestion of wildlife species undercooked meat (game meat) containing cysts with larvae of the respective nematode and their wild hostess include wild boar, bears and walruses (McIntyre *et al.*, 2007). The infection intensity is proportional to the number of larvae, assuming acute gastrointestinal symptomatic presentation, but it can evolve to striated muscles, pulmonary, cardiac, cerebral, and meningeal infection according to the parasites that infect those tissues, and it can evolve to death (McIntyre *et al.*, 2007). *Angiostrongylus cantonensis* was the least found parasite, however it is responsible for causing eosinophilic meningitis (Espírito-Santo *et al.*, 2013), therefore the risk of contamination by such parasite is not negligible.

Eiras *et al.* (2018) and Bravo and Gontijo (2018) studies highlight the gnathostomiasis as another parasitic nematodiasis acquired by the consumption of raw or undercooked fish meat containing the tertiary infective larvae. Some people may be infected by the intake of live fish, such as loaches, consumed in such way associated with whiskey or rice wine in Japan (Eiras *et al.*, 2018). Drinking water containing crustaceans (*Cyclops*) which act like intermediary hostess of larvae may also allow contamination (Subhedar *et al.*, 2014). The infection presents cutaneous symptoms (migratory nodular dermatitis or panniculitis), which oscillate in gravity and may have chronic course, however more severe complications may arise when deeper structure are invaded, such as lungs, mediastinum, eyes or central nervous system, because the parasite causes direct trauma injuries to the tissues and also by secretion of proteolytic and hemolytic compounds associated with tissue inflammation secondary to the intense eosinophilia (Bravo, Gontijo, 2018). The authors emphasize that few physicians who operate in non-endemic zone know those parasites, which results in difficulty to recognize the symptoms.

Intestinal capillariasis is rare, however it is a recognized nematodiasis arising by raw or undercooked fish meat ingestion due to high mortality aligned with delayed diagnosis and treatment, which frequently result in death because of protein loss by gastroenteropathy. Low incidence may be related to the fact that the endemic areas are farther from the most common tourism locations (Eiras *et al.*, 2018).

The formation of histamine in the fish and consequent risk for scombrototoxicosis motivate the traceability of that substrate, and it is an important quality criterium, since its levels are low in newly-captured fish and increase as they deteriorate, thereby indicating the fish freshness (Ntzimani *et al.*, 2008). Fish of families Scombridae (tuna, bonito, mackerel), Scomberesocidae (sand diver), Pomatomidae (bluefish), Coryphaenidae (common dolphinfish), Carangidae (yellowtail amberjack), Clupeidae (herring, sardine) and Engraulidae (anchovy) are the most involved in cases of scombrototoxicosis (Souza *et al.*, 2015), which present face and neck flushing, followed by a sensation of intense heat, face and neck rashes, general discomfort, diarrhea, intense and throbbing headache. Other signals include vertigo, pruritus, fainting spells, mouth and throat burning sensation and dysphagia (González *et al.*, 2020).

Souza *et al.* (2015) did not find official data on the occurrence of intoxication by histamine in Brazil and emphasize that many cases are not notified because it is not a disease with obligatory notification. In addition, intoxication symptoms may be mild and may not motivate the search for specialized care and the physicians, which, frequently, are unaware of the intoxication, which minimizes its consideration as diagnosis. Authors emphasize Evangelista's work (2010), who described the detection of histamine in scombrid related to three intoxication outbreaks involving tuna in the northeast region which affected a total of 25 people.

Apart from the previous complications, the finding of positive association between the consumption of yusheng and group B streptococcal bacteremia impresses by its gravity related to consumption of raw fish meat, which far exceeds the other clinical presentations described previously. The fact that the number of weekly cases dropped from 26 to only 5 after public health alert to interrupt the sale of raw fish-based dishes prepared with bighead carp and snakehead corroborates with the finding in the case-control study (Tan *et al.*, 2016).

The endemic acute myalgia outbreak, described by Marques, Costa, Bentes (2017) associated with consumption of raw or undercooked fish was characterized by short period of time between the emergence of myalgia and the exposition among affected family members, suggesting viral etiology or simultaneous exposure to a toxin. Despite both hypotheses have been investigated, Haff disease was taken as probable final cause of the outbreak. Rhabdomyolysis associated to Haff disease is considered an emerging disease, due to the increase in the consumption of fish meat and other freshwater crustaceans, and it is attributed to a toxin (unidentified), due to the rapid

evolution and absence of fever (Júnior *et al.*, 2016). Rhabdomyolysis evolves with muscle necrosis which liberates the protein myoglobin to the circulation and may cause rapid renal failure (Marques, Costa, Bentes, 2017). Haff disease and all rhabdomyolysis cases must be aggressively treated for prevention of severe metabolic and renal effects, which may lead to acute renal failure and other causes of morbimortality (Júnior *et al.*, 2016).

It is a basic human right to live in food security condition (Brasil, 2007), that guarantees to everybody regular and permanent access to quality food, in sufficient amount and based on health-promoting eating habits and which are socially, economically and environmentally sustainable (Brasil, 2013). Therefore, fish coming from aquaculture and fishing must meet the quality desired by the industry and the consumers by means of quality control in all phases of the production chain (collection, handling, conservation and preparation) (Brasil, 2013). The whole productive sector involved in the production of fish meat must actively participate in the public policies that guide the quality of this food due to its nutritional importance and to guarantee their safety (Cribb, Filho, Mello, 2018).

In view of the several risks linked to the consumption of raw or undercooked fish meat, ranging from gastrointestinal problems to allergic reactions and death, it is indispensable that the best practices for fishing, handling, preserving and cooking fish meat are adopted. Since it contains more water and less muscle fiber, fish meat is more susceptible to deterioration and contamination by several microorganisms such as virus, bacteria and worms, which may cause serious problems to human health. Therefore, for a safe fish consumption aiming to prevent these infections, such food must be apparently healthy, clean and be prepared with filtered water and well cooked.

Tighter action of the sanitary surveillance to audit the applying of the procedures of contaminants control, encouragement of notification of cases by healthcare professionals, and guidelines on safer ways of consuming fish meat to the population, emphasizing the risks of ingestion of raw or undercooked food will contribute to minimize the incidence of complications.

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DECLARATION OF INTEREST

The authors declare no conflicts of interest.

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