



Anisakis allergy: unjustified social alarm versus healthy diet

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Dear Editor,

We read with interest, but some consternation, the recent publication “World-wide prevalence of *Anisakis* larvae in fish and its relationship to human allergic anisakiasis: a systematic review” by A. R. Rahmati et al. (2020).

A recent review by Mattiucci et al. (2018) has already demonstrated patterns of distribution of anisakid nematodes in different regions of the world. Therefore, the attempt of matching *Anisakis* infection levels by geographic areas with the risk of disease, and even searching for hot spots, appears to be an intangible exercise. Unfortunately, and analogically to many other fields in science, there is no simple linear association between certain events, in this case the prevalence of anisakids in fish and the prevalence of human anisakiasis.

Relevant intermediate factors contributing to *Anisakis*-associated disease are not only weekly or monthly fish consumption rates, or which fish species that are most frequently consumed. Exposure to live anisakids in different populations is highly biased by several other factors: Firstly, fish infection rates do not directly translate to the exposure level of consumers in given geographic areas since globalization has strongly facilitated intercontinental trade with seafood including fresh fish. Secondly, anisakiasis is highly associated with fish-eating habits rather than per capita fish consumption rates. In this respect, the history of the first description of this zoonosis and its clinical forms is very illustrative since it was shown that only lightly processed fish (herring) was the source of exposure to the parasite (van Thiel et al. 1960).

Consequently, the so-called freezing requirement was implemented in the international legislation on food safety concerning fish (EC 2004, FAO, Codex alimentarius 2004). The leading Japanese research experience on gastric and intestinal anisakiasis is not coincidental but closely associated with the frequent consumption of raw fish in the country (Yamamoto et al. 2020). However, Rahmati et al. (2020) identify Japan as a cold spot for *Anisakis* prevalence, which illustrates well that other factors not considered by the authors are apparently more important for translating anisakid infection rates in fish to the risk of anisakiasis, and that the proposed algorithm for risk estimation does not fit the epidemiological reality. For example, Norway being identified as allergic anisakiasis hot spot in the study has no traditional food habits that involve raw or only lightly processed fish. Previous studies indicated indeed very low prevalence (<2%) of *Anisakis* sensitization in a Norwegian population (Lin et al. 2014). The latter publications, which must have come to the authors' attention when searching the literature, strongly contrast their postulate that Norway has a human allergy rate to *Anisakis* of 18.4–22.5%, but were nevertheless ignored.

However, we are even more concerned about the methodology and interpretation of how the supposed *Anisakis* allergy hot spots were identified. Rahmati et al. (2020) do not provide any information about the references used for data collection, nor about the criteria that led the authors to postulate hot spots. It is already well known that sensitization (i.e., presence of specific IgE against *Anisakis* as measured in serum or by skin-prick test) is not to be interpreted as “allergy”. After assessing possible false positives through cross-reactivity, sensitization should be interpreted as a marker of previous contact with a live parasite in the context of an evolutionarily conserved immune reaction. Clinically, these patients can behave without symptoms (subclinically), with gastric (or intestinal) anisakiasis, sometimes accompanied by allergic features (gastro-allergic anisakiasis). Thus, when analysing data on the possible relationship between fish consumption rates, *Anisakis* infection levels in fish, and allergy associated with *Anisakis*, it is essential not to mix up sensitization prevalence and clinical data.

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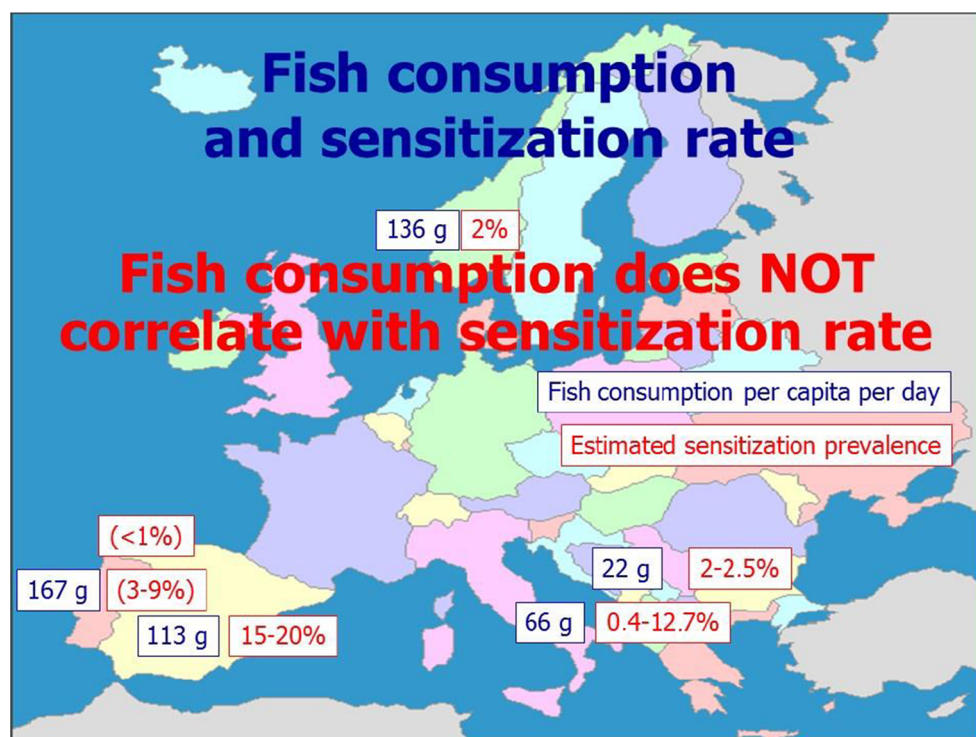
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Fig. 1 Fish consumption and sensitization rate



Recent publications have already given numbers to the risk of anisakiasis, and even associated allergic features, with solid epidemiological data (Bao et al. 2017; Herrador et al. 2019). For every population or region, the prevalence of IgE antibodies against *Anisakis* could be a measure to assess the true exposure to *Anisakis* in its live and potentially invasive stage. In fact, a recent analysis comparing fish consumption with *Anisakis* sensitization rates concluded that “fish consumption per se is not the main risk factor for sensitization” (Daschner and Cuéllar 2020). As shown in Fig. 1, the least correlation was found for Norway with a very high per capita fish consumption rate but very low prevalence of IgE against *Anisakis*, not to mention virtually absent clinical manifestation of allergy to the parasite, which strongly opposes the results of Rahmati et al. (2020). Indeed, a study more than a decade ago already showed that the *Anisakis* sensitization rate in different regions of Spain is associated with raw fish-eating habits rather than the general fish consumption rate (Puente et al. 2008).

Research on parasites in fish is important since time trends as well as geographic distribution patterns of various parasites provide important knowledge to prevent fish-borne diseases and to maintain healthy fish stocks. It is inherent to research that analytic results and reality are not necessarily the same. A big concern of surveys on fish epidemiology and anisakiasis is the lack of data in some parts of the world with high (even raw) fish intake, which can lead to bias in how disease hot spots are identified. However, our main concern is still the (ir)responsibility of claiming unvalidated *Anisakis* allergy hot spots, as if *Anisakis* was a hidden allergen, potentially

prompting consumers to avoid eating wild or even cultured fish, although anisakiasis as well as gastro-allergic anisakiasis can be prevented by simple methods and recommendations which are laid down in the internationally recognized and widely implemented regulations (EC 2004, FAO, Codex alimentarius 2004).

Norway, Spain, and Japan are among the countries with highest life expectancies, and high fish consumption has been suggested to be a relevant factor in this respect (Daschner 2016). Therefore, world-wide efforts to promote fish as a healthy food resource should be balanced against the informative value of publishing dubious, unvalidated, or even erroneous *Anisakis* allergy postulates. Concern about *Anisakis* occurrence in fish is necessary. However, the dissemination of presumably false assumptions about associated, otherwise preventable allergy risk, as exemplified by the present study of Rahmati et al. (2020), is not in support of the efforts to implement a healthy fish-including diet among the general public worldwide.

References

- Bao M, Pierce GJ, Pascual S, González-Muñoz M, Mattiucci S, Mladineo I, Cipriani P, Bušelić I, Strachan NJC (2017) Assessing the risk of an emerging zoonosis of worldwide concern: anisakiasis. *Sci Rep* 7: 43699. <https://doi.org/10.1038/srep43699>
- Daschner A (2016) Risks and possible health effects of raw fish intake. In: Raatz SK, Bibus DM (eds) *Fish and fish oil in health and disease prevention*, Amsterdam, Elsevier/Academic Press, Amsterdam, pp 341–354

- Daschner A, Cuéllar C (2020) Progress in Anisakis allergy research: milestones and reversals. *Curr Treat Options Allergy* 7:457–470. <https://doi.org/10.1007/s40521-020-00273-9>
- EC (2004). Regulation (EC) No 853/2004 of the European Parliament and of the Council of 29 April 2004 laying down specific hygiene rules for food of animal origin. Official Journal of the European Union, 2004 (L 139/55), 151. Retrieved from <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:32004R0853>
- FAO, Codex alimentarius (2004). Codex stan 244–2004, Standard for salted Atlantic herring and salted sprat
- Herrador Z, Daschner A, Perteguer MJ, Benito A (2019) Epidemiological scenario of anisakidosis in Spain based on associated hospitalizations: the tip of the iceberg. *Clin Infect Dis* 69:69–76. <https://doi.org/10.1093/cid/ciy853>
- Lin AH, Nepstad I, Florvaag E, Egaas E, Van Do T (2014) An extended study of seroprevalence of anti-Anisakis simplex IgE antibodies in Norwegian blood donors. *Scand J Immunol* 79:61–67
- Mattiucci S, Cipriani P, Levsen A, Paoletti M, Nascetti G (2018) Molecular epidemiology of Anisakis and anisakiasis: an ecological and evolutionary road map. *Adv Parasitol* 99:93–263. <https://doi.org/10.1016/bs.apar.2017.12.001>
- Puente P, Anadón A, Roderó M, Romarís F, Ubeira F, Cuéllar C (2008) Anisakis simplex: the high prevalence in Madrid (Spain) and its relation with fish consumption. *Exp Parasitol* 118:271–274
- Rahmati AR, Kiani B, Afshari A, Moghaddas E, Williams M, Shamsi S (2020) World-wide prevalence of Anisakis larvae in fish and its relationship to human allergic anisakiasis: a systematic review. *Parasitol Res* 119:3585–3594. <https://doi.org/10.1007/s00436-020-06892-0>
- van Thiel P, Kuipers FC, Roskam RT (1960) A nematode parasitic to herring, causing acute abdominal syndromes in man. *Trop Geogr Med* 12:97–113
- Yamamoto K, Takahashi O, Kobayashi D (2020) Comparison of risk factors between human intestinal and gastric anisakiasis. *Parasitol Int* 75:102024. <https://doi.org/10.1016/j.parint.2019.102024>

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