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A preliminary report on the awareness and knowledge of seafood-borne parasitic diseases among medical doctors in Australia

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Abstract

Despite the increasing popularity of seafood in Australia and various reports of infection with transmissible parasites in Australian edible aquatic animals such as fish, the number of reported cases of human infections in the country is low. This raised the question that Australian medical doctors may not be fully aware of the presence of these parasites in Australia, which in turn can lead to misdiagnosis of infections. This also may lead to an underestimation of the risk seafood-borne parasites may pose to public health. This preliminary study was conducted to determine the awareness and level of knowledge among Australian medical practitioners in New South Wales, the most populated and multicultural state in Australia, about seafood-borne parasitic diseases. Medical doctors, both general practitioners and gastroenterologists, were surveyed through an anonymous questionnaire (n=376). Although the response rate was low at 11%, participants represented a diverse group in terms of gender, age, nationality and expertise. Despite several publications on occurrence of zoonotic parasites in Australian fish and other edible aquatic animals, and also in humans in the country, all respondents said no seafood-borne parasite had been reported as being seen within Australian or overseas practice. Although, due to low response rate, we are unable to confidently comment on the level of awareness, the findings of this study clearly suggest that further research is needed to investigate the extent of unawareness among Australian medical doctors about these highly important parasites. This was the first study in Australia aimed at assessing the level of awareness about seafood-borne parasites among medical practitioners.

Keywords: education, medical doctors, seafood-borne parasites

Medical research into the health benefits of regular consumption of seafood is plentiful. Australia's leading health research body, the National Health and Medical Research Council (NHMRC), strongly encourages Australians to eat more fish and less red meat. Hence, the demand for fish consumption in the country is high and it is sharply rising. Along with higher consumption of fish and seafood in general comes the emergence of seafood-borne diseases, including those due to parasites. It has been shown that wild-caught fish can be heavily infected with zoonotic parasites [1,2]. Australia is a multicultural country where 85% of the population lives within 50 km of the coast and seafood is available in many forms. Meals based on raw or undercooked fish have been known to cause infection in humans [3–5]; however, a critical review of these publications [6] suggested that Australian medical doctors may not be fully aware of seafood-borne parasitic diseases and their symptoms.

This prompted the present study to survey medical doctors to explore the level of knowledge about seafood-borne parasitic diseases among health professionals. The word ‘seafood’ in this context encompasses fish and shellfish products from marine and freshwater ecosystems that directly or indirectly (as feed) are meant for human consumption (https://www.britannica.com/topic/seafood). The research questions were whether doctors know about the most common seafood-borne parasites infecting humans and whether they considered seafood-borne parasite infections when diagnosing patients with a history of eating seafood. This was a preliminary study conducted in New South Wales, the state with the highest population in Australia. Anonymous questionnaires were mailed out to all gastroenterologists (GEs) in NSW who were listed in http://sah.org.au (n=220) and general practitioners (GPs) located in Wagga Wagga and coastal towns along the south coast of Australia (Ulladulla/Milton northern limit to Narooma-southern limit, n=156). Participation involved medical practitioners filling in a short questionnaire which had three sections, including section 1 to collect general profile data of the participant, such as the gender and age, followed by sections 2 and 3 which were designed specifically to address the aims of this research which was to assess the current knowledge about seafood-borne parasites among Australian medical doctors. Section 2 provided a scenario in which a family with the history of regularly consuming raw fish become ill and the actions taken by their medical practitioner followed by questions from the participants to seek their opinions about the course of the actions in the scenario. The scenario was based on a family cluster of disease associated with marked peripheral eosinophilia [7] in people with the history of regular raw seafood consumption (Figure 1). This was later critiqued [8] due to not considering differential diagnosis from anisakidosis, a disease with similar

symptoms common in seafood consumers worldwide. Section 3 asked participants specifically about seafood-borne parasites in Australia. Participants were asked to proceed to sections 2 and 3 in turn to avoid guessing the answers to the questions.

Section 2: Study questions

The following scenario has been prepared in two parts, A and B. Please read each part and answer the relevant questions:

Part A:

John (55 years old) and Helen (50 years old) have 2 children Andrew (18 years old) and Sarah (16 years old). The family's regular diet includes milk, yoghurt, bread, fruits (banana, orange and apple), cereals, salad, red meat, seafood, including sashimi, and chicken. No family member has travelled overseas or out of their urban environment in the last 2 years. There are no pets in the household, and no home-grown or local market food is consumed. One day John felt mild abdominal distension and pain, diarrhoea, nausea and vomiting. He went to see his GP.

1) If you were his medical practitioner, what would you do next? Please list your actions.

Part B:

John was referred to a diagnostic service and underwent blood and stool tests. The blood test showed a high eosinophil count. His stool test was positive for some protozoan parasites therefore the rest of the family were also referred to the diagnostic service despite showing no symptoms. The laboratory results for the whole family are shown below:

	John	Helen	Andrew	Sarah
Blood test:				
Absolute eosinophil (normal range)	10.9×10^9/L (0.03-0.60 x 10^9/L)	5.2×10^9/L (0.03-0.60 x 10^9/L)	0.9×10^9/L (0.03-0.60 x 10^9/L)	0.5×10^9/L (0.03-0.60 x 10^9/L)
WBC (normal range)	21.5×10^9/L (4.3-10.8 x 10^9/L)	12.4×10^9/L (4.3-10.8 x 10^9/L)	9.7×10^9/L (4.3-10.8 x 10^9/L)	6.6×10^9/L (4.3-10.8 x 10^9/L)
Blood film:	No blast cell	-	-	-
Stool test:				
	Blastocystis hominis *Endolimax nana* *Entamoeba hartmanni* *Diantamoeba fragilis* (high number)	*Blastocystis hominis* *Endolimax nana* *Diantamoeba fragilis* (high number)	*Diantamoeba fragilis*	Negative (repeated three times)
Bone marrow biopsy	No malignancy	-	-	
PCR test for *Diantamoeba fragilis*	Positive	Positive	Positive	Positive

Based on these results, the GP attributed the illness to *Diantamoeba fragilis* and treated the three cases with *D. fragilis* on microscopy with metronidazole (400 mg 3 times daily for 7 days), which resulted in subsequent fall in eosinophil counts and the complete resolution of John's symptoms.

2) Do you agree with the diagnosis and the action taken by the GP?

☐ Yes ☐ No

If no, 2.1) please suggest alternative diagnosis and course of action.

Section 3: Additional questions

3) What food-borne parasites have you come across in your patients? And how often?

While practicing within Australia? _____

_____

While practicing overseas? _____

_____

4) In your opinion, is there a considerable risk of being infected with **seafood** borne parasites in Australia?

☐ Yes

☐ No

☐ Not sure

5) Do you think wild caught fish are likely to be infected with parasites that can be transmitted to humans?

☐ Yes

☐ No

☐ Not sure

6) Can you list 3 zoonotic parasites commonly found in Australian seafood without the help of any resources? If yes, please list them below and read on. If no, this is the end of the survey and thank you.

Parasite 1: _____
Parasite 2: _____
Parasite 3: _____

7) Do you feel confident you would recognise the symptoms caused by the parasites you listed above? If so, please list them:

Parasite 1: _____
Parasite 2: _____
Parasite 3: _____

8) What specific diagnostic test would you recommend for the parasites you listed?

Parasite 1: _____
Parasite 2: _____
Parasite 3: _____

Figure 1. Sections 2 and 3 of the questionnaire sent to medical doctors in the present study.

Data were analysed using SPSS (version 24) software. Descriptive statistics were used and differences between groups were determined using Pearson's Chi-Square test (X^2) (or Fisher's Exact Test - FET) and Student's Independent T-Test. This study was approved by Charles Sturt University's (ethic approval number: 400/2016/31) and The University of Notre Dame Australia's Human Research Ethics Committees (ethic approval number: 016189S).

Questionnaires were received from 23 GPs and 17 GEs, an overall response rate of 11%. The majority of respondents were female (57.5%) with no significant difference between specialities (Table 1). Mean age of GEs was higher than for GPs (p=0.014) and GEs reported having more experience (in years) as a medical practitioner (p=0.008). Almost four times as many GPs were international medical graduates (IMGs) than GEs (43.5% vs 1.8%, p=0.030). While 77% of GPs did their general practice training in Australia, all GEs gained their fellowship in Australia (p=0.056). Overall, 57.5% of respondents had worked overseas, with no difference between specialties.

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Table 1: Demographic characteristics of participants

Characteristic	GP (n=23)	GE (n=17)	All (n=40)	Test-statistic	p-value
Age (years) [mean (SD)]	45.4 (10.1)	54.2 (11.3)	49.1 (11.4)	t(38)=-2.566	**0.014**
Age range (years)	30 - 62	38 - 80	30-80		
Female [n (%)]	15 (65.2)	8 (47.1)	23 (57.5)	X^2=1.319	0.251
Years as medical practitioner [mean (SD)]	18.9 (11.3)	29.5 (12.4)	23.4 (12.8)	t(38)=-2.814	**0.008**
IMG [n (%)]	10 (43.5)	2 (11.8)	12 (30.0)	X^2=4.682	**0.030**
Australian Fellowship/ general practice training [n (%)]	17 (77.3)	17 (100)	34 (87.2)	FET	0.056
Worked overseas [n (%)]	13 (56.5)	10 (58.8)	23 (57.5)	X2=0.021	0.884

GP - general practitioner; GE – gastroenterologist; IMG – international medical graduate

When asked what food-borne parasites practitioners had come across within Australian practice, less than two-thirds of respondents (61%) reported having seen a patient with a parasite and

a further 17% listed bacterial genera. Significantly more medical practitioners who had worked overseas could name a food-borne parasite than those who had not practiced overseas (82.6% vs 29.4%, X^2=11.526, p=0.001).

The three most commonly reported parasite genera that had been seen within Australia practice were *Giardia, Blastocystis* and *Dientamoeba* (Figure 2). Similar proportions of each species were seen by GEs and GPs. E*. verniculens*, pin worm, liver fluke and *Ascaris* had been seen in Australian practice, but not in overseas practice. While in overseas practice, the most commonly reported parasite genera were *Giardia* and *Entamoeba* (each seen by 9.8% of respondents) (Figure 2). *Cryptosporidium* was the only water-borne parasite mentioned in the survey. There was no difference between specialities. Three genera were seen in overseas practice but not in Australian practice, namely *Taenia, Trichinella* and hookworm.

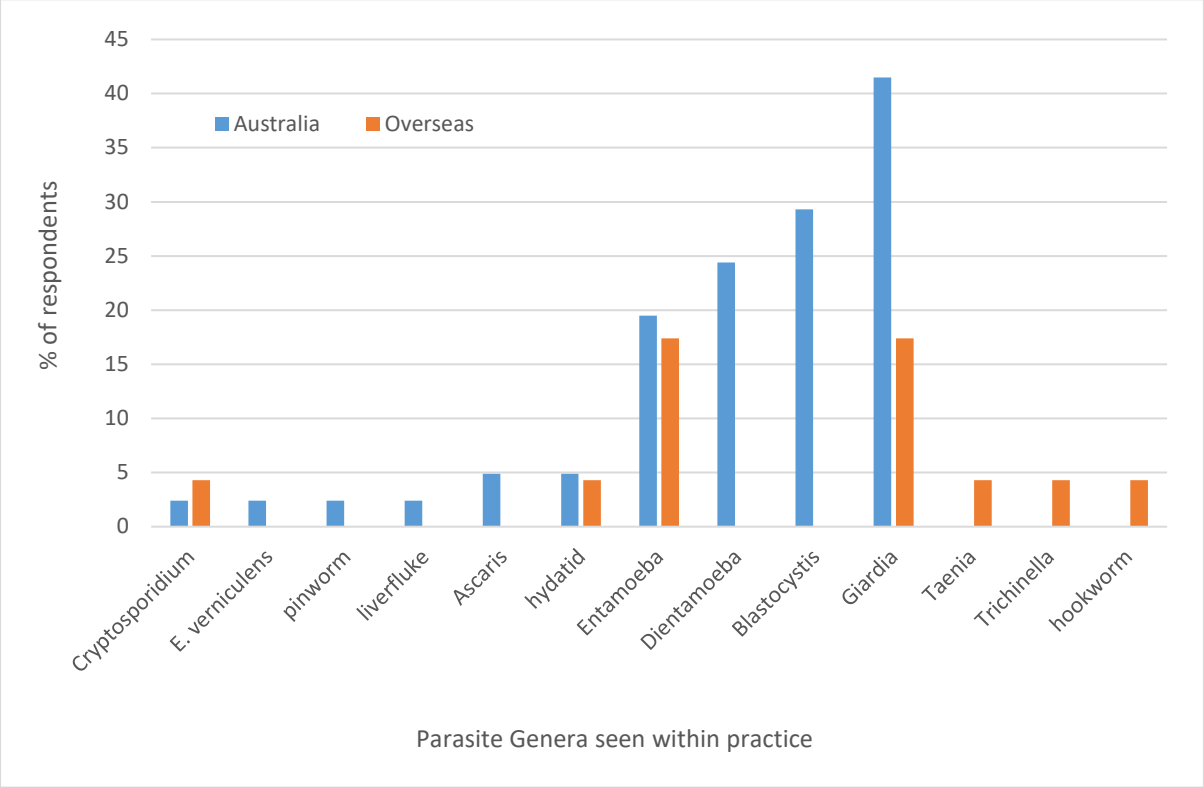

Figure 2. Proportion of respondents who reported seeing specific parasites within Australian and overseas practice [In this list the presence of parasites such as *Entamoeba, Dientamoeba* and *Giardia* among the most common reported/diagnosed parasites is interesting. None of these parasites are considered seafood-borne and can all occur in humans asymptomatically. If they cause symptoms, they may mimic symptoms caused by seafood-borne parasites such as anisakids.]

Participants were asked whether they could name three zoonotic parasites found in Australian seafood. Less than 10% (n=4) of respondents could name one seafood-borne parasite, with only one respondent able to list two genera. Respondents listed *Anisakid, Gnathostoma, Paragonimus* and *Diphyllobothrium* but reported none of these has been seen within Australian or overseas practice despite previous reports of these parasites in humans in Australia [6].

Overall, 15.4% of the respondents felt that there was a considerable risk of being infected with seafood-borne parasites in Australia, 33.3% were unsure, and the remaining 51.3% felt that there was no risk of infection. Although there was no difference between specialities, there was a difference in the perceived risk of infection with seafood-borne parasites in Australia between Australian medical graduates (AMGs) and IMGs (FET, p=0.013). While almost 42% of IMGs felt that there was a considerable risk of infection, only 3.8% of AMGs felt there was a risk. Only one quarter of respondents felt that wild caught fish were likely to be infected with parasites that can be transmitted to humans, a further 47.5% were unsure and 27.5% did not feel that transmission was likely. Means were similar between specialities and between AMGs and IMGs. There was no difference in perceived risk of infection with seafood-borne parasites in Australia between medical practitioners located in coastal regions versus inland regions.

This was the first study in Australia aimed at assessing the level of awareness about seafood-borne parasitic diseases among medical practitioners. Although the response rate was low, respondents were from a diverse background in terms of gender, expertise and overseas experience. The most important finding of this study was that none of the respondents considered regular consumption of seafood in regard to symptoms observed in the scenario provided, resulting in a differential diagnosis which did not include seafood-borne parasitic diseases as a possibility. This finding is similar to what Roser and Stensvold [8] from Statens Serum Institute, Copenhagen, Denmark raised about the possibility of misdiagnosis of seafood-borne parasitic diseases in Australia. A misdiagnosis may result in unnecessary actions. For example, symptoms of anisakidosis, a globally common seafood-borne parasitic disease, may mimic those caused by appendicitis and with gastric tumour [9] leading to unnecessary surgery [e.g., [10]], and use of anaesthetics, such as suxamethonium, which may have serious side effects, such as cardiac arrest, in some patients. Another implication of not being aware of zoonotic parasites in seafood has been under-reporting the human cases which, in turn, resulted in assuming no or low risk due to these parasites [11,12]. Therefore,

further investigation to determine the extent of the knowledge gap among Australian medical doctors is essential.

More importantly, the factor(s) behind the lack of awareness must be determined. There are sporadic publications that argued a decline in available taxonomic expertise, a shift in research funding toward other areas of medical research [6,13] and a significant decrease in the contact hours for medical parasitology teaching in the last decades across all Australian medical schools, with a shift toward teaching parasitology through a combined disciplinary and problem-based approach in the clinical semesters [14] may have contributed to the lower number of human cases due to seafood-borne parasites. These could be why significantly more medical practitioners who had worked and studied overseas could name a food-borne parasite than those who had not practiced overseas. This is an important finding which may further indicate some underlying issues with medical education in Australia and should be investigated further with more targeted studies.

Published literature also suggest that engagement between science and other stakeholders is in need of improvement. For example, based on their correspondence with the New South Wales Food Authority, a team of medical doctors were told no *Anisakidae* species were identified in the food chain through their surveillance activities [15], which suggests research outcomes on the occurrence and prevalence of a range of transmissible parasites in fish caught or sold in NSW [e.g., [1,2]] are overlooked by these authorities.

In conclusion, it is timely for both clinicians and pathologists to become aware of the spectrum of manifestations, the complications, and the epidemiology of these emerging parasites. A significant lack of knowledge combined with the lack of appropriate standard diagnostic techniques for various seafood-borne parasitic diseases in Australia may lead to these diseases to remaining unrecognised and under reported.

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