THE BARRIERS AND DRIVERS OF SEAFOOD CONSUMPTION IN AUSTRALIA: A NARRATIVE LITERATURE REVIEW

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ABSTRACT

Although seafood is considered to be an important part of a healthy and balanced diet, many Australians still do not consume the recommended amounts for good health. Fish is an excellent source of protein, omega-3 fatty acids and other nutrients, and studies have shown that seafood-rich diets can have a lower impact on the environment than diets high in other animal proteins. Concerns about health and sustainability have led to an increased interest in understanding consumers' attitudes towards seafood. This review aims to assess the current knowledge on drivers and barriers to seafood consumption in the Australian context. Systematic search strategies were used to identify relevant peer-reviewed journal articles from three electronic databases (SCOPUS, Web of Science and Science Direct) and grey literature reports from targeted government and industry websites. Accepted studies investigated drivers and/or barriers to seafood consumption in Australia through qualitative, quantitative or mixed method designs. Initial searches identified 504 publications from which fourteen met the criteria for the review process. The reviewed studies revealed that influences on seafood consumption in Australia are similar to those identified in other developed countries. The leading drivers of seafood consumption are health, taste and convenience, while the main barriers are price, availability, concerns about quality, and a lack of confidence in selecting and preparing seafood. Some possible intervention strategies targeted towards these factors are explored in the discussion. Future research should focus on designing and implementing specific interventions so that their effectiveness in increasing seafood consumption in Australia can be assessed.

INTRODUCTION

There is growing interest in understanding consumer attitudes towards seafood consumption due to concerns about food sustainability and health. While there has been extensive research into understanding barriers and drivers of seafood consumption in European countries (Bredahl and Grunert, 1997, Brunsø et al., 2009, Altintzoglou et al., 2010), it is only recently that researchers have examined these barriers in the Australian context.

Many consumers believe the Australian seafood industry to be unsustainable (FRDC, 2013). Although there are valid concerns over destructive fishing practices and overfishing in some global wild-capture fisheries, Australian fisheries are among the most sustainably managed in the world (Kearney, 2013, Pitcher et al., 2009). Much of the seafood consumed in Australia is imported (Ruello, 2011), with a growing proportion sourced from aquaculture, which now provides almost half of all fish for human consumption (FAO, 2014). In the context of the growing demand for food, wild-caught and farmed seafood can be an environmentally-friendly source of protein (Bene et al., 2015). Land use required for seafood production is low in comparison to other animal protein (Nijdam et al., 2012), as is the use of fresh water, pesticides and fertilisers. Seafood can also have a lower carbon footprint than other animal proteins (Nijdam et al., 2012, Scarborough et al., 2014). Tilman and Clark (2014) determined that a pescetarian diet has the potential to reduce global greenhouse gas (GHG) emissions from food production by 45% when compared with the projected average global omnivorous diet for the year 2050. This suggests that there is indeed a place for seafood as a significant protein source and that current consumption levels can be increased to meet recommended dietary guidelines as part of a sustainable and healthy diet.

Regular consumers of fish tend to have lower risks of numerous health conditions, including cardiovascular disease, stroke and dementia (Weichselbaum et al., 2013, NHMRC, 2013, Larsson and Orsini, 2011). These conditions present a serious health burden in Australia which is set to increase as the population ages (AIHW, 2014). Seafood is the best dietary source of long-chain omega-3 polyunsaturated fatty acids which have been linked to a range of health benefits (Nestel et al., 2015, Deckelbaum and Torrejon, 2012). In order to achieve these health benefits, the Australian Dietary Guidelines (NHMRC, 2013) recommend that adults consume about 2 serves of fish (especially oily fish) per week, where a serve is 100g cooked weight. These figures are generally on par with recommendations given in other developed countries (Thurstan and Roberts, 2014), although other Australian health organisations recommend higher intakes (Table 1).

***** Table 1 here*****

Apparent consumption figures indicate that Australian seafood intakes have increased slightly over the past two decades (Stephan and Hobsbawn, 2014). This is supported by national survey data in which 24-hour dietary recalls showed that the average fish and seafood intake of Australian adults has increased from 28.9g to 32.4g per day between 1995 and 2011-2012 (ABS, 2014, ABS, 1999). Amongst the 19% of the adult population who ate seafood on the day prior to the most recent survey, the median quantity eaten was 133g (ABS, 2014). Other research data, however, suggests that a large proportion of Australians are still not eating the recommended amounts of seafood. A recent report by the Australian Seafood Cooperative Research Centre (ASCRC) found that over 40% of Australians were consuming fewer than two serves of fish per week (Lawley, 2015), and this survey was restricted to participants who had consumed at least some seafood in the past 6 months. Two smaller studies found that only about 20% of participants were eating

more than one serve of fish per week (FRDC, 2013, Rahmawaty et al., 2013), suggesting that a considerable proportion of Australians are not meeting the current fish intake recommendations for good health.

Research suggests that Australians are well aware of the health benefits of seafood (Birch and Lawley, 2012, FRDC, 2005, Grieger et al., 2012), yet a large proportion still do not consume the recommended amounts. There are clearly numerous other factors that influence consumers' decisions to purchase or consume seafood, such as price, taste and habit. In order to develop successful strategies to increase the percentage of Australians who eat two serves of fish per week (NHMRC, 2013), we must first understand the reasons behind consumers' current attitudes towards seafood consumption. Therefore the aim of this review was to assemble and assess the recent published information on the drivers and barriers to seafood consumption in Australia. The discussion focuses on how these drivers and barriers can be utilised by the seafood industry, the government, and health professionals to help increase seafood intakes in Australia.

METHODS

Design

A narrative format was chosen for this review due to the broad nature of the research question and the wide variability of the information sources and study designs included. The design was based on the narrative overview guidelines by Green et al. (2006), a set of publication and reporting guidelines developed to help standardise and increase objectivity in narrative review reporting. Some elements of this paper were also based on the Preferred Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Moher et al., 2009).

Search strategy

A systematic search of peer-reviewed journals and grey literature was performed to retrieve relevant publications. Specific search terms were used in three electronic databases: Scopus, Web of Science and ScienceDirect (Table 2). To capture the current trends in consumer behaviour, searches were restricted to articles published in the past ten years (from 2005 to September 2015). Reference lists of selected articles were also searched for further relevant papers. The grey literature search was done through websites of relevant Australian government and industry organisations including the Australian Government Department of Agriculture and Water Resources, the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES), the Fisheries Research and Development Corporation (FRDC) and the ASCRC (table 2).

***** Table 2 here*****

Selection criteria

To be eligible, studies had to contain data on barriers and/or drivers of seafood consumption in Australian residents of any age. This included studies investigating influences on total amount of seafood consumed or on the amount of seafood consumed relative to other protein or food choices, but not studies focusing exclusively on consumers' preferred attributes when making seafood purchase decisions. Studies investigating influences on participants' whole dietary patterns where fish was only a small component (e.g. general healthy diets) were also excluded.

Quality assessment of selected studies

The studies selected for review were critically appraised using a set of nine criteria developed by Hawker et al. (2002) to assess methodological rigour. Each criterion was assessed as 'very poor', 'poor', 'fair', or 'good' using a simple numeric scoring system (see Table S1 for details). This quality assessment tool was chosen for its simplicity and its suitability for the appraisal of different study types.

RESULTS

Description of included studies

Initial searches identified 504 publications from which 46 were selected for full-text assessment (Figure 1), including 23 peer-reviewed journal articles and 23 government/industry reports. Fourteen papers were ultimately selected for the review process (Table 3), including eight journal articles (reporting seven different studies) and six government/industry reports (reporting five different studies). The majority of selected studies were based on cross-sectional survey data, but two qualitative focus group studies (McManus et al., 2007, Neale et al., 2012) and two mixed methods studies (Birch and Lawley, 2012, Altintzoglou et al., 2010) were also included. Barriers and drivers of seafood consumption were investigated through a range of closed and open questions in 11 surveys (with a total of 15199 respondents) and 28 focus group discussions (with 171 participants). Three studies focused specifically on finfish consumption (Birch and Lawley, 2012, Birch and Lawley, 2014, Grieger et al., 2012), while others examined fish and seafood as a general category. Sample populations varied in age (Table 3), though most studies included participants of a wide age range (usually ≥18 years). Most studies restricted their samples to the main (or joint main) grocery buyer in the household (Table 3). The majority of participants in the selected studies were females as females are more likely to be the main grocery buyers in a household. Nearly all government/industry reports restricted participants to those who had eaten seafood in the past 6 months, thus their results do not account for the barriers to seafood consumption in non-eaters of seafood.

Quality assessment

The appraisal criteria of Hawker et al. (2002) yielded an average and median total score of 29.5/36 ('fair') for the included studies (where 9 = 'very poor' and 36 = 'good') (Table S1). Ultimately no studies were rejected solely on the basis of quality, though assessments of individual studies revealed that several aspects in study design or reporting were of less than optimum quality. Only two of nine studies (Grieger et al., 2012, McManus et al., 2012) reported survey response rates and justified the sample sizes used. However, most other survey-based studies used large sample sizes of >1000 people (Table 3). Some authors raised the concern of a bias towards respondents with a high interest in or greater knowledge of seafood consumption due to the participant selection process, so there is some question over representativeness of study populations. A number of selected studies failed to report on ethics approval (Table S1). The three reviewed qualitative and mixed methods studies were of reasonable quality, but some noteworthy concerns were a lack of consideration of researcher reflexivity and researcher bias, as well as a low level of generalisability due to small sample sizes and the exploratory nature of the studies.

*****Table 3 here*****

158 *****Figure 1 here*****

159 ***Drivers and barriers of seafood consumption***

160 The selected studies identified some major influences on seafood consumption in Australia, as outlined
161 below. Most of these have both positive and negative aspects and can thus function as both drivers and
162 barriers.

163 *Health*
164 Perceived health benefits of fish and seafood are widely reported motivators of seafood consumption in
165 Australia (Rahmawaty et al., 2013, FRDC, 2005, Neale et al., 2012). Consumers appear to value both the
166 direct personal benefit and the benefit to other family members. Grey literature has consistently shown
167 health to be the top or second most commonly cited reason for increasing fish consumption (FRDC, 2005,
168 Livaditis and Danenberg, 2011, Danenberg and Remaud, 2010, Danenberg and Mueller, 2011, Lawley,
169 2015). The recent ASCRC 'Seafood omnibus' survey included an open question about reasons for eating
170 more seafood, and while 'health' was the second most common response after 'taste', a number of
171 respondents also expressed feeling a moral obligation to eat seafood with responses like 'I know I should'
172 or 'good for my family' (Lawley, 2015). The flipside to this positive view of seafood and health is the fear
173 that seafood may pose a health risk due to food-borne contaminants like mercury. Although respondents
174 in some of the reviewed studies expressed concern about contaminants in fish, very few selected health
175 concerns or pollutants when asked about barriers to consumption (FRDC, 2005, Livaditis and Danenberg,
176 2011). The one exception where safety concerns were perceived as an important barrier to consumption
177 was in a cross-sectional survey administered to parents of 9-13 year old children (Rahmawaty et al., 2013).

178 *Cost*
179 Australian consumers perceive the price of seafood to be a substantial barrier to consumption (FRDC, 2005,
180 Birch and Lawley, 2012, Birch et al., 2012, McManus et al., 2007, Livaditis and Danenberg, 2011, Danenberg
181 and Mueller, 2011, Danenberg and Remaud, 2010, Lawley, 2015), particularly where fresh seafood is
182 concerned (Grieger et al., 2012; Rahmawaty et al., 2013; Birch et al., 2012). In the reviewed grey literature,
183 price was by far the most frequently cited reason (62-68%) for a lower seafood intake by consumers
184 reporting a decrease in seafood consumption (Danenberg and Mueller, 2011, Danenberg and Remaud,
185 2010, Livaditis and Danenberg, 2011). The ASCRC's 'Eat more fish' survey found that 45% of respondents
186 had not eaten fish in the past month because it was 'too expensive' (Livaditis and Danenberg, 2011). In the
187 same survey a far smaller percentage of respondents named expense as a reason for consuming no pork
188 (17%), chicken (20%), beef (27%) or lamb (36%), indicating that seafood is perceived as a more expensive
189 choice than other animal proteins. Conversely, cheaper seafood prices are seen as an enabler of
190 consumption (Danenberg and Mueller, 2011, Livaditis and Danenberg, 2011, McManus et al., 2012,
191 McManus et al., 2007, Lawley, 2015), and individuals who reported consuming more seafood now than
192 before often cited good prices as a reason (though price was cited as a barrier more often). Interestingly,
193 results of some studies reviewed here found that cost remained a major perceived barrier regardless of fish
194 consumption level or level of dietary education (Birch and Lawley, 2012, Neale et al., 2012).

195 *Taste and sensory qualities*
196 Taste is one of the top drivers of seafood consumption in Australia while simultaneously being a barrier for
197 individuals who consume less fish (Birch et al., 2012, Danenberg et al., 2012, Livaditis and Danenberg, 2011,
198 Lawley, 2015, Rahmawaty et al., 2013, Neale et al., 2012). Other sensory qualities of fish perceived as
199 barriers to consumption include smell, texture and the presence of bones as well as the dislike of touching,

preparing or cooking seafood (Birch and Lawley, 2012, Rahmawaty et al., 2013, Livaditis and Danenberg, 2011, FRDC, 2005). Taste is far more often perceived as a positive quality than a negative quality. In the 'Eat more fish' survey, 50% of respondents reported 'liking the taste' as a reason for consuming more seafood in the past month, while only 17% of respondents reported disliking seafood as a reason for not eating it (Livaditis and Danenberg, 2011). Some Australians also reported eating seafood for greater dietary variety or as a change from meat (Birch et al., 2012, Livaditis and Danenberg, 2011, Danenberg and Mueller, 2011, Danenberg and Remaud, 2010, FRDC, 2005).

Food preferences of family members

Family members', including children and partners, dislike of fish was another reported barrier to seafood consumption (McManus et al., 2007, Neale et al., 2012). In an exploratory qualitative study, mothers of 4-6 year-old children described using tactics like the association of fish with chips or disguising fish as chicken in order to encourage fish consumption in their children (McManus et al., 2007). Less frequent fish consumers or non-consumers were more likely to view the taste preferences of family members as a negative influence on levels of seafood consumption (Birch and Lawley, 2012, Rahmawaty et al., 2013).

Availability

Poor availability of quality seafood was perceived as a barrier among Australian seafood consumers (Grieger et al., 2012, McManus et al., 2007, Livaditis and Danenberg, 2011, Danenberg and Mueller, 2011, Danenberg and Remaud, 2010). Lack of availability of fresh Australian as opposed to imported seafood was often the major concern, while increased availability was perceived as an enabler. Reasons for reducing or increasing seafood consumption in the ASCRC 'Final seafood omnibus' survey showed that people increased seafood consumption if they had better access to a diverse range of seafood (Lawley, 2015). Birch et al. (2012) found that in contrast to fresh seafood, convenience and availability were seen as major drivers in the consumption of frozen seafood varieties.

Concerns about quality

Concerns about freshness, short shelf life and origin were all seen as barriers to seafood consumption. In an open ended survey question, food purchasers and preparers in a coastal town identified 'more local produce' as a leading enabler of seafood consumption (15% of respondents, second highest response after 'cheaper prices') (McManus et al., 2012). The grey literature reviewed here confirms that Australians strongly prefer Australian fish to imported products and decreased availability of local or Australian seafood is one of the top reasons for consuming less (FRDC, 2005, Danenberg and Remaud, 2010, Livaditis and Danenberg, 2011, Danenberg and Mueller, 2011, Lawley, 2015). Australian consumers find it difficult to assess freshness and evaluate quality of seafood and consider it important that the seafood they buy has never been frozen (Birch et al., 2012, McManus et al., 2007, FRDC, 2005). They also display a lack of trust in information provided when purchasing fish in supermarkets and perceive there to be a lack of quality standards and labelling for displayed seafood (McManus et al., 2007, Lawley, 2015). Many Australians mistakenly believe that seafood must be consumed on the day it is purchased (FRDC, 2005), and thus only buy fresh seafood if they are sure they will consume it that day. Although consumers consistently expressed concern over sustainability of the seafood they purchase, when it came to making actual purchase decisions sustainability dropped out of importance (Livaditis and Danenberg, 2011).

Confidence and convenience in purchasing or preparing seafood

Australians lack confidence in selecting and purchasing seafood, and the level of confidence in preparing seafood is a significant determinant of whether it features regularly on the household menu (McManus et

al., 2007, Rahmawaty et al., 2013, FRDC, 2005). Many consumers do not feel well-informed about or familiar with seafood (Birch and Lawley, 2012) and thus unsurprisingly prefer to stick to familiar types and species (Danenberg and Remaud, 2010, Danenberg and Mueller, 2011). Convenience is also an important driver of seafood consumption (Livaditis and Danenberg, 2011, Birch et al., 2012, Danenberg and Mueller, 2011, Danenberg and Remaud, 2010) with consumers appearing to consider fish to be quick and easy to prepare in discussions of drivers, yet difficult to prepare and cook in discussions of barriers (FRDC, 2005). In two studies consumers identified the provision of quick-and-easy recipes at point of purchase as an enabler of seafood consumption (McManus et al., 2012, FRDC, 2005).

Habit and role of seafood in cuisine

One study of 899 household grocery purchasers with varying levels of fish intake indicated that habit may pose a considerable barrier to seafood consumption (Birch and Lawley, 2014). Past habit, or eating fish on a regular basis as a child, was associated with greater familiarity with seafood and higher likelihood of being in the habit of consuming seafood in adulthood. Regular seafood consumers were more likely than lighter consumers to be in the habit of including seafood on their shopping list and serving seafood for everyday meals. The role of seafood in cuisine also appears to influence fish consumption levels. Many participants in a qualitative study by Neale et al. (2012) considered fish to be more of a special occasion food rather than an everyday food, and likewise seafood was not regarded as an everyday meal but more often as an entertaining entrée in a survey of 1005 household grocery purchasers living in Melbourne (FRDC, 2005). 'Eating out less' was a commonly given reason for consuming less seafood than a year ago in three surveys by the ASCRC (Livaditis and Danenberg, 2011, Danenberg and Remaud, 2010, Danenberg and Mueller, 2011).

DISCUSSION

A search of peer-reviewed journal articles and grey literature showed that perceived health benefits, taste and convenience are the most important drivers of seafood consumption in Australia. Consumers appear to choose seafood as a healthy, tasty, convenient meal option that provides a change from meat. The most significant barriers to seafood consumption in Australia are price, availability, concerns about quality and lack of confidence in selecting or preparing seafood. Research into barriers and drivers of seafood consumption in Australia has expanded considerably over the past ten years. Similar barriers and drivers of seafood consumption have previously been reported in other developed countries (Brunsø et al., 2009, Verbeke and Vackier, 2005, Trondsen et al., 2003), and there is now a relatively good understanding of consumer attitudes towards seafood. Future research should focus on how identified influencing factors can be exploited to increase fish consumption to the levels suggested by the Australian Dietary Guidelines (NHMRC, 2013). This discussion explores theoretical frameworks of consumer behaviour and potential strategies to increase fish consumption based on the drivers and barriers identified in this review.

One useful theoretical framework that has been used to explain consumer behaviour with respect to seafood consumption is Ajzen's (1991) Theory of Planned Behaviour (TPB) (Honkanen et al., 2005, Scholderer and Trondsen, 2008, Verbeke and Vackier, 2005). This theory posits that a person's behaviour is determined by their intention to perform that behaviour, which is in turn a function of three variables: 1) their attitude toward that behaviour, which depends on their beliefs about the outcomes of this behaviour, 2) their subjective norms, which depend on their beliefs about how people they care about will view that behaviour, and 3) their perceived behavioural control, which depends on beliefs about their ability to

perform that behaviour. In the case of consumer behaviour, outcome beliefs are realised as consumer expectations of health, quality, taste and pleasure, normative beliefs are realised as expectations regarding the health and preferences of family members, while control beliefs are realised as consumer expectations of adequacy of product supply (including price, variety and availability) and self-efficacy (ability to select and prepare the product) (Scholderer and Trondsen, 2008). Studies applying the TPB to seafood consumption have consistently found perceived behavioural control to be the strongest determinant of behavioural intention, which is in agreement with the findings of this review that price, availability and confidence in selecting and preparing seafood are among the greatest barriers to seafood consumption.

Habit is another important determinant of seafood consumption (Birch and Lawley, 2014, Honkanen et al., 2005, Verbeke and Vackier, 2005). Including habit as a separate predictor of perceived behavioural control, behavioural intention or even behaviour itself within the TPB has been shown to better explain consumer behaviour with respect to seafood (Verbeke and Vackier, 2005, Honkanen et al., 2005, Scholderer and Trondsen, 2008). Successful interventions to increase seafood consumption may need to focus on influencing consumers' habits by breaking undesirable habits and establishing new habits rather than relying solely on persuasive communications (Honkanen et al., 2005).

The reviewed studies confirm that Australians are largely aware of the health benefits of seafood yet despite this recognition, many do not consume the recommended amounts. Having a positive attitude about consuming fish for its health properties is not as strong a predictor of intention to eat fish as properties such as taste (Verbeke and Vackier, 2005), so these findings are not surprising. This suggests that promoting health benefits alone will not increase seafood intakes above current levels. Nevertheless, health is consistently one of the top reported reasons for increasing or maintaining seafood consumption. Furthermore, a recent community-wide intervention trial aiming to increase seafood consumption in a coastal Australian town successfully boosted seafood intakes by employing a diverse range of health-related resources (McManus et al., 2011). The study reported a 23% increase in seafood sales during the intervention period and a residual 15% increase in the month following the intervention (McManus et al., 2011), confirming the importance of keeping the health benefits of seafood at the forefront of consumers' minds. Older people tend to be greater consumers of seafood than younger people (Olsen, 2003, Verbeke and Vackier, 2005), potentially because older people place greater importance on eating healthy food (Olsen, 2003). Children and teenagers show the lowest frequency and level of seafood consumption (ABS, 2014) and increasing consumption levels in younger consumers may need to focus on strategies other than health, with convenience and cost being particularly important among young adults (Altintzoglou et al., 2010).

Fresh seafood is significantly more expensive in Australia than proteins like chicken or beef (FRDC, 2010), although in recent years some more affordable seafood products have become available due to increased imports. Around 66% of seafood consumed in Australia is now imported (Department of Agriculture, 2015). Frozen and thawed Vietnamese basa (catfish) fillets are Australia's most commonly eaten seafood import (Ruello, 2011) due to their extremely low cost, white boneless flesh and neutral flavour. Helping consumers to identify the cheapest species and cuts and offering meal ideas that are affordable, tasty and convenient could help to improve consumers' perceptions of the costs associated with eating seafood. It must be noted that Birch and Lawley (2012) found no significant difference in seafood intake between respondents who made evaluative judgements that seafood was expensive and those who did not, so some doubt exists as to whether the attitude that seafood is an expensive meal option actually does negatively

affect consumption levels. While the increased level of seafood imports may provide some lower cost options for consumers, it may also reduce the availability of local seafood products.

Research suggests that a large number of edible Australian fish are currently undervalued by consumers (Danenberg et al., 2012), and this is an area worth exploring given consumers' clear preference for Australian rather than imported seafood products. An ASCRC analysis of choice for various undervalued Australian species (such as Australian salmon, latchet, silver warehou, sardines and mackerel) showed that consumers have deeply engrained behavioural preferences for a narrow selection of seafood species (Danenberg et al., 2012). Many of Australia's undervalued species are unfamiliar, bony and/or strong flavoured fish that require a greater level of knowledge to prepare and use. Past experience with purchasing and preparing fish is a key component of consumers' perceived behavioural control, predicting behavioural intention to eat fish (Verbeke and Vackier, 2005). Thus convincing consumers to try these new products is likely to be a slow and challenging process.

Australian consumers report a strong preference for fresh over frozen or canned seafood; however, there appears to be significant confusion about what is actually meant by 'fresh' seafood. In a study by McManus et al. (2014), 58% of people thought 'fresh' meant 'caught the same day as displayed', while 15% perceived it to mean 'never been frozen' (the standard industry definition). Confusion over labelling and lack of knowledge about how to evaluate seafood quality seems to be largely responsible for Australians' lack of confidence in selecting seafood. Developing specific regulations for labelling fresh unpackaged seafood could improve understanding of the products on offer and help consumers make more informed and more confident purchase decisions (McManus et al., 2014). In the study by Birch et al. (2012), some consumers reported that the per kilo price format given in supermarkets makes fish seem expensive, suggesting that providing an easy way to identify the price of a single serving may help to increase sales of fresh seafood. Currently, much of the fish sold in Australia is cut into large portions, and some study participants indicated that serving them in smaller, less expensive portions may appeal to consumers (Birch et al., 2012).

The reviewed studies indicate that seafood consumption levels can also be negatively influenced by food preferences of family members, an important element of consumers' normative beliefs (Verbeke and Vackier, 2005). One of the selected focus group-based studies indicated that Australian parents find it hard to get young children to accept fish- and seafood-based meals (McManus et al., 2007). Birch and Lawley (2012) proposed that developing seafood products that are acceptable to all members of the family (i.e. without bones or fish odour) may reduce the negative influence of family preferences on seafood intake. A Norwegian study found that offering more than one seafood choice at a meal increased children's liking of the dish they ate, suggesting that including children in meal decision-making processes could help increase fish intakes in children and their families (Altintzoglou et al., 2015).

Consumers in different European countries show considerable variation in their level of seafood preparation skills and ability to evaluate quality of seafood (Brunsø et al., 2009). Australian consumers generally lack confidence in buying and preparing seafood (McManus et al., 2007, Rahmawaty et al., 2013, FRDC, 2005), thus favouring convenient, easy to prepare seafood options. The development of new palatable seafood products that appeal to the price conscious and time-poor consumer is a promising strategy that is already being considered in Europe (Altintzoglou et al., 2010) and by the Australian seafood industry (Lawley, 2015, Livaditis and Danenberg, 2011). Birch et al. (2012) found that pre-packaged fresh chilled seafood products were seen as a more convenient and easy to prepare option than unpackaged fresh seafood. This format also has the potential to address the barrier of availability by being able to be

easily stocked in small local shops without a deli counter. Australian study participants who were asked to identify factors that would enable them to increase their seafood consumption suggested being provided with, education on how to cook it and, quick and easy recipes at the point of purchase (McManus et al., 2012, FRDC, 2005). In one study, participants suggested that a consumer campaign to improve the image of seafood would help increase their consumption levels (FRDC, 2005). The highly successful 2012-14 media campaign to increase sales of Tasmanian farmed Atlantic salmon ('That's the beauty of Tassal') is a great example of an effective strategy to increase awareness and sales of new seafood products, with an attributed sales growth of over 20% (Hamilton, 2014).

A limitation of this review is that the included studies analysed perceived drivers and barriers to seafood consumption, and these may not necessarily align with actual barriers. The majority of studies, interviewed household grocery purchasers who consumed at least some seafood in the past 6 months, thus the barriers experienced by non-purchasers and non-consumers of seafood may not be adequately represented.

CONCLUSION

The leading drivers of seafood consumption in Australia are health, taste and convenience, while the most important barriers are the expense of seafood, concerns about quality, inadequate availability and a lack of confidence in selecting and preparing seafood. Some possible strategies to increase seafood consumption in Australia are to:, implement and educate consumers on a clear labelling system for fresh unpackaged seafood; design new products that appeal to the health conscious, price conscious and time poor consumer; take better advantage of currently undervalued and well-priced Australian seafood species; and provide consumers with resources like cooking instructions and recipe ideas at the point of purchase. Future research should focus on exploring and testing some of these interventions for their effectiveness in motivating seafood consumption in Australia.

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510 Table 1: Australian seafood intake recommendations

Recommended by:	Serves / week	Grams / week	Year
NHMRC Australian Dietary Guidelines	Around 2	~200	2013
Australian National Heart Foundation	2-3	300-600	2015
Food Standards Australia and New Zealand	2-3	300-450	2011

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514 Table 2: Specific search terms used in literature searches

Electronic databases	**Search field**	**Search terms used**
Scopus	abstract, title, keywords	(fish OR seafood) AND (Australia*) AND (consum* OR intake OR purchas* OR buy) AND (barrier* OR driver* OR cost OR prefer* OR choice OR behavio* OR attitude*)
Science Direct	abstract, title, keywords	
Web of Science	Topic	
Government and industry organisation websites		**Search strategy and search terms used**
Australian Government Department of Agriculture and Water Resources		*Fisheries > search* (fish OR seafood) AND (consumption OR consumer)
Australian Bureau of Agricultural and Resource Economics and Sciences		*Publications > Publications by topic > Fisheries and aquaculture > browse*
Fisheries Research and Development Corporation		*Research > Market Research > browse* *Research > Final Reports > search* (consumption OR consumer)
Australian Seafood Cooperative Research Centre		*Search* (consumption OR consumer)

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Table 3: Description of studies selected for review. References in bold text are peer-reviewed journal articles while others are grey literature reports.

Reference	Focus	Research design	Sample population (age in years)	Sample size	Data analysis	Results
(Birch and Lawley, 2012)	Barriers to purchase across finfish consumption segments	Cross-sectional, web-based survey (June 2010)	Main grocery shopper of household, including regular, light or very light fish consumers (18-55 and older)	899	Factor analysis; ANOVA	Lighter fish consumers more likely than regular consumers to perceive ▸ functional risk associated with being less informed about and less familiar with fish, experiencing more difficulties with selecting fish, recognising if fish is fresh and preparing and serving fish ▸ social risk due to other household members disliking fish ▸ psychological risk associated with unpleasant experiences or sensory qualities No difference between consumption segments perceived in ▸ Financial risk (fish not considered an expensive meal option by 48%) ▸ Physical risk (contamination, spoilage, etc.)
(Birch and Lawley, 2014)	The influence of habit on seafood consumption across consumption segments	Cross-sectional, web-based survey (June 2010)	Main grocery shopper of household, including regular, light or very light fish consumers (same study sample as above) (18-55 and older)	899	Factor analysis; ANOVA	Regular fish consumers were more likely than lighter fish consumers to ▸ Have a positive attitude towards fish ▸ Be familiar with fish (preparation, information) ▸ Be in the habit of consuming seafood (include on shopping list, do without having to consciously remember, serve for everyday meals) No difference between consumption segments found in past habit (eating fish on a regular basis as a child), but past habit was correlated with seafood familiarity and being in the habit of consuming seafood in adulthood. Patterns of childhood consumption occasions were associated with adult consumption occasions.
(Birch et al., 2012)	Drivers and barriers to seafood consumption in Australia	Mixed methods: cross-sectional web-based survey, focus groups	Household members responsible for food purchasing (focus groups); regular and light fish purchasers (survey) (18-55 and older)	1815 (survey); 60 (10 focus groups)	Descriptive statistics; qualitative analysis	Main drivers: health, taste, convenience, a desire for diet variety. Main barriers: price, concerns regarding origin, concerns about freshness, difficulty in evaluating seafood quality, not liking the taste or texture of fish. Main drivers of pre-packaged fresh chilled seafood products: convenience and ease of preparation Main barriers of pre-packaged fresh chilled seafood: price and concerns about origin and freshness.
(Grieger et al., 2012)	Knowledge, information sources, barriers and drivers of finfish consumption in older Australians	Cross-sectional, web-based survey (Nov-Dec 2010)	Older adults with varying levels of fish consumption (≥51)	854	Multiple regression analysis	Most frequently reported barriers to fresh finfish consumption: ▸ Too expensive (37%) ▸ No particular barrier (20%) ▸ Poor availability (16%) Most frequently reported barriers to canned fish consumption: ▸ No particular barrier (39%) ▸ Too expensive (15%) Consumers were more likely to eat at least 2 serves fresh finfish per week if they ▸ Were exposed to multiple sources of information ▸ Could correctly identify current recommendations for fish consumption ▸ Believed that fish improves general health ▸ Reported fewer barriers towards canned fish consumption

Reference	Focus	Research design	Sample population (age in years)	Sample size	Data analysis	Results
(McManus et al., 2007)	Perceptions, drivers and barriers of seafood consumption in young children	Qualitative, focus groups	Mothers of 4-6 year old children (23-45)	38 (7 focus groups)	Thematic analysis of transcribed discussions	Significant determinants of whether seafood features regularly on the household menu were • Perceived cost • Freshness • Availability/accessibility • Level of confidence in preparing seafood • Whether family members like seafood (particularly husband or partner)
(McManus et al., 2012)	Attitudes towards seafood and patterns of consumption in a coastal town	Cross-sectional, mail-based survey (Feb 2011)	Household members responsible for food purchasing and/or cooking (18-75 and older)	300	Descriptive statistics	Consumers generally checked labels when making purchasing decisions, sought more accurate labelling, were confident in preparing seafood and would purchase more seafood if it were more readily available and locally sourced. Main enablers towards increased seafood consumption (open ended question): • Cheaper prices (42%) • More local produce (15%) • Quick-and-easy recipes at point of purchase (11%) Main perceived information-related drivers of seafood consumption: • Healthy, easy low-cost recipes (67%) • Information on price per serving (63%) • Specific health benefits of various types of seafood (59%) • How to avoid potential risk (58%)
(Neale et al., 2012)	Comparing attitudes to fish consumption between clinical weight-loss trial participants and non-trial individuals	Qualitative, focus groups (Nov 2009)	Participants of a weight loss trial and non-trial participants from the same study population (30-50 and older)	29 (6 focus groups)	Thematic analysis of coded transcribed data	The main factors that influenced fish consumption were • Health impact • Cost • Physical and sensory characteristics • Food preferences of family members • The role of seafood in cuisine Themes were similar between trial and non-trial participants, but a higher perceived importance of education and knowledge in trial participants suggested that dietary intervention may have influenced perceptions of trial participants. Cost was considered a substantial barrier in both groups.
(Rahmawaty et al., 2013)	Factors that influence consumption of fish and omega 3-enriched foods among families with young children	Cross-sectional, web and paper-based survey (Jun-Sept 2011)	Parents of children aged 9-13 in regional NSW, divided into frequent, occasional and non-fish eaters (<55)	262	Descriptive statistics	Primary motivators for fish/omega-3 source consumption were • Perceived health benefits • Influence of media and health professionals in health promotion • Taste (among fish consumers) • Preferences of family members (also a negative influence in non-consumers) Primary barriers were • Unpleasant physical properties • Concern about pollutants • Difficulties in preparing seafood • Price (fresh not canned fish)

Reference	Focus	Research design	Sample population (age in years)	Sample size	Data analysis	Results
(FRDC, 2005)	FRDC The retail sale and consumption of seafood in Melbourne	Mixed methods: Two surveys: 1. In-home consumption (face-to-face interview); 2. Out-of-home consumption (self-completion)	1. Household grocery purchasers 2. Household grocery purchasers and non-grocery purchasers (≥15)	1248 total 1. 1005 2. 1248	Descriptive statistics	Consumers preferred familiar types of seafood, preferred Australian over imported products, doubted the quality of frozen seafood and were unsure how to tell if it has been frozen. Seafood was not regarded as an everyday meal, but more often as an entertaining entrée. People ate seafood for their health, to add variety to the diet and because they like the taste. People were concerned about the impact of pollution. Main perceived barriers to consumption were ▸ Price (34% agreement vs. 45% disagreement) ▸ Lack of confidence buying/preparing seafood (41% agreement)
		Focus groups (Aug 2004-May 2005)	Household grocery purchasers/food preparers who prepared food at home at least 4 times/week and at least occasionally bought fish or seafood (18-44 and >44)	44 (5 focus groups)	Qualitative analysis – details not given	Health was the top reason for increasing fish consumption, while price was the top reason for reducing it. Main perceived drivers of fish consumption were ▸ Health benefits ▸ Adding variety from meat and chicken ▸ Quick and easy to cook in discussions of drivers, yet difficult to prepare and cook in discussions of barriers Main perceived barriers were ▸ A lack of confidence in buying, cooking and serving fish and seafood – success seen as unpredictable ▸ A limited availability of good outlets ▸ The limited storage capacity of seafood Consumers did not show great concern over mercury or water pollution. Consumers said they would be encouraged to eat more fish by ▸ Education on how to cook it ▸ Provision with simple meal ideas ▸ A consumer campaign to improve the image of fish
(Livaditis and Danenberg, 2011)	ASCRC Simplot 'Eat more fish' online survey Exploring seafood consumption in relation to other competitor proteins	Cross-sectional, web-based survey (Feb 2011)	Household grocery purchasers who had eaten seafood in the past 6 months (≥18)	1011	Descriptive statistics	Top reasons for not eating seafood in the past month were ▸ Expense (45%) ▸ Poor availability of quality seafood (28%) ▸ Dislike for preparing/cooking it (16%) ▸ Do not like seafood (14%) Reasons for eating more seafood than a year ago (31% respondents) were ▸ Liking the taste (50%) ▸ Personal health reasons (48%) ▸ Good prices (35%) ▸ Want a change from meat (34%) ▸ Easy to prepare (34%) Top reasons for eating less seafood than a year ago (17% respondents) were ▸ Expense (68%) ▸ Less local Australian seafood available (23%) ▸ Eating out less (16%)

Reference	Focus	Research design	Sample population (age in years)	Sample size	Data analysis	Results
(Danenberg and Remaud, 2010) (Danenberg et al., 2012)	ASCRC Omnibus consumer research findings (wave 1) Seafood intake and consumer acceptance of innovation in the seafood industry	Cross-sectional national web-based surveys (Nov-Dec 2009)	Household grocery purchasers who had eaten seafood in the past 6 months (18-70)	2643	Descriptive statistics	25% of people claimed to be eating more seafood than 12 months ago because of • Health (54%) • Liking the taste (52%) • Easy preparation (40%) • Wanting a change from meat (40%) • Having a fresh fish shop nearby (29%) 15% of people claimed to be eating less seafood than 12 months ago because • It was too expensive (63%) • They were eating out less (23%) • They haven't been fishing or caught/been given seafood (22%) • Less Australian or local seafood is available (21%) • It is not available nearby or where they shop (16%)
(Danenberg and Mueller, 2011) (Danenberg et al., 2012)	ASCRC Omnibus consumer research findings wave 2 Seafood intake and consumer acceptance of innovation in the seafood industry	Cross-sectional national web-based surveys (Dec 2010-Jan 2011)	Household grocery purchasers who had eaten seafood in the past 6 months (18-70)	3629	Descriptive statistics	24% of people claimed to be eating more seafood than 12 months ago because of • Health (60%) • Liking the taste (58%) • Easy preparation (44%) • Wanting a change from meat (37%) • Good prices (34%) 12% of people claimed to be eating less seafood than 12 months ago because • It was too expensive (62%) • They were eating out less (29%) • They haven't been fishing or caught/been given seafood (20%) • Less Australian or local seafood is available (20%) • It is not available nearby or where they shop (10%) Results were very similar to the 2009 survey.
(Lawley, 2015)	ASCRC A Final Seafood Omnibus: Evaluating changes in consumer attitudes and behaviours	Cross-sectional national web-based survey (March 2015)	Household grocery purchasers who had eaten seafood in the past 6 months (≥18)	2538	Descriptive statistics and thematic analysis	41% of respondents reported increasing consumption since 5 yrs ago. Reasons given in response to an open question were • Taste + • Health + • Availability: having a fish shop nearby, better and easier products available and Woollies/Coles are stocking a better range • Moral obligation ('I know i should', 'good for my family') • Affordability 17% of respondents reported eating less seafood than 5 yrs ago for reasons of • Affordability + • Quality (including a lack of quality standards, uncertainty of origin and labelling, and lack of good quality fresh seafood) • Availability and expense were also reasons given