THE OFFICIAL JOURNAL OF THE BRITISH DIETETIC ASSOCIATION

Journal of Human Nutrition and Dietetics

Journal of Human Nutrition and Dietetics

RESEARCH PAPER

Health-related beliefs and consumer knowledge as determinants of fish consumption

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Keywords
communication, consumer, fish, health beliefs, knowledge.

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doi:10.1111/j.1365-277X.2010.01045.x

Abstract

Background: Despite scientific evidence on the positive effects of seafood consumption on human health, the consumption of fish remains below the recommended intake levels for the majority of Europeans. The present study aimed to explore cultural differences in potential determinants of fish consumption: consumers' knowledge and health-related beliefs, as well as the relationship between those variables, socio-demographics and fish consumption frequency, using data from five European countries.

Methods: A cross-sectional consumer survey was carried out in 2004 with representative household samples from Belgium, the Netherlands, Denmark, Poland and Spain. The sample consisted of 4786 respondents, aged 18–84 years, who were responsible for food purchasing and cooking in the household.

Results: European consumers had a very strong belief that eating fish is healthy. Consumers' belief that eating fish is healthy, their interest in healthy eating and objective fish-related nutrition knowledge, positively, but only weakly, influenced fish consumption frequency. Subjective knowledge was found to be a stronger predictor of fish consumption than the previously noted factors. Age and education contributed, both directly and indirectly through knowledge, to explain fish consumption behaviour. However, the path coefficients in the estimated model were relatively low, which indicates that fish consumption frequency was also determined by factors other than health-related beliefs and consumers' knowledge.

Conclusions: The findings of the present study suggest that communication should focus on health-related benefits other than fish consumption alone. Communicating that eating fish is healthy and stressing the health benefits of fish alone, as is still commonly performed (e.g. in generic promotion and other types of public information campaigns) will be insufficient to achieve higher levels of compliance with fish consumption recommendations.

Introduction

Strong scientific evidence exists regarding the positive effects of seafood consumption on human health when included at least twice a week in a normal diet (Mozaffarian & Rimm, 2006; Sioen *et al.*, 2007). However, despite the predominantly healthy image of fish as a food product and the favourable attitudes that consumers hold towards eating fish (Trondsen *et al.*, 2004), the consumption of seafood still remains below the recommended intake levels among the majority of European consumers (Welch *et al.*, 2002). Recently, several studies have investigated the impact of a wide range of determinants of fish consumption, such as motives, barriers, convenience orientation and product involvement, aiming improve the understanding of factors influencing consumer

decision-making related to fish (Verbeke & Vackier, 2005; Olsen *et al.*, 2007). Nevertheless, few studies have focused on understanding the impact of consumers' knowledge and health-related beliefs on fish consumption behaviour (Pieniak *et al.*, 2008b).

Consumers' attitudes towards food and nutrition have been found to be important factors influencing food consumption behaviour in general (Hearty *et al.*, 2007), as well as fish consumption behaviour in particular (Verbeke *et al.*, 2005). In the consumer behaviour literature, the concept of involvement has widely been used and was shown to have robust effects on explaining consumers' purchase and eating decisions (Marshall & Bell, 2004), including fish consumption (Verbeke & Vackier, 2005; Olsen, 2003). In the present study, a food and health-related involvement construct has been included, namely an interest in healthy eating, which has already been reported to influence seafood consumption (Olsen, 2003).

Product knowledge is an important factor in consumer decision-making. Two knowledge constructs are distinguished: objective knowledge (i.e. accurate information about the product stored in consumer's long-term memory) and subjective knowledge (i.e. people's perceptions of what or how much they know about a product based on their subjective interpretation). The level of correspondence between objective and subjective knowledge usually is not high (Park *et al.*, 1994), with consumers being generally overconfident about themselves (Alba & Hutchinson, 2000). A positive relationship has been reported between knowledge and dietary health preventive behaviour (Petrovici & Ritson, 2006), as well as between knowledge and positive beliefs towards health-related behaviour (e.g. breast-feeding) (Swanson *et al.*, 2006).

Consumer demographics, such as age and education, are often discussed as major determinants of food choice in general and fish consumption in particular. However, such demographics are more likely to be correlates of actual determinants, such as an interest in and knowledge about issues related to nutrition or health status (Grunert & Wills, 2007). Previous research has identified age as an important dimension in behaviour towards seafood consumption (Verbeke & Vackier, 2005; Trondsen *et al.*, 2004). Ageing is arguably associated with a higher awareness of health and diet–disease relationships (Senauer *et al.*, 1991). Mckay *et al.* (2006) suggested that educational level, more than any other socioeconomic factor, could predict health-related behaviour patterns and diet quality. Higher education was more likely to promote more healthful diets because more highly educated people access and process nutrition information more effectively (Popkin *et al.*, 2003). Seafood consumption has also been positively directly associated with education (Myrland *et al.*, 2000; Trondsen *et al.*, 2004).

In the present study, we have concentrated on countries with a weak (Poland), moderate (Belgium, the Netherlands and Denmark) and strong tradition (Spain) of eating fish. Based on the Food Balance Sheets data provided by the Food and Agriculture Organization (FAO, 2006), Spain reported one of the highest fish intake levels in Europe and in the world, with 45 kg capita year^{-1}. Belgium, Denmark and the Netherlands reported moderate fish consumption levels of 24, 23 and 23 kg capita year^{-1}, respectively, close to the EU-27 average of 21.4 kg capita year^{-1}. Poland was among the countries with the lowest consumption of fish within Europe, with only 9 kg capita year^{-1}. Determinants of fish consumption might be different depending on the country, its fish consumption level, tradition and habit (Brunsø *et al.*, 2009; Pieniak *et al.*, 2009). Therefore, some cross-cultural differences are expected. The present study aimed to investigate the associations between health-related beliefs, consumer knowledge and fish consumption frequency through a structural equation model and multigroup analysis. On the basis of the results obtained in previous research, we hypothesised that when consumers were: (i) more strongly convinced that fish is healthy; (ii) more interested in healthy eating; and (iii) more knowledgeable about fish, their fish consumption would be more frequent.

Materials and methods

Study design

The overall research design for this study has been described in detail elsewhere (Pieniak *et al.*, 2007, 2008a) and is only summarised here. Cross-sectional survey data were collected through questionnaires in five European countries: Belgium, Denmark, the Netherlands, Poland and Spain during November/December 2004. All relevant international guidelines and standards relating to the collection of personal data from human beings have been abided. Participants in the consumer studies were adult volunteers from whom written informed consent was obtained. The data collection fieldwork was performed by professional market research agencies, taking into account the highest professional and ethical standards relating to market and social research, including obtaining informed consent and the anonymous processing of personal data.

Households were selected at random, either from panels (Belgium and the Netherlands), telephone books (Denmark), census data (Poland) or through random walk procedures (Spain), taking predetermined quota with respect to age and regional distribution into account within each country. All questionnaires were self-administered by the participants (i.e. participants completed the survey themselves without interference from the researchers, the

agency or interviewers). The dataset used contained only fully anonymous and non-identifiable records.

Study sample

A total sample of 4786 consumers (n = 800–1100 respondents per country) was obtained. The sample comprised 3652 women (76.3%) and 1134 men (23.7%). This gender distribution reflects the criterion that all respondents were the main responsible people for food purchasing within their household. The age of the respondents was in the range 18–84 years [mean (SD) = 42.7 (12.6) years].

Measurement instrument

The master questionnaire was developed in English and then translated (using the back-translation method) into the different languages by professional translation services. The questionnaires have been pretested in the national languages in pilot studies.

Belief that eating fish is healthy (as a part of consumers' attitude towards fish healthiness) was measured by the item 'Eating fish is healthy' to be answered on a seven-point Likert scale, ranging from 'totally disagree' to 'totally agree'.

Interest in healthy eating was measured by three items (for items, see Table 1) adapted from the Food Choice Questionnaire (Steptoe *et al.*, 1995). Only the most appropriate, useful and relevant items related to fish were included based on findings from exploratory focus group discussions (Brunsø *et al.*, 2009).

Subjective knowledge about fish was measured by three items on a seven-point Likert scale; consistent with measures used in previous studies (Park *et al.*, 1994). Consumer's level of objective knowledge related to fish was measured with four statements that were assumed to be common (fish-related) nutrition knowledge among the population. Two of the statements were false: 'Fish is a source of dietary fibre' (fish does not contain any dietary fibre, although many consumers believe so because of some fish's fibrous texture) and 'Cod is a fatty fish' (cod is classified as a lean fish). The two other statements were true: 'Fish is a source of omega-3 fatty acids' and 'Salmon is a fatty fish'. For the four statements, a 'true/false' scale was used (Park *et al.*, 1994). Knowledge constructs and interest in healthy eating have been cross-culturally validated across the consumer samples taken from Belgium, the Netherlands, Spain, Denmark and Poland (Pieniak *et al.*, 2007, 2008b).

Fish consumption frequency was based on self-reported fish consumption at home and out of home. A nine-point frequency scale ranging from 'never' to 'daily or almost every day' was used. This response scale was recoded into frequencies per week and aggregated to compute one behavioural variable, namely (total) fish consumption frequency (times per week).

Statistical analysis

First, data were analysed using the statistical software SPSS, version 15.0 (SPSS Inc, Chicago, IL, USA). To determine the unidimensionality of the five construct

Table 1 Factor loadings, reliability estimates and variance extracted for construct measures

Constructs and items	Standardised factor loading	Composite reliability	Variance extracted
Belief that eating fish is healthy			0.50
Eating fish is healthy	1.00 (fixed)		
Subjective knowledge		0.87	0.68
I have a lot of knowledge how to evaluate the quality of fish	0.90		
I have a lot of knowledge of how to prepare fish for dinner	0.86		
My friends consider me as an expert on fish	0.71		
Objective knowledge			0.50
Sum score based on four nutritional questions	1.00 (fixed)		
Interest in healthy eating		0.91	0.78
It is important to me that the food I eat on a typical day is good for my physical and mental health	0.92		
It is important to me that the food I eat on a typical day keeps me healthy	0.88		
It is important to me that the food I eat on a typical day is nutritious	0.85		
Fish consumption frequency			0.50
How often do you eat fish at home and out of home	1.00 (fixed)		

All factor loadings are significant at $P < 0.001$. Fit-statistics for the pooled data: χ^2 (20) = 186.48, $P < 0.001$; root mean square error of approximation = 0.042; goodness of fit = 0.991; comparative fit index = 0.991.

measures, namely interest in healthy eating, subjective knowledge, objective knowledge, belief that eating fish is healthy and fish consumption frequency, a maximum likelihood confirmatory factor analysis on the pooled sample was performed using the robust maximum likelihood procedure in LISREL, version 8.72 (Jöreskog & Sörbom, 1989). Because of the large sample size, chi squared might not be the most appropriate measure of goodness-of-fit (Browne & Cudeck, 1993). Therefore, three other indices are used: the root mean square error of approximation (RMSEA), the goodness of fit index (GFI) and the comparative fit index (CFI). Values below 0.08 for RMSEA (Browne & Cudeck, 1993) and above 0.90 for GFI and CFI (Bollen, 1989) suggested an acceptable fit of the model.

The analysis confirmed that all items in the measurement model reflect the theoretical constructs as expected and a five-factor solution was best suited for the data. Standardised factor loadings and reliability estimates are presented in Table 1. The individual item loadings on the constructs were all highly significant, with values in the range 0.71–0.92 and *t*-values in the range 40.65–112.61. No cross loadings of note appeared. Hence, all the items were considered in the interpretation of the factors (Hair *et al.*, 2006). Additionally, Cronbach's alpha internal reliability coefficients were above the threshold value of 0.7 for satisfactory scales.

Subsequently, multigroup analysis was performed to test for factorial invariance (i.e. to assess whether the psychometric properties of the constructs were stable across the five countries) in accordance with the procedure recommended by Steenkamp & Baumgartner (1998). The invariance assumptions were tested in a stepwise fashion, relaxing constraints starting from the model where all parameters were constrained to be equal (Table 2).

As a result of the large samples involved in the analysis, the Satorra–Bentler chi-square differences were significant at every step ($P < 0.001$). However, the only parameters that differ substantially (model RMSEA = 0.1) between countries were the latent (unobserved) factor means, which indicates that the model constructs differed substantially between countries, as shown below.

The mean scores of the resulting constructs were calculated and analysis of variance (*F*-tests) with Tukey's honestly significant difference *post hoc* comparison of mean scores across the countries being used to detect differences in the five constructs. Next, structural equation model parameters were estimated and the general fit of the model was assessed using the robust maximum likelihood procedure in LISREL, verison 8.72. With the use of structural equation modelling, the examination of all the relationships between constructs and items was performed simultaneously, which was a substantial advantage compared to single equation modelling (Bollen, 1989). Error variance (20%) was introduced during estimation to one-item measures as described by Jöreskog & Sörbom (1999). As a result, one-item measures used in the analysis were not totally free of measurement error.

Results

Cross-cultural differences in health-related beliefs and consumers knowledge

The results presented in Table 3 indicated that Polish and Danish consumers held the strongest belief that eating fish is healthy, whereas consumers in the Netherlands showed the lowest belief that eating fish is healthy. In general, European consumers had a very positive belief that eating fish is healthy. Furthermore, Spanish, Polish and Belgian consumers were the most interested in healthy eating, whereas respondents from the Netherlands and Denmark displayed the lowest interest in healthy eating. Additionally, Danish consumers reported the highest, whereas Polish and Dutch consumers displayed the lowest objective knowledge. Dutch consumers also perceived themselves as having the lowest knowledge about fish, whereas Poles and Spaniards evaluated themselves as most knowledgeable about fish. Interestingly, Poles scored the lowest on objective knowledge while at the same time the highest on subjective knowledge. Finally, Spaniards

Table 2 Measurement invariance analysis

Model	Constraints relaxed	Satorra–Bentler scaled χ^2	d.f.	RMSEA	Satorra–Bentler scaled $\Delta\chi^2$	Δd.f.	*P*
0	None	5744.65	539	0.100			
1	Equality of latent factor means	3470.43	511	0.078	2029.95	28	<0.001
2	Equality of measurement error variances	3009.51	471	0.075	354.47	40	<0.001
3	Equality of factor covariances	1348.96	359	0.054	1438.41	112	<0.001
4	Equality of item intercepts	921.90	331	0.043	566.40	28	<0.001
5	Equality of factor loadings	845.04	315	0.042	65.04	16	<0.001

RMSEA, root mean square error of approximation.

Table 3 Cross-country differences in latent variable means

	Country					
	Belgium (n = 852)	Denmark (n = 1110)	Netherlands (n = 809)	Poland (n = 1015)	Spain (n = 1000)	F-value
Belief that eating fish is healthy*	6.10[b]	6.38[d]	5.99[a]	6.45[d]	6.25[c]	25.71
Subjective knowledge*	3.25[b]	3.40[b]	2.96[a]	3.77[c]	3.79[c]	56.20
Objective knowledge**	2.42[b]	3.11[d]	2.19[a]	2.18[a]	2.58[c]	144.00
Interest in healthy eating*	6.05[b]	5.80[a]	5.74[a]	6.20[c]	6.30[d]	56.07
Fish consumption frequency***	1.10[b]	1.43[c]	0.95[a]	1.20[b]	2.60[d]	219.91

The multiple comparisons (*post hoc*) Tukey's honestly significant difference test was used on (*) a seven-point Likert scale (1 = totally disagree; 7 = totally agree); (**) a seven-point scale (0 = all answers correct; 6 = all answers correct); (***) a frequency scale (times per week). Superscripts letters indicate significantly different means. All differences are significant at $P < 0.001$.

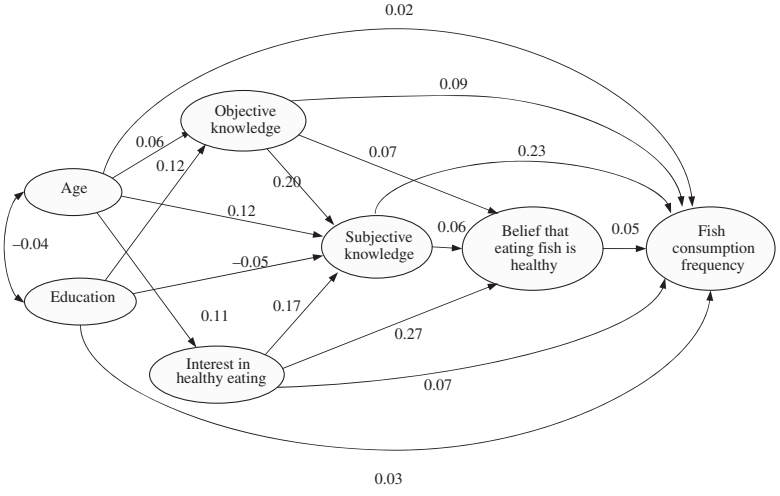

Figure 1 Standardised solutions for hypothesised relationships between age, education, health-related beliefs, knowledge and fish consumption frequency. All designed paths are significant at $P < 0.001$. Goodness-of-fit statistics for the pooled data: $\chi^2_{(512)} = 3484.61$, $P < 0.001$; root mean square error of approximation = 0.078; goodness of fit index = 0.86; comparative fit index = 0.86.

reported the highest fish consumption frequency, followed by Danes, whereas consumers in the Netherlands displayed the lowest fish consumption frequency. The fish consumption frequency among Belgians and Poles was on a moderate level and not significantly different from each other.

Structural relationships between fish consumption and its determinants

In general, the model as presented in Fig. 1 performed well. The RMSEA value was 0.078, which is below the threshold level of 0.08. The GFI was 0.86 and the CFI was 0.86, which are close to the recommended level of 0.90. In addition, the other goodness-of-fit indices were satisfactory. The path diagram is displayed in Fig. 1.

First, the belief that eating fish is healthy had a direct positive but very weak association with fish consumption frequency. Second, interest in healthy eating had a direct positive but weak relationship with fish consumption frequency and a stronger also positive relationship with subjective knowledge. Third, subjective knowledge had a significant positive and moderate direct effect on fish consumption frequency, whereas objective knowledge had a positive but much weaker association with fish consumption frequency. Additionally, objective knowledge had a significant effect on subjective knowledge. Fourth, interest in healthy eating and both objective and subjective knowledge had significant positive direct effects on the belief that eating fish is healthy.

Age was significantly associated with interest in healthy eating. Furthermore, a positive relationship between age and both constructs of knowledge was found. However, the association between age and subjective knowledge was stronger than between age and objective knowledge. Interestingly, a direct significant but very weak path between age and fish consumption frequency was confirmed in the model. The results obtained in the presemt study indicated that interest in healthy eating, subjective and objective knowledge acted as mediators between age and fish consumption frequency. Finally, education level was found to be positively associated with objective knowledge and negatively linked to subjective knowledge. Thus, people with a higher education level reported a higher

level of factual nutrition knowledge about fish but, at the same time, they perceived themselves to a lesser degree as being very knowledgeable about fish. Although significant, these effects were rather weak.

Discussion

To our knowledge, the present study is the first to investigate the impact of both health-related beliefs, and subjective and objective fish-related nutrition knowledge on fish consumption by means of a multigroup structural equations analysis. The proposed model contributes to a better understanding of health-related beliefs and knowledge factors influencing fish consumption behaviour across European Union countries with a different fish consumption level or tradition. The findings obtained indicate that significant differences exist with respect to the belief that eating fish is healthy, an interest in healthy eating, subjective and objective knowledge about fish, and the fish consumption frequency between the five considered European Union countries. Despite the observed cross-cultural differences, a predominantly healthy image of fish emerged, which is consistent with previous studies based on other cross-sectional consumer data (Verbeke & Vackier, 2005; Trondsen *et al.*, 2004).

The results obtained support a positive relationship between attitude (also towards healthy eating) and dietary (and lifestyle) behaviour (Hearty *et al.*, 2007; Petrovici & Ritson, 2006). However, the association found between the belief that eating fish is healthy and fish consumption frequency was weaker than might have been expected. For example, Olsen (2003) reported much stronger relationships between attitude towards eating fish and fish consumption behaviour. In the study by Olsen (2003), attitude was specified as a more general predisposition of people towards particular behaviour, whereas we have concentrated specifically on only one component of attitude, namely the belief that eating fish is healthy. Our result is relevant because it suggests that a very positive belief (which holds true for the majority of consumers in all five investigated countries) that eating fish is healthy is actually not sufficient to convince/encourage people to eat fish (more) frequently. Improving this belief is superfluous because it is already very strong and leaves little room to be further improved. Furthermore, this weak relationship suggests that many people are convinced that eating fish is healthy but, nevertheless, they refrain from eating fish (more) frequently.

The present study also highlights the importance of considering consumers' interest in healthy eating as a target variable (e.g. in communication aiming at stimulating fish consumption and aligning it with public health recommendations). Consumers' interest in healthy eating was shown to positively influence fish consumption behaviour, which confirms previous studies (Olsen, 2003; Verbeke & Vackier, 2005).

People who evaluated themselves as having better knowledge about fish and those who actually were more knowledgeable about nutritional aspects of fish consumption held a stronger belief that eating fish is healthy. This indicated that the association of fish with health was clearly a part of consumers' cognitive representations of fish and contributed positively to a higher frequency of fish consumption.

Most importantly, subjective knowledge is found to be more strongly associated with behaviour than actual (objective) knowledge, which is in line with previous studies investigating knowledge in relation to food consumption behaviour in general (Radecki & Jaccard, 1995) and fish consumption behaviour in particular (Rortveit & Olsen, 2007). The weak correlation between objective knowledge and fish consumption frequency might be a result of measuring only food-specific attribute knowledge. Food attribute knowledge, including nutrient and food composition issues, on which much of nutrition education in Europe has focused, dealt with only one part of the knowledge hierarchy (Wansink *et al.*, 2005). In addition to food attribute knowledge (i.e. nutrient content in fish), we hypothesised that fish consumption frequency was more likely to be affected when people linked their knowledge about nutrients in fish to particular tangible benefits of consuming this food. Although this might be a rather speculative finding from the current analysis, it would suggest that nutrition education, as well as food marketers, should concentrate rather on improving consumers' awareness about tangible benefits from eating a particular food, rather than on the composition of the food in the strict nutritional sense.

The present study confirmed that age and education were significant factors in explaining fish consumption behaviour directly, which supports previous studies (Trondsen *et al.*, 2004; Verbeke & Vackier, 2005). Nevertheless, direct relationships between these socio-demographic variables and fish consumption were very weak. Additionally, elderly people were found to be more involved in healthy eating, which corroborates previous studies (e.g. Kearney *et al.*, 1998). Thus, fish consumption frequency appeared not to increase predominantly 'naturally' or 'automatically' with biological ageing, but rather with the changing interest in healthy eating and knowledge that occur with ageing. Older and more highly educated people are reported to make greater use of nutrition labels (Satia *et al.*, 2005), which may explain their higher factual nutritional knowledge, as discovered in the present study.

Age differences with respect to an interest in healthy eating and knowledge might be a consequence of shared experiences, attitudes and preferences of the different cohorts of the age classes (Reynolds & Rentz, 1981). Attitudes towards food might form according to the impact of their particular historical era, the cultural (e.g. religious influences) and social settings (e.g. family and employment effects) to which they were exposed throughout their lives, and the timing and trajectories of their individual experiences of past and current events (Devine & Olson, 1991; Furst *et al.*, 1996). Therefore, characteristics of a given age cohort may affect their relationship to food (Rentz *et al.*, 1983). If this so-called age-period–cohort interpretation is correct, younger consumers might not easily change their attitudes (and thus also interest) over their life course. Hence, a lower demand for healthy food, including fish, could be expected over the longer term as the younger generation grows older.

Furthermore, a positive relationship between a consumer's education level and an interest in healthy eating was demonstrated. Previous studies (Drichoutis *et al.*, 2005) found a positive relationship between educational level and the use of nutrition information from food labels. Additionally, higher education was more likely to promote more healthful diets because more highly educated people might have access to better nutrition information (Popkin *et al.*, 2003). The results obtained in the present study suggest an indirect effect of education on fish consumption frequency, which was mainly mediated by objective knowledge. This fits with the findings of Trondsen *et al.* (2004), who reported that more experience and better knowledge about seafood influenced the perception of the relationships between food and health.

The present study has a number of limitations. A first limitation of the study was that it explicitly focused on the food attribute-related objective knowledge (Wansink *et al.*, 2005). Nevertheless, knowledge about the benefits of fish consumption might also explain some variance in fish consumption behaviour. Further research to explore the impact of consumers' actual knowledge on fish consumption frequency is recommended, including its different levels from nutrients to benefits. Furthermore, the present study focused deliberately on the role of consumer knowledge, an interest in healthy eating and the belief that eating fish is healthy. These factors are only one kind of driver of food choice, dietary habits and eating behaviour, and mostly not even the main one. We admit that the model estimated in the present study is incomplete. Other factors, such as availability, convenience, ethical and sustainability concerns, price perceptions and simple (dis)liking, may account for differences in fish consumption behaviour. These barriers and motives have been covered extensively in previous studies, whereas the aim of the present study was to concentrate specifically on the health-related beliefs and knowledge. Future research investigating the impact of perceptions, motives and barriers, together with the factors investigated in the present study, is recommended. Finally, our selection of countries imposes some limitations and further cross-cultural validation of our findings is recommended.

Despite being statistically significant, both the intercorrelations and path coefficients between the model constructs were relatively low. Health-related beliefs and involvement, as well as consumers' knowledge about fish, had relatively little influence on fish consumption. One implication is that health information aiming at further strengthening the beliefs that fish consumption is important for health (because of its favourable nutrient content) is not likely to generate very significant impacts. The results obtained in the present study advocating that communicating that eating fish is healthy, as well as stressing the health benefits of fish alone (as is still commonly performed, for example, in generic promotion and other types of public information campaigns), will be insufficient in terms of increasing fish consumption frequency and achieving higher compliance with fish consumption recommendations. Therefore, a continued focus almost exclusively on the health benefits of fish and nutrition education, aiming at improving objective health-related knowledge about fish, may not be the most effective and efficient use of resources. Another implication of the study is that improving people's subjective knowledge is more likely to cause an increase in fish consumption compared to strategies aiming at increasing consumers' objective knowledge (Pieniak *et al.*, 2006). Public health authorities as well as producers are recommended to inform people about the beneficial aspects of eating fish beyond the benefits for human health, or in terms of human nutrition alone. Instead, such information could also try to explain why fish is wholesome and what fish can contribute in terms of tangible benefits to consumers' beyond health and nutrition alone. Therefore, incorporating information other than health-related benefits from fish consumption (e.g. enjoyment and pleasure) and reinforcing positive attitudes towards fish with arguments that extend beyond health and nutrition in the strict sense are recommended. Additionally, it should aim at improving consumers' self-confidence in evaluating fish quality, and reinforcing a person's belief that she/he is knowledgeable about fish, because what people believe to know appears to be more important than what they actually know. Finally, it is recommended that future consumer studies dealing with food and nutrition distinguish between consumers' subjective and objective knowledge. It is also recommended that both conspectus of knowledge

are assessed separately; and that the associations between both knowledge constructs and attitudes/beliefs, an interest in healthy eating and food intake or consumption frequency are explored.

Conflict of interests, source of funding and authorship

The authors declare that they have no conflicts of interest.

This work was performed within the Consumer Pillar of the FP6 Integrated Research Project SEAFOODplus, contract No. FOOD-CT-2004-506359. The financing of the work by the European Union is gratefully acknowledged.

ZP participated in the study design, performed the statistical analysis and drafted the manuscript. WV participated in the study design, contributed to the statistical analysis, helped draft the paper and coordinated the project. JS participated in the study design and contributed to the statistical analysis and drafting of the paper. All authors critically reviewed the manuscript and approved the final version submitted for publication.

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