Health and Seafood Consumption Patterns among Women 45-69 years: A Norwegian Seafood Consumption Study 1996

Trondsen, T; Braaten, T.; Lund, E.; Eggen, AE.
Norwegian College of Fishery Science
University of Tromso, Breivika,
9037 Tromsø, Norway
Phone +4777645567, Fax +4777646020, Email: torbjorn@nfh.uit.no

Submitted for publication in "Appetite" 26.04.01

Abstract: Main research question: The aim of the study was to investigate how health perception, eating habits and socioeconomic pattern influence choice of seafood. Materials and methods: A randomly drawn sample of Norwegian women aged 45 to 69 years answered a self-administrated mail questionnaire about eating habits, socioeconomic status, and questions related to health. There were 9407 women answered the questionnaire (response rate 52.5%). Findings: The mean level of seafood consumption was 2.7 times a week. Seafood consumption increased with (i) increasing belief in the idea that food is important for health (ii) using medicine for cardiovascular disease (iii) other healthy eating habits (iv) increasing age, (v) increasing household size, (vi) decreasing family income, and (vii) having residence in coastal areas. The growing consumption of fat fish is greater in central eastern Norway, while lean fish consumption is related to traditional food consumption. Processed fish consumption is related to consumption of other fast food. Conclusions. Seafood consumption is strongly related to consumption of three food groups: healthy food, fast food, and traditional food. The marginal benefit is high for health information and the marketing of seafood as healthy food, which fit into the current food lifestyle of consumption in all three food segments. Marketing implications are outlined.

Key words*: Food lifestyle, seafood, consumer behavior, segments, consumption, food choice, health, promotion, market barriers, marketing, Norway.*

Introduction

Malnutrition is increasingly accepted as a threat against health. The new lifestyle epidemic is obesity which may lead to diabetes, cardiovascular diseases etc. (WHO, 1998). Medical research has, however, shown that consumers who increase consumption of fish oil (Omega-3) reduce the risk of several of the lifestyle diseases (Connor & Connor, 2000). Substituting intake of meat with a food mix where fat fish or lean fish/fish oil combined with vegetables might improve the quality of the fat consumption, and reduce consumers' calorie intake, and prevent lifestyle diseases. Based on such knowledge, medical authorities, nutritionists and physicians recommend several options of health-oriented strategies, where diet, exercise and use of medical treatment are combined (WHO, 1988).

Understanding how health factors are influencing consumption behavior and seafood demand is important both for seafood marketers and public health agents who want to promote a healthier eating and lifestyle.

Recommendations about healthy eating have been shown to influence consumers' beliefs about food and health and the consumption pattern. (Variyam *et al*, 1998; Nayga, 2000; Harel *et al*, 2001). Generally, health information has been shown to be efficient in influencing food and seafood consumption (Foxall, 1998). Health information elasticities in general are larger in absolute value than price elasticities in the US poultry market, which means that one may get more sales from investment in food-health information when compared to using similar percentage price reductions (Kinnucan *et al*, 1997). On the other side, negative food-health information may also have tremendous negative impact on food consumption as illustrated by linkage in the media between meat consumption and BSE disease (Verbeke *et al*, 1999).

Earlier research indicated that the healthy food information penetrates differently into different parts of the population. For example, women , more than men, tended to comply with dietary guideline recommendations through being influenced by written materials, their social networks and relatives/friends. Men were more influenced by mass media and physicians (Mcintosh *et al*, 1995; Turrell, 1997; Fagerli & Wangel, 1999).

The question remains how this knowledge influences the consumers' seafood attitudes and consumption pattern in different market segments. A US study indicated a positive relationship between seafood consumption and health consciousness. Fish eaters were significantly more likely than others to report recent exercise, effort to loose weight, periodic monitoring of serum cholesterol, and not currently being smokers (Altekruse *et al*, 1995). Dietary behaviors and their relative saliency in the food choice

decision reflected a diversity of determinants, including socioeconomic factors, food preferences, beliefs, skills in preparation and local supply of fish products (Turrell, 1998; Myrland & Trondsen *et al*, 2000). Over the past years there has been an increased demand for seafood at the consumer level, which has resulted in higher seafood prices. Average seafood consumption per capita in the world reached 16 kg in 1998 (live fish weight equivalent), an increase of almost 18 percent from 1988. The per capita consumption in Norway was 50,5 kg in 1998, an increase of almost 14 percent since 1988 (National Marine Fisheries Services, 1999; FAO, 2000). The food consumption trend in Norway is changing, and people tend to change their preferences from beef to chicken and fish (Rickertsen, 1996). This may be a consequence of the perception that fresh seafood contributes to good health, tastes good and thus gives raise to a greater willingness to pay premium prices for good quality and to prepare seafood at home. It may also be associated with an increased number of seafood choices as: new product forms, increased availability of seafood through the away-from-home food sector, an expanded role of the supermarkets as seafood suppliers and an overall better economy. An earlier Norwegian study found that seafood consumption increased with increasing size of the household, increasing age and higher education among women 30-44 years. The presence of school-aged children in the household and region of residence were significant determinants of the kind of seafood consumed, while product attributes more than product price were important perceived barriers for total fish consumption (Myrland & Trondsen *et al*, 2000). However, our understanding remained limited of how seafood consumption is influenced by consumers' health and beliefs about healthy food in a lifestyle and socioeconomic perceptive.

In recent years some imaginative approaches to the analysis of consumer demand for seafood have produced new insights. These approaches have extended the neo-classical model of consumer choice to explore the attitudes of buyers towards seafood consumption, to estimate the willingness to pay for different quality dimensions, and even more fundamentally, to uncover the process of preference formation. (Myrland & Trondsen *et al*, 2000)

Curiously, little attention has been paid to understanding the complementary relationship between the consumption of seafood and other healthy food on the one hand, and consumers' health and beliefs about healthy food on the other.

The orientation of the present study was to understand the consumption pattern of different seafood, especially fish. In particular, we were interested in how seafood consumption is influenced by factors, which can be changed through marketing and health information.

The aim of this study is to investigate how seafood consumption is influenced by consumers' self-perceived health status and their beliefs about healthy food, in a framework, which include attitudes to fish consumption, food consumption pattern and socioeconomic background.

Understanding how healthy food perception and food lifestyle factors influence consumption behavior and demand is important for marketers who want to target specific market segments.

Materials and methods

The Norwegian Seafood Consumption study (NSCS) is a study based on a data collected in 1996 as a part of the epidemiological "Norwegian Women and Cancer study" (NOWAC). The main objective for the epidemiological study is to test whether the presence of seafood in the diet is a protection factor for several health problems in women. Product prices, a central variable in any demand analysis, were not included in the survey sample. However, the data include information on self-perceived health and health problems, healthy food attitudes, demographics, eating habits and more traditional non-market variables. The age group 45-69 years consisted of individuals who belonged to households ranging in size from one person to several members, including children, and the income- and education levels were broadly distributed. These individuals had relatively long experiences as consumers, food purchasers and homemakers. The results were expected to be valid for women. Earlier studies have, however, shown no difference between the sexes regarding seafood consumption in Norwegian households and in the U.S. food-at- home market (Myrland, 1998; Fagerli & Wandel, 1999; Nayga & Capps, 1995).

The random sample of women aged 45 through 69 years was drawn from The Central Person Register kept by Statistics Norway and is representative for the Norwegian population as a whole.

The Register contains information on all persons living in Norway, including temporary residents. All persons have been given a unique identification number consisting of six digits for the birth date (day, month, and year) and a five-digit number used for a control algorithm and that includes information on gender. In addition, the register contains information on name, address, citizenship and marital status.

Each woman was asked to return the completed questionnaire, together with an informed consent statement for later linkage to national health registers. Those unwilling to participate were asked to return the uncompleted questionnaire. After six weeks a reminder was mailed to those who had not returned the original invitation.

Altogether 17928 women were sampled from the national population register. No respondents had been part of previous NOWAC surveys. A total of 9407 women filled in the questionnaire and returned it by mail. The crude response rate was 52.5%.

The respondents were asked several questions related to their consumption of 74 central food items. We selected those identified as dinner dishes, including five non-fish and three fish dishes. Because the data were generated by an epidemiological study, they employed represented perceptions towards three generic classifications of seafood products, rather than towards specific brands or species of seafood. However, the material was extensive and permits a pioneering investigation into the roles of socio-economic, attitudinal and lifestyle practice (food consumption pattern and physical activities) in seafood consumption choices.
Consumption of these food items was determined by asking: "For each of the listed food items please indicate how many meals you on average consumed during the last year." (1) Almost never, (2) Once each month, (3) 2-3 times a month, (4) Once each week, (5) Twice a week, (6) Three times a week, (7) 4-5 times a week, (8) 6-7 times a week. To avoid problems associated with lack of model fit, the eight -point scales was converted to a binary scale. Once a week or higher (4 or higher) was re-coded to 1, other values were coded to zero. Definitions of these and other binary variables are given in Table 1 (Pages 10 and 11). All explanatory variables operationalised in a scale way are converted into binary form.

The analyses focus on women's consumption of seafood products, by considering consumers' attitudes, health factors, food consumption pattern and socioeconomic factors in one model (Fishbein & Ajzen, 1975; Neste *et al*, 1998; Furst *et al*, 1996). We have chosen an exploratory approach in the selection of explanatory variables in order to control for as many potentially significant variables as possible in one model. The choice of variables in the model was based on reported findings in the literature and our own experience about factors we expected were associated with seafood consumption and healthy diet in Norway. The final model includes only variables that have a significant association with one or more of the fish consumption measures.
The model is described in Figure 1 (page 9).

The model focuses on the direct associations between the explanatory variables and seafood consumption patterns. The mechanisms by which explanatory variables are expected to influence seafood consumption are not a part of the model.
The dependent variables were different seafood consumption patterns. They were defined as number of seafood dinners per week of (1) fat fish (salmon, herring etc), (2) lean fish (cod etc.), and (3) processed fish (fish cakes sticks, puddings etc.).
The food consumption variables were divided in "healthy food" and "non-seafood" categories. Healthy food consumption was reflected in questions about regular use of specific food items regarded as healthy. For example, values of "5-A-Day" variable were calculated on the bases of reported consumption of five units of vegetable and fruit a day (Hjartåker & Lund 1998).
Other food items were cut of meat and other non-seafood items that may belong in the consumer's "evoked set". These items may thereby provide variety, thereby influencing frequency of seafood consumption (Richardson *et al*, 1993). An evoked set is the set of foods that come to mind when the consumer is asked to list dinner dishes. Food consumption reflects the weekly combination of dinner meals, which normally are limited to seven dinners a week.
The Norwegian Data Inspectorate approved the study and the data is based on informed consent.

Statistical methods
Both the SAS software package (version 6.12) and the SPSS software package (version 9.0) were used to compute calculations and conduct analyses. Missing values of food consumption variables were handled in the following way: In the questionnaire the food consumption questions are grouped into several tables. Each table concerns consumption of related food or beverages. When a table was only partially filled in by a participant, we have assumed that non-answered questions indicate no consumption. On the other hand, a blank table is left without imputations. Multiple logistic regression models were used in the statistical analyses, where odds ratios (OR) with corresponding p-values were calculated through maximum likelihood estimation (Hosmer & Lemeshow, 1989). A stepwise variable selection procedure generated the significant associations on the 5% significance level. Associated with each analysis, a Hosmer and Lemeshow goodness-of-fit test was carried out to confirm the adequacy of the model. A goodness-of fit test evaluates how well the model can predict the outcome variable, where the higher p-value the better fit. Although frequencies of fish consumption for dinner originally were divided into eight levels, we preferred to use binary response variables. We found that a number of predictors, combined with several levels of the response variable, might give too many empty cells and hence unstable parameter estimates.

Results
Table 2 (page 11) shows that the women surveyed were heavy fish eaters. On average they consumed 11.5 meals of fish per month (2.7 times a week): 2.5 fat fish meals, 5 lean fish meals and 4.1 processed fish meals. The women consumed meat in 9 meals per month. Table 1 (pages 10-11) shows, for each fish dinner category, the proportions of women eating fish dinners once or more per week, which were 65% for lean fish, 59% for processed fish and 29% for fat fish. 51% felt that they consumed enough fish.

There were about 60 % of the women who had consumed meat (cut of meat and processed meat) at least once a week, while 20 % or less of the women had consumed porridge, pizza and rice/pasta dishes, respectively.
About 45% of all the women were living in the coastal regions north and west, while 52% of the responders were born in those areas. Only 1.5% of the respondents were born abroad. Of the respondents, 39% reported that, as children, they had at least consumed fish for dinner 3 times a week as kids.

Table 1 (Pages 10-11) shows that four-fifths the respondents had medium income or lower. The level of education was rather high, with 64% reporting ten or more years of education. More than half of the respondents lived in 2-person household, 17% in 3-person households, and 16% lived alone. Eighteen of the households included teenager children.
On health issues, 9% of the respondents perceived their health to be bad or very bad. 22 per cent reported problems with migraine headaches, and 14 per cent were regular users of medicine for cardiovascular disease. These were the most important health status indicators reported.

Beliefs about food and health are subjective internalized norms (Manstead, 2000). Health considerations may be expected to be an important factor for food choices, since 79% of the women stated that diet was important or very important for their health.
The women's body weight may also be an important factor for women's choice of food, since 52% wanted to reduce their weight. Table 1 shows that 38% of the women were defined as overweight, with a Body Mass Index (BMI) of 25 or higher (WHO, 1998). Physical activities were rather high: 45% reported middle or high amounts of physical activity, in term of physical work and sport/leisure activity. Among the women, 28% were regular smokers.
Healthy food patterns were related to a minority of the respondents. Fish oil was most frequently reported, with more than a third of the respondents were drinking fish oil daily. However, 29% of the women had daily food supplements, 27% did not use fat spread on bread and 17% eat 5-A- Day of vegetables and/or fruit.

Table 3 (Page 12) gives an overview of how the five main groups of explanatory variables ("Food and health beliefs", "Perceived health", "Fish consumption attitude", "Food consumption pattern" and "Socioeconomic pattern") contribute to predict the consumption of fat, lean and processed fish, respectively. The change in chi-square values describes the improvement in prediction when the variable groups are successively added to the model, measured as the proportion of the total model chi-square.

Table 4 (a-c, pages 12-13) shows the relative direct associations between fish consumption for dinner and each of the explanatory variables, measured by odd ratios.

"The fish consumption attitude" variable had the strongest relationship to consumption of lean fish (45% of the total Chi-square value when socioeconomic and food consumption pattern are already included in the model) "Socio-economic pattern" and "Food consumption pattern" variable group had the strongest association with consumption of processed fish, with each accounting for 40 % of the total Chi-square value. The "Food consumption pattern" variable group was the most important when explaining the variation in consumption of fat fish (50 % of the total Chi-square value, adjusted for socioeconomic factors).
Table 4a (page 12) shows that the region of residence was of a significant importance in explaining the consumption of all seafood categories. In the case of eating fat fish, living on the east coast regions (except the east central capital area) increased the odds by a third when compared to the eastern inland region. Living in Northern Norway increased the probability for eating lean fish by more than two third and the probability doubled of eating processed fish, but decreased the probability of eating fat fish by28 % to eat fat fish, all when compared with the figures for the Eastern inland region.
Living in West-Norway and Mid-Norway (Trøndelag) region increased the probability by of having processed fish for dinner once or more per week, compared with the eastern inland region (OR=1.75).
The effect of age
Table 4a shows that the probability of eating lean fish increased strongly with increasing age. The consumption more than doubled if the consumers were 65-69 years compared to 45-49 years. On the other side, no significant age effect for consumption of either fat or processed fish was uncovered in this analysis.
The effect of education
Education level did not appear to have any significant influence on the consumption of any of the fish categories. (The figures is not reported in table 4a)
The effect of income
Family income level was estimated to have a strong negative relationship with the consumption of processed fish. The probability for having lean and processed fish for dinner decreased by 40% if income increased from the lowest to the highest income level. The consumption of lean fish decreased significantly for only the highest income group. Fat fish consumption was not statistical related to the income level.
The effect of household characteristics
Generally, the probability of eating lean fish increased significantly from 30 to 60 % if two or more lived in the household, while the probability of consuming fat fish decreased about 40% if four and more lived in the households, compared to single households

The presence of children in the household did not have an additional significant effect in itself on the consumption of fish products (not shown in Table 4a)

The effect of eating fish in childhood

The probability of having high consumption levels of either lean fish (OR=1.53) or processed fish (OR=1.23) increased if the women had had fish for dinner three times or more in childhood

The effect of region of residence in childhood

To have lived in a coastal region during childhood was significantly negatively associated with fat fish consumption. (OR=0.55 – 0.68) compared to the eastern inland area.

The food consumption pattern

Table 4b (Page 13) shows that there are, apparently, complementary pattern between each fat, lean and processed fish and other food products.

The consumption of fish was significantly and positively associated with eating meat, but not to the more processed products, such as pizza, pasta and the traditional Norwegian porridge dinner. Fat fish and lean fish consumption were significantly positively associated with eating meat, with the odds ratio being1.92 and 1.70, respectively. The probability of weekly consumption of processed fish increased significantly if the respondents had minced meat (OR=2.39), cut of meat (OR=1.13), pizza (OR=1.23) and porridge (OR=1.33) once or more per week.

Table 4b (page 13) shows a strong relationship between fish consumption and healthy food variables, although the relationship was most significant for fat fish, less for lean and processed fish. There was a positive association between eating fat fish and the consumption of 5-A- Day of fruit/vegetables (OR=1.98) and the use of vegetable oil in cooking (OR=1.84). Intake of fish oil daily as a food supplement was also positively associated with eating fat fish (OR=1.37) and lean fish (OR=1.34)

Table 4b shows that the attitude variable fish consumption attitude " I am eating enough fish" had one of the single strongest association with both fat fish (OR=2.06) and lean fish (OR=4.78)

Perceived health and beliefs about food and health

With respect to health, none of the variables, reporting perceived health, diabetes problems, the wish to reduce body weight, physical activity or BMI was related to fish consumption pattern, and thus excluded from the model. However, eating fat fish was positively associated with the use of medicine for cardiovascular disease (OR=1.30) and current smoking behavior (OR=1.28).

Table 4c (page 13) shows that, of the health variable considered, the most important in influencing the fish consumption was beliefs about food being important for one's own health. There was a positive association between the respondents' belief that food is important for health and choosing fat (OR=1.40) or lean fish (OR=1.39) for dinner once or more per week, but this relationship was not uncovered in the case of processed fish.

Discussion

The response rate in this study was less than optimal making the study vulnerable to non-response bias. We know that the non-responders differed from the responders with respect to age and geographical distribution, and could weaken the generalisability of the study. However, the distribution of lifestyle factors did not, vary according to response rate in another part of the NOWAC study of adult Norwegian women (Lund & Gram, 1998)

Eating fish is a part of a broader food consumption pattern limited by availability of ingredients, skill of preparation and preferences. People make choices between seafood products, and between seafood and other complementary and substitute products. This cross-sectional study indicates that different social forces influence these choices, depending on the stage in the products life cycle and the size of the market. Whether there is high consumption of lean fish in a traditional mature market strongly associates with the users' attitudes toward fish consumption, while a medium level of consumption of traditional processed fish in a mature market is associated with a broader, current fast food consumption pattern and with the consumers socio-economic background. The lower but growing consumption level of fat fish (mainly salmon and trout) is more associated with the broader healthy food consumption pattern. Our findings indicate that the consumption of non-seafood items was a stronger predictor of the consumption of fat fish and processed fish than of lean fish. Meat cuts and minced meat were complementary to all three categories of fish, while fast food, like pizza and porridge were complementary to consumption of processed fish.. Healthy food items were complementary to fish, especially fat fish. This indicates that the growing consumption of aquaculture salmon and trout is associated with patterns of healthy cooking and drinking, while lean fish and processed fish are part of a traditional food pattern.

The consumption of fat fish was associated with use of medicine for cardiovascular disease and current smoking. The consumption of both fat and lean fish was associated with the belief that food is important for health. This finding confirms the findings of a positive association between seafood consumption and consumers interests in products that content polyunsaturated fatty acids (Foxall *et al*, 1998). The fact that health variables were associated to fat fish consumption confirms the view that fish choices are a part of a broader food consumption pattern (Altekruse *et al*, 1995).

One reason for the differences in consumption was the influence of region of residence. Lean fish and processed fish consumption dominated the Norwegian coastal

regions, and fat fish consumption dominated the central eastern region. The observed consumption patterns may, to a large extent, be linked to the local supply of fresh seafood. In Northern and Western Norway the availability for lean fresh cod is greatest and this, historically has played an important role in food consumption patterns. Processed fish products are also mainly made from lean codfish.

On the other hand, fresh fat fish as mackerel and herring has traditionally been important in the southeastern parts of Norway. A new supply tendency in recent, where aquaculture salmon plays a more important role, seems to fit into the traditional preference for fat seafood amongst people in the capitol of Oslo and the surrounding areas. These findings are consistent with earlier research, which have uncovered important regional differences in seafood demand (Wessells & Anderson, 1992; Johnston, 1995; Olsen, 1989; Myrland & Trondsen *et alal*, 2000). The importance of the region of birth in explaining adult seafood eating habit confirms this: while learning about food and food habits happen throughout the life span, much occurs the first 5 years of life (Nestle *et alal*, 1998, Hursti, 1999).

The consumption of fish increases with age. This positive association between age and consumption of fat and lean fish but no processed fish in the age groups 45-69, confirms previous studies of Norwegian women in the age group 30-44 years (Myrland & Trondsen *et alal*, 2000; Olsen, 1989)

Earlier studies have shown that higher consumption of recommended healthy food such as fish and potatoes is related to a lower consumption of meat, chocolate and alcohol among older women (Johansson *et al*, 1997; Hjartåker & Lund, 1998). These findings indicate a growing intention among women to adhere to better nutrition behavior as they grow older and gain weight (Renner *et al*, 2000).

Education level was not a significant predictor for the consumption of any of the three fish product group. This finding contradicts earlier findings in Myrland & Trondsen *et al* (2000) where the education level in the age group 30-44 year was positively associated with the consumption of each of these product groups. However, this may be explained by the fact that there are large differences in education level between these two Norwegian populations. University level education was held by 57% in the age group 30-45 compared to 31% in the age group 46 to 69. The subjects of the earlier study represent a different and younger generation. Education might be most important for diet in the cases where emerging knowledge about food and health has to be considered, adopted and implemented into new consumption practice. Fish for the older women are more traditional and viewed as cheap food. In this age group, knowledge about cooking and diets have been communicated from mother to daughter rather from nutritionists through education and mass media, which may be more important for the younger generations. Seafood consumption's association with education is also confirmed by Nauman *et al*, (1995) and Huang (1995). Its association with healthy eating and behavior is supported by MartinezGonzalez *et al* (1998) and Shi (1998). In addition, the differences between generations in linking education and seafood consumption support however the hypothesis offered by Myrland & Trondsen *et al* (2000) that the importance of education in explaining seafood consumption may have increased since the late 1980's and will grow by increasing education level in the society. Age and level of education may reflect the finding that more experience and knowledge influence the perception of the relationships between food, health and after-meal feelings (ibid).

The household income level was negatively associated with the consumption of lean and processed fish, but not of fat fish. This findings may support the hypothesis that income appears to play a smaller role in explaining the frequency of seafood purchases for at-home use than it does in explaining consumption pattern or expenditure (Herrmann *et al*, 1994 and Nauman *et al*, 1995). The finding contradicts the findings in Myrland and Trondsen *et al* (2000) where no relationship was found between income and seafood consumption patterns in the Norwegian 30-44 year women.. A main difference is the very high consumption level of lean and processed fish in the 45-69 year population. This population consumed monthly 9.1 meals lean and processed fish and 2,5 meals fat fish. The similar figures in the 30-34 year group were 6,9 meals and 2,1 meals respectively (Myrland and Trondsen *et al*, 2000). This difference may reflect a generation effect. Lean and processed fish have traditionally been seen as cheap food, especially in the coastal areas where people also can catch their own fish for free. This finding confirms similar findings that lower income is associated with increased consumption of self-caught fish (Burger *et al*, 1999).

This is also confirmed by the finding that increasing household size increases consumption of the cheaper lean fish. Households with children did not increase consumption of processed fish, unlike the findings reported for the age group 30-44 years by Myrland and Trondsen *et al* (2000). This difference indicates a generation effect, where fast food is more strongly associated to younger women living in families with children.

The influence of education and income on seafood consumption is consistent with the generally documented association between socioeconomic status, exercise, weight control, and healthy diet and behavior (Jeffery *et al*,1991; Tucker *et al*,, 1995; Hjartåker & Lund, 1998, Johansson *et al*, 1999; Uitenbroek *et al*, 1996). Our study indicates, however; when it comes to fish consumption among older women in high consumption traditional seafood markets, neither education nor normal income

plays a positive role in consumption of fish. Indeed, higher income appear to have a negative effect on the consumption of processed fis, and very high income levels appear to be associated with reduced consumption of lean fish.

Conclusion

Beliefs about food and health, perceived health status and the consumers' overall food consumption pattern were all positively associated whitefish consumption pattern among women 45-69 years bracket. Food- health belief and health status also have an effect on the selection of products. The health influence is stronger in the case of fat fish consumption, which is growing, than the more traditional, high frequency lean fish consumption. A health conscious segment is identified, where consumption of seafood, especially fat fish, is strongly related to a broader healthy diet pattern. Fish consumption is also positively associated to increasing age.

We have also identified a fast- food segment, where processed fish and such other products as hamburgers, pizza and porridge are included. This segment plays a less important role for fish consumption than in the case for household with younger women. A third important segment is the traditional lean fish and processed fish segment, constrained by the availability of cheap fresh codfish in Norway.

Education and income play no significant positive role for fish consumption among older women. Increasing income has a negative impact on the consumption of processed fish and the highest income level is associated to lower lean fish consumption.

Marketing implications

Even though seafood consumption in Norway is high compare with other countries (2,5 times higher than in the USA), this study shows several important potentials for both health authorities and seafood industry to improve seafood consumption and sales in market segments where the fish consumption still is low. All promotion and health information that strengthen knowledge about the relationship between food choice and health will increase seafood consumption. Promotion of the links between seafood products and health may be a profitable business investment. Health-promotion elasticities in the US poultry market are found to be higher than price elasticities (Kinnucan *et al* , 1997). It means that investment in positive food-health information gives more sales than will lower prices by a comparable percentage. Alliances between health authorities and seafood industries may therefore have the potential to increase healthy eating. In this paper we have focused on women, but we expect that the same results are valid for men who live in households with women who carry on the cooking traditions. The marginal effect of healthy food information for men may be most effective through mass media and through direct advices from physicians. (Mcintosh *et al*, 1995; Turrell, 1997; Fagerli & Wandel, 1999).

In the Norwegian context, we have found that seafood consumption is positive related to fish landings regions and to age, where the level of consumption already is very high. The marginal effect of marketing and promotion effort would be highest by focusing the 38% of the population who expressed that they are not eating enough fish, i.e. younger people in the inland regions far away from the fish landing regions. There is also a potential in the fast food segment for seafood to substitute for other food. Further development of high quality, healthy and low calorie seafood, which fit into the fast food segments, might be recipe for success. Seafood might be marketed together with other healthy foods, such as fruit, vegetables, vegetable oils and fish oils. Healthy fast food lines combining processed fish, as fish burgers, healthy hamburgers and pizza is another option. To design, target and get high response rates from marketing and health information campaigns, it is necessary to understand why people who want to eat more fish, do not eat more fish. What kinds of barriers do they experience? Are the main barriers in lack of local supply of fresh and tasty products to an affordable price, or are the barriers in the consumers' preferences, family attitudes or skills in preparation seafood meals. These are important questions for further investigations.

Litterature

Altekurse, SF.& Timbo, BB.& Headdrick, ML.& Klontz, KC. (1995). Associations between diet and health behavior- Results from the 1992 Rhode Island behavior risk factor survey. *Journal of Behavioral Medicine*. Vol. 18, No 3, June, pp 225-232

Bredahl, L.& Grunert, KG. (1997). Determinants of the consumption of fish and shellfish in Denmark: An application of the theory of planned behavior. In J.B.Luten, Børresen,T. and Oehelenschlager, J. (eds*.) Seafood from producer to consumer, integrated approach to quality*, pp.21-30. Amsterdam, Elsevier

Burger, J & Stephens, WL & Boring, CS & Kuklinski, M & Gibbons, JW & Gochfeld, M (1999). Factors in exposure assessment: Ethnic and socioeconomic differences in fishing and consumption of fish caught along the Savannah River. *Risk Analysis*. Vol. 19, No 3 pp 427-438

Connor, WE. & Connor, SL (2000). The importance of N-3 Fatty acids in health and disease. Proceedings *IIFET Conference 2000*. Oregon State University

Cox, DR. & Snell, EJ. (1989). *Analysis of Binary Data*, Second Edition. London. Chapman and Hall.

Foxall, G & Leek, S & Maddock, S (1998). Cognitive antecedents of consumers' willingness to purchase fish rich in polyunsaturated fatty acids (PUFA). *Appetite.* Vol. 31, No 3, pp 391-402.

Fisbein, M. & Ajzen, I. (1975). *Beliefs, attitude, intention and behaviour*. Don Mills, New York Addison Westley

FAO (2000): Statistical databases. *http://apps.fao.org*

Fagerli, RAa. & Wandel, W. (1999). Gender Differences in Opinions and Practices with regard to a "Healthy Diet". *Appetite*, 32, 171-190

Furst, T. & Connors, M. & Bisogni, CA. & Sobal J.; Falk LD. (1996). Food Choice: A conceptual Model of the Process. *Appetite* 26, 247-266.

Harel, Z. & Riggs, S & Vaz, R. & White, L. & Menzies, G. (2001): Omega-3 polyunsaturated fatty acids in adolescents: Knowledge and consumption. *Journal of Adolescent Health* Vol. 28. No 1. pp 10-15

MartinezGonozalez, MA. & LopezAzpiazu, I. & Kearney, J. & Keraney, M. & Gibney, M. & Martinez, JA. (1998). Definition of healthy eating in the Spanish adult population: a national sample in a pan-European survey. *Public Health.* Vol. 112, No 2, pp 95-101.

Herrmann, R O. & Rauniyar, G P. & Hanson, G D. & Wang, G. (1994) Identifying Frequent Seafood Purchasers in the Northeastern U.S. *Agricultural and Resource Economics Review.* October 1994, pp. 226-235.

Hosmer, DW. & Lemeshow, *S. (1989). Applied Logistic Regression.* New York. John Wiley & Sons, Inc.

Hjartåker, A.& Lund, E. (1998). Relationship between dietary habits, age, lifestyle, and socio-economic status among adult Norwegian women. The Norwegian Women and Cancer Study. *European Journal of Clinical Nutrition* 52, 566-572

Huang, C. L. (1995). Socio-demographic Determinants of Seafood Consumption Patterns in the United States. In: David S. Liao (Ed.) International Cooperation for Fisheries and Aquaculture Development: *Proceedings of the 7th Biennial Conference of the International Institute of Fisheries Economics and Trade*. National Taiwan Ocean University, Keelung, Taiwan, R.O.C. Volume III, pp. 200-211.

Hursti, UKK. (1999). Factors influencing children's food choice. *Annals of Medicine.* Vol 31. pp 26-32

Johansson, L. & Solvoll K & Bjørneboe G-EAa. & Drevon, CA. (1997). Dietary habits among Norwegian men and women. *Scandinavian Journal of Nutrition* 2, pp 63-70)

Johansson, L. & Thelle, DS. & Solvoll, K. & Bjorneboe, GEA. & Drevon, CA (1999). Healthy dietary habits in relation to social determinants and lifestyle factors. *British Journal of Nutrition*. Vol. 81. No 3 pp 211-220

Jeffery, RW. & French, SA. & Forster, JL. & Spry, VM. (1991). Socioeconomic status differences in health behaviors related to obesity- the healthy worker project. *International Journal of Obesity*. Vol. 15, No 10, pp 689-696

Johnston, RS. (1995). Developments in Seafood Markets and Marketing Research. In: David S.Liao (Ed.) International Cooperation for Fisheries and Aquaculture Development: *Proceedings of the 7th Biennial Conference of the International Institute of Fisheries Economics and Trade*. National Taiwan Ocean University, Keelung, Taiwan, R.O.C. Volume III, pp. 17-30.

Kinnucan, HW. & Xiao, H. & Hsia, CJ. & Jackson, JD. (1997). Effects of health information and generic advertising on US meat demand. *American Journal of Agricultural Economics*. Vol. 79, No 1, pp 13-23

Leek, S. & Maddock, S. & Foxall, G. (2000*).* Situational determinants of seafood consumption. *British Food Journal*, 102, 18-39.

Lund, E. & Gram, IT. (1998): Response rate according to title and length of questionnaire. *Scandinavian Journal of Social Medicine*

Mcintosh, W.A. & Fletcher, R.D. & Kubena, K.S. & Landman,W.A. (1995). Factors associated with sources of influence information in reducing red meat by elderly subjects. *Appetite*. Vol. 24, No 3, June, pp219-230

Manstead, A.S.R.(2000). The role of moral nom in the attitude-behavior relation. In D. J. Terry and M.A. Hogg (eds.*). Attitudes, behavior and social context: The role of norms and group membership*, pp 11-30. Magwah, NJ: Lawerence Erlbaum

Myrland, Ø. & Trondsen, T. & Johnston, R.S. & Lund, E. (2000). Determinants of Seafood Consumption in Norway: Lifestyle, revealed preferences, and barriers to consumption *Food Quality and Preferences* Vol. 11 Issue 3 page: 169-188

National marine Fisheries Services (1999): Fisheries of the United States. *http://www.st.nmfs.gov/st1/fus/fus99/index.html*

Nayga, RM. (2000). Schooling, health knowledge and obesity. *Applied Economics*. Vol. 32, No 7, pp 815-822

Nayga, RM. Jr. & Capps, O. Jr. (1995). Factors Affecting the Probability of Consuming Fish and Shellfish in the Away from Home and at Home Markets. *Journal of Agricultural and Applied Economics*. Vol. 27, No. 1, pp. 161-171.

Nestle, M. & Wing, R. & Birch, L. & DiSogra, L. & Drewnowski, A. & Middleton, S. & Sigmnan-Grant, M. & Sobal, J. & Winston, M. & Economos, C. (1998). Behavioral and Social Influences on Food Choice. *Nutrition Reviews*, Vol. 56, No 5.

Nauman, FA. & Gempesaw, CM.& Bacon, JR.& Manalo, A. (1995) Consumer Choice for Fresh Fish: Factors Affecting Purchase Decisions. *Marine Resource Economics*. Vol. 10, pp. 117-142.

Olsen, SO. (1989). Seafood in Norwegian households: Differences in attitude and consumption behavior (in Norwegian). Tromsø. Institute of Fisheries and Aquaculture.

Sparks, P. & Guthrie, CA. (1998). Self-identity and the theory of planned behavior: A useful addition or unhelpful artifice? *Journal of Applied Social Psychology* 24, 1393-1410.

Renner, B. & Knoll, N. & Schwarzer, R. (2000): Age and body make a difference in optimistic health beliefs and nutritional behavior. *International Journal of Behavioral Medicine*. Vol. 7, No 2, pp 143-159.

Richardson, N J. & Shepherd, R. & Elliman, N A. (1993) Current Attitudes and Future Influences on Meat Consumption in the U.K. *Appetite*, Vol. 21, pp. 41-51.

Rickertsen, K. (1996). Structural change and the demand for meat and fish in Norway. *European Review of Agricultural Economics*. Vol. 23, No 3, pp 316-330.

Shi, LY. (1998). Socioeconomic characteristics and individual health behaviors. *Southern Medical Journal* Vol. 91, No 10. pp 933-941

Trondsen, T. (1997). Marketing potential and barriers for fresh packed fish. A survey of buyer perception in UK and French seafood distribution. *Journal of Food Products Marketing Vol. 4 (2), pp79-99*

Trondsen, T. (1997). Value-added fresh seafood. Barriers to growth. *Journal of International Food & Agribusiness Marketing Vol. 8 (4), pp 55-78.*

Trondsen, T. & Johnston, RS. (1998). Market Orientation and Raw Material Control. *Journal of Market Focused Management* 3, 193-210

Tucker, K. & Spiro, A. & Weiss, ST. (1995). Variation in food and nutrient intakes among older men – age, and other socio-economic factors. *Nutrition Research*. Vol. 15, No 2, pp 161-176

Turell, G. (1997). Determinants of gender differences in dietary behavior. *Nutrition research*. Vol. 17, No 7, July, pp 1105-1120

Turrell, G. (1998). Determinants of healthy choice in a population-based sample. *American Journal of health behavior.* Vol.22, No. 5, pp 342-357

Uitenbroek, DG. & Kerekovska, A. & Fetchieva, N. (1996). Health lifestyle behavior and socio-demographic characteristics. A study of Verna, Glasgow, and Edinburgh. *Social science & Medicine*. Vol. 43, No 3, pp 367-377

Variyam, JN. & Blaylock, J. & Smallwood, D. (1998). Informational effects of nutrient intake determinants on cholesterol consumption. *Journal of Agricultural and resource Economics*. Vol. 3, No 1, pp 110-125

Verbeke, W. & Viaene, J. & Guiot, O. (1999). Health communication and consumer behavior on meat in Belgium: From BSE until dioxin. *Journal of Health Communication*. Vol. 4, No 4, pp 345-357

Wessells, C R. & Anderson, J L. (1992). Innovations and Progress in Seafood Demand and Market Analysis. *Marine Resource Economics*. Vol. 7, pp. 209-228.

WHO (1998): *Obesity: preventing and managing the global epidemic.* Report 1-278.

Figure and tables

Figure 1: Model

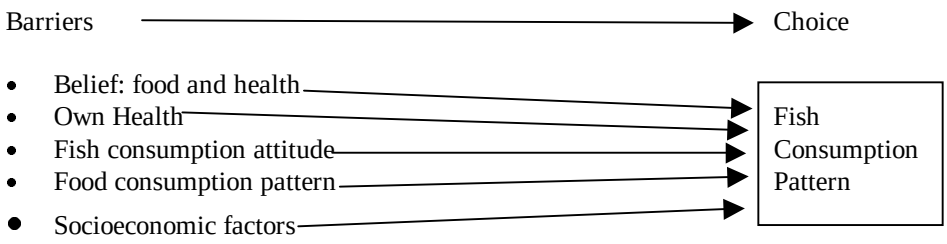

Table 1. Characteristics of the sample

	n	Pct. yes
Food and health beliefs		
• "Food important for health" (important/very important)	9077	79
• Perceived health (poor/very poor),	9064	9
• Wishes to reduce the body weight	9199	52
Fish consumption attitude		
• Do you eat enough fish	9087	51
Perceived Health Status		
• Have you had migraine?	8703	22
• Have you had diabetes?	8703	2
• Do you use of medicine for cardiovascular disease?	9009	14
• Do you use of pain relievers	9044	8
• High physical activity (6-10,on a scale 1-10)	8400	45
• BMI (Weight /(height in meter)^2 < 20	9261	7
• BMI 20-24,9	9261	55
• BMI >25	9261	38
• Current smoker	9294	28
Food Consumption Pattern		
Healthy food		
• Fat spread on bread	9183	73
• Five or more units of vegetables or fruit per day	9236	17
• Oils from soy, olive or corn for cooking	9367	4
• Fish oil all forms in winter ≥ once a day	9364	37
• Other food supplements ≥ once a day)	9364	29
• One glass wine ≥ once a week	9289	27
-Consumption of non-fish dinners ≥ once a week		
• Minced meat	8960	64
• Cut of meat dishes	8960	57
• Pizza	9309	10
• Pasta and rice	9163	19
• Porridge	9100	15
▪ Shrimp and crab	9095	3
Consumption of fish dinners		
• Fat fish (mackerel, salmon etc.) for dinner ≥ once a week.	8960	29
• Lean fish (cod etc.) for dinner ≥ once a week)	8960	65
• Processed fish for dinner ≥ once a week	8960	59
Socio-economic variables		
-Age	9407	
• 45 - 49		26
• 50 - 54		24
• 51- 59		20
• 60 - 64		16
• 65 - 69		14
Annual household income income is	8894	
• Very low income (< NOK 150.000)		15
• Low income (NOK 150,000 - NOK 300.000)		38
• Medium income (NOK 301,000 - NOK 450,000)_		29
• High income (NOK 451,000 - NOK 600,000)		14
• Very high income (>NOK 600,001)		4

	n	Pct. yes
Region of residence in childhood	8702	
• Central Inland (Hedemark and Oppland counties)		14
• Central East (The Oslo and Akershus counties)		15
• South East (The South Eastern counties except the above)		17
• West coast/ Mid (West Norway and Trøndelag counties)		36
• The Northern counties (North Norway)		16
• Abroad		2
Region of residence.	9407	
• Central Inland		14
• Central East		22
• South East		19
• West coast/ Mid		33
• Northern		12
Consumed fish more than 3 times a week as children	9099	39
Years of education	8370	
• <10		36
• 10 - 12		33
• 13+		31
Household size (number)	9121	
• 1		16
• 2		54
• 3		17
• 4		9
• 5+		4
Children in the household	9405	
• No children in household		77
• 0 - 7 years		1
• 8 - 12 years		4
• 13 -19 years		18

Table 2. Average consumption of different food items per Month (mean number of times)

Variable	*n*	*Mean*	*SD*
Lean fish (Cod, haddock etc.)	8960	4.96	3.82
Processed fish (Cakes, sticks, puddings etc.)	8960	4.10	3.18
Fat fish (Salmon, trout, mackerel etc.)	8960	2.46	2.75
Cut of meat	8960	4.27	3.34
Minced meat	8960	4.69	3.26
Fish oil	9364	13.17	15.4
Pizza	9309	1.27	1.51
Vegetables and fruit	9236	112.51	47.66
Pasta and rice	9163	5.06	4.03
Porridge	9100	1.49	1.49
Shrimp and crab	9095	0.88	1.04
Glass of vine	9289	3.55	5.79

Table 3. Explaining fat fish, lean fish and processed fish for dinners per week by percent contribution to the total Chi-Square value of blocks of independent variables.

	Fat fish 1+ meals pr wk	Lean Fish 1+ meals pr wk	Processed fish 1+ meals pr wk
	Δ Chi-sq	Δ Chi-sq	Δ Chi-sq
SOCIOECONOMIC PATTERN	25.8 %	37.7 %	41.8 %
FOOD CONSUMPTION PATTERN OTHER THAN FISH	50.1 %	15.8 %	44.0 %
FISH CONSUMPTION ATTITUDE	18.9 %	45.0 %	13.5 %
PERCEIVED HEALTH STATUS	2.7 %	0.2 %	0.5 %
FOOD-HEALTH BELIEFS	2.5 %	1.4 %	0.3 %
Hosmer and Lemeshow goodness-of-fit statistic	p=0.98	p=0.58	p=0.18

Table 4a. The odds ratios for consuming fat fish, lean fish and processed fish at least once a week described for different sosiodemographic variables and mutually adjusted for all explanatory variables presented in 4a-4c.

	Fat fish 1+ meals pr wk	Lean fish 1+ meals pr wk	Processed fish 1+ meals pr wk
	OR	OR	OR
Age (years			
• 45-49	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)
• 50-54	0.98	1.18*	0.97
• 55-59	1.12	1.38***	0.98
• 60-64	1.22	1.53***	1.12
• 65-69	1.24	2.12***	1.03
Income			
• Very low	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)
• Low	1.14	0.93	0.78**
• Medium	0.99	0.98	0.80*
• High	1.05	0.77	0.64***
• Very high	1.19	0.52***	0.54***
Persons in household (number)			
• 1	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)
• 2	0.89	1.61***	1.16
• 3	0.88	1.29*	1.05
• 4	0.62***	1.32*	1.23
• 5+	0.70	1.56*	1.27
3 fish meals per week as kid	1.11	1.53***	1.23**
Childhood region of residence			
• *Central Inland*	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)
• Central East	0.81	0.78*	1.04
• South East	0.85	0.81	0.98
• West Coast/Mid.	0.68**	0.91	1.11
• Northern	0.55***	1.01	1.19
• Abroad	1.66*	0.98	0.65
Region of residence			
• *Central Inland*	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)
• Central East	1.15	1.14	1.07
• South East	1.32*	0.90	1.01
• West coast/Mid	1.02	1.27	1.75***
• Northern	0.72*	1.73***	2.01***

*p<=0.05, **p<=0.01, ***p<=0.001

Table 4b. The odds ratios (OR) for being a consumer of fat fish; lean fish and processed fish described for different food consumption variables and mutually adjusted for all explanatory variables presented in 4a-4c.

	Fat fish 1+ meals pr wk	Lean fish 1+ meals pr wk	Processed fish 1+ meals pr wk
	OR	OR	OR
FISH CONSUMPTION ATTITUDE			
"I'm eating enough fish"	2.06***	4.78***	1.74***
FOOD CONSUMPTION PATTERN			
-Healthy food			
Five-A-Day vegetables and/or fruit	1.98***	1.50***	1.41***
Use vegetable oil for cooking	1.84***	1.24	0.96
Fish oil daily	1.37***	1.34***	1.23***
Wine weekly	1.37***	0.99	1.04
-Non-seafood (1+ times a week)			
Minced meat	1.41***	1.70***	2.39***
Cut of meat	1.92***	1.70***	1.13*
Pizza	0.85	0.89	1.23*
Porridge	1.03	1.10	1.33***

*p<=0.05, **p<=0.01, ***p<=0.001

Table 4c. The odds ratios (OR) for being a consumer of fat fish, lean fish and processed fish described for health related variables and mutually adjusted for all explanatory variables presented in 4a-4c.

.

	Fat fish 1+ Meals pr wk	Lean fish 1+ meals pr wk	Processed fish 1+ meals pr wk
	OR	OR	OR
FOOD-HEALTH BELIEFS			
"Food important for health"	1.40***	1.39***	1.09
PERCEIVED HEALTH STATUS			
Migraine problems	1.06	0.99	1.03
Cardiovascular medicine user	1.30**	1.15	0.97
Current smoker	1.28***	1.07	0.91