Consumption of seafood -The influence from overweight and health beliefs.

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Abstract

Main research question: How is seafood consumption influenced by overweight and health beliefs in a region of traditional high-level fish consumption?

Materials and methods: A randomly drawn sample of women aged 45–69 years who live in Northern Norway answered a self-administrated questionnaire about eating habits, socioeconomic factors and questions related to health sent to them by mail; 7556 women answered the questionnaire (response rate 56.1%) analyzed by logistic regression methods.

Findings: The mean consumption of seafood was 15 times a month. There were 46% of the respondents who were overweight, 77% agreed that food is important for health and 55% had a desire to reduce weight. Overweight women consumed less lean fish than normal weight women (OR=0.8). Fish consumption was not associated to the desire to reduce weight. However, a general healthy food consumption pattern was both a strong predictor for weekly fish consumption and for normal weight and for the desire to reduce weight. Very high family income was associated to higher fat fish consumption (OR=1.9) normal body weight and for the desire to reduce weight (OR=2.1). High fish consumption in childhood and the belief that food is important for health were both strong predictors high fish consumption (OR=2.1 and 1.4 respectively for lean fish). Kids <7 years in the household predicted processed fish consumption (OR=2.9) but not the beliefs that food is important for health, that is predicted by teenagers in the households (OR=1.4). Education predicted high fat fish consumption, while age was a strong predictor for high lean fish consumption (OR=1.88 for >60 years compared to 45-49 years).

Main conclusion: Higher fish consumption was predicted the more consumers' believe and behave according to foods importance to health, but not by overweight or desire to reduce weight. High fish consumption in childhood and high level of education and income in the population was also predictors of high fish consumption. Promoting of seafood as a low calorie healthy food and improving the healthy aspects of processed fish products may increase seafood consumption. The consumption effect will most probably be strongest among consumers with highest education and income. Teaching kids and teenagers eating seafood improves seafood consumption as adult.

Key word*s: Food lifestyle, seafood, consumer behavior, segments, consumption, food choice, health, overweight, promotion, market barriers, marketing, Norway*

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Introduction

How does overweight and health influence choice of seafood in a region of traditional high-level fish consumption? This question is important for promotion of seafood's consumer values and for improving the healthy dieting in the population. Modern malnutrition is increasingly accepted as a threat to health. The new food-related lifestyle epidemic is being overweight and obesity[1], which may lead to diabetes, cardiovascular diseases, etc. (WHO, 1998). Medical research has, however, shown that a high consumption of fish oil (omega-3), e.g. cod liver oil or fatty fish, reduces the risk of several of the lifestyle diseases (Connor & Connor, 2000). Substituting the intake of fatty meat with a mixture of seafood and vegetables might improve the quality of the fat consumed and reduce consumers' total calorie intake, and could prevent lifestyle diseases. Based on such knowledge, medical authorities, nutritionists and physicians recommend several options of health-oriented strategies, in which diet, exercise and use of medical treatment are combined (WHO, 1998).

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). The elasticity in health information in general has been found to be larger in absolute value than the elasticity in price in the US poultry

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[1] Overweight=BMI>25, Obese=BMI>30. BMI (Body Mass Index) is measured as Body weight in kgs/High in meter^2 (WHO, 1998)

market, which means that one may get more sales from investment in food-health information than from using similar percentage price reductions (Kinnucan *et al.*, 1997). On the other hand, negative food-health information may also have a tremendous negative impact on food consumption as illustrated by the linkage in the media between meat consumption and bovine spongiform encephalitis (BSE) (Verbeke *et al.,* 1999).

Earlier studies have indicated that information about healthy food penetrates differently into different sectors of the population, e.g. women, more than men, tend to comply with dietary guideline recommendations from written materials, their social networks and relatives/friends. Men are influenced more by the mass media and by physicians (Mcintosh *et al.,* 1995; Turrell, 1997; Fagerli & Wangel, 1999).

There is still the question of how this knowledge influences consumers' attitudes towards seafood and the pattern of seafood consumption in different market sectors. Altekruse *et al.* (1995) showed a positive relationship between seafood consumption and health consciousness. Fish eaters were significantly more likely than others to report recent exercise, effort to lose weight, periodic monitoring of serum cholesterol, and being non-smokers. Dietary behavior and its relative saliency in food choice reflect such diverse determinants as socioeconomic factors, food preferences, beliefs, skills in preparation and local supply of fish products (Turrell, 1998; Myrland & Trondsen *et al.,* 2000). However, most studies have focused on consumer groups in low fish consumption regions where high prices and lack of quality supply might be significant barriers to consumption. In the coastal regions around the world the situation might be different: Access to local seafood sources might make it possible to prepare good quality and cheap seafood meals.

Food consumption patterns are strongly related to local food supply (Nestle *et al.,* 1998). Local food sources make it possible to prepare quality meals from fresh raw materials; they provide an antecedent for dissemination of taste preferences, meal preparation and eating practices over the generations and throughout the marketing routes. A complete meal, however, contains several items that are based on raw materials and practices of different origins. Globalization of the food markets influences mixing of food cultures. The food consumption pattern observed in a particular market is a function both of the long local tradition and of new trends of different origins.

In the past there has been increased demand for seafood at the consumer level, which has resulted in higher seafood prices. Globally average seafood consumption per capita in the world reached 15,9 kg in 2000 (live fish weight equivalent), an increase of 15,2% from 1990, where per capita consumption in Asia showed strongest growth, while the seafood consumption decreased in Africa and America. The per capita consumption in Norway was 51.2 kg in 1998, an increase of 13% since 1990 (FAO, 2002). Purchasing power relative to local and import supply is expected to be important factors supply of fresh fish is for fish consumption, but also the changing consumer attitudes. 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 and tastes good, which thus gives rise to more willingness to pay premium prices for good quality seafood and to prepare it at home. It may also be associated with increased numbers of seafood choices such 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. Local supply of fresh fish keeps also prices for good quality on a reasonable level. The level of seafood consumption is much higher among people living in coastal areas than it is among people living far away from the coast due to better access to good quality fish and shellfish (Myrland & Trondsen *et al.,* 2000). The effect of the dissemination of health information on food practices is therefore expected to differ between coastal regions and other regions according to the supply and purchasing power situation. The appeals to adopt health and food messages accord with diffusion theory: they are expected to be highest if the adopters do not have to change consumption habits (Rogers, 1983).
 An earlier Norwegian study found that seafood consumption among 30- to 44-year olds increased with increasing size of household, increasing age and higher education among the women. The presence of school-aged children in the household and living region were discriminating factors for the type of seafood consumed, whereas product attributes rather than product price were important perceived barriers to total fish consumption (Myrland & Trondsen *et al.,* 2000). However, we have limited understanding of how seafood consumption is influenced by variations in consumers' health attributes as overweight and beliefs about health and food controlled for regional variation in supply and consumption levels and for different lifestyle habits and socioeconomic factors.

Aims of the study
Despite the research reviewed above, our understanding remains limited about how health factors as overweight and the belief about food and health influence the consumption pattern of fish in a setting with very good supply of relative cheap fresh fish and where fish consumption is very high.

Understanding such influences is of prime importance for marketers who want to differentiate their promotion effort and product offers, trying to satisfy uncovered needs in specific market segments through improved product quality, distribution and communication, as well as to health educators who want to make their campaigns more effective. The aim of the study is to rectify this gap.

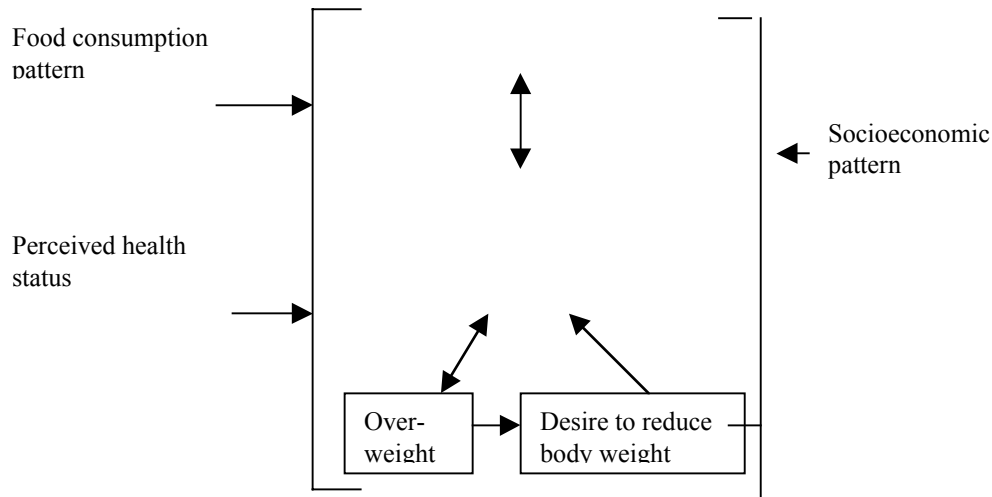Figure 1 shows the main relationships to be investigated.

Figure 1. Relationships for investigation

Materials and methods
The Norwegian Seafood Consumption study (NSCS) is a study based on data collected as a part of the "The Norwegian Women and Cancer Study" (NOWAC) in 1997. The main objective of the study is whether or not seafood in the diet is protective against several health problems. The study includes information on self-perceived health and health problems, healthy food attitudes, demographics, eating habits and more traditional non-market variables. Product prices, a central variable in any demand analysis, were not included. The study population 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 experience as consumers, food purchasers and homemakers.

Participants
The random sample of women aged 45 through 69 years was drawn from the Central Person Register kept by Statistics Norway. The north Norwegian population counts for about 10.6% of the Norwegian population; they live mainly in coastal areas where fishing and fish processing are the main professional and leisure activities.

The Register contains information on all people living in Norway, including temporary residents. Everyone has been given a unique identification number consisting of six digits for the birth date (day, month, and year), and a five-digit number used as a control algorithm, which includes information on sex. In addition, the Register contains information about 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 13 460 women were sampled randomly from the national Central Person Register. A total of 7556 women filled in the questionnaire and returned it by mail. The crude response rate was 56%. The Norwegian Data Inspectorate approved the study. Data storage and processing was based on the informed consent of the participants.

Measures

The present analyses will focus on the effect overweight and health-food perception on women's intake of seafood products, including consumers' attitudes, health factors, food consumption pattern and socioeconomic factors in one model (Fishbein and Ajzen, 1975; Furst *et al.,* 1996; Nestle *et al.,* 1998;). An exploratory approach was chosen in the selection of explanatory variables in order to control for as many potential 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 that we expected to be associated with seafood consumption and healthy diet in Norway. The final models presented in Table 3 and 4 include only explanatory variables, which have a significant association with the compared dependent variables.

Seafood consumption. The respondents were asked several questions relating 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 collected within the framework of an epidemiological study, they employed represented perceptions towards three generic classifications of seafood products, rather than specific brands or species of seafood: fatty fish (salmon, herring, etc.), lean fish (cod, etc.), and processed fish (fish cakes sticks, puddings, etc.). 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." Participants indicated their consumption frequencies on eight-point scales with response categories (1) Almost never, (2) once each month, (3) two to three times a month, (4) once each week, (5) twice a week, (6) three times a week, (7) four to five times a week, (8) six to seven times a week. To avoid problems associated with lack of model fit, the eight-point scale was converted to a binary scale. Once a week or more ((4) was re-coded to 1, other values being coded to 0. Definitions of these and other binary variables are given in Table 1.

Table 1a. Characteristics of the study population

	n	Pct. yes
Socioeconomic variables		
Age	7556	
45–49		26
50–54		22
51–59		19
60–64		17
65–69		15
Annual household income is	7057	
• Very low income (< NOK 150 000)		23
• Low income (NOK 150 000–NOK 300 000)		42
• Medium income (NOK 301 000–450 000)		25
• High income (NOK 451 000–600 000)		9
• Very high income (>NOK 600 001)		2
Region of residence in childhood	7013	
• Central Inland (Hedemark and Oppland counties)		2
• Central East (Oslo and Akershus counties)		1
• South East (south-eastern counties except the above)		1
• West coast/Mid (West Norway and Trøndelag counties)		5
• The northern counties (North Norway)		90
• Abroad		1
Region of residence.	7556	
• Northern		100
Consumed fish more than 3 times a week as child	7366	78
Years of education	6688	
• <10		67
• 10–12		25
• 13+		18
Household size (number)	7310	
• 1		16
• 2		54
• 3		19

• 4	8
• 5+	3

Children in the household 7555

- No children in household
- 0–7 years 1
- 8–12 years 5
- 13–19 years 17

Table 1b. Characteristics of the study population

	N	Pct. yes
Food and health beliefs		
• "Food important for health" (important/very important)	7237	77
• Perceived health (poor/very poor),	7208	13
• The desire to reduce the body weight	7396	55
Fish consumption attitude		
• Do you eat enough fish	7342	74
Perceived health status		
• Have you have had migraine?	7025	22
• Have you had diabetes?	7025	3
• Do you use of medication for cardiovascular disease?	7220	17
• Do you use of pain relievers	7219	10
• High physical activity (6-10, on a scale 1-10)	6459	45
• BMI (Weight /(height in meter)^2 < 20	7407	7
• BMI 20–24.9	7407	49
• BMI >25	7407	46
• Current smoker	7464	33
Food consumption pattern		
Healthy food		
• Fat spread on bread	7374	76
• Five or more units of vegetables or fruit per day	7379	14
• Oils from soy, olive or corn for cooking	7513	3
• Fish oil, all forms, in winter (once a day)	7519	35
• Other food supplements (once a day)	7519	25
• One glass of wine (once a week)	7450	16
-Consumption of non-fish dinners (once a week)		
• Minced meat	7199	52
• Cut of meat dishes	7199	57
• Pizza	7488	8
• Pasta and rice	7270	17
• Porridge	7289	26
• Shrimp and crab	7216	1
Consumption of fish dinners		
• Fatty fish (mackerel, salmon, etc.) for dinner (once a week)	7199	18
• Lean fish (cod, etc.) for dinner (once a week)	7199	83
• Processed fish for dinner (once a week)	7199	73

Food consumption pattern. These variables reflect the weekly combination of dinner meals by which seafood items may be substituted. Food consumption variables were divided into "healthy food" and "non-seafood" categories. Consumption of healthy foods was reflected in questions about regular use of specific food items regarded healthy. For example, values for a "5-a-day" of vegetable and fruit variable were calculated on the basis of reported consumption of five units of vegetable and fruit a day (Hjartåker & Lund, 1998).

Other food items were cuts of meat and other non-seafood items as minced meat, pizza, pasta and rice, and porridge, which appear in the consumer's "evoked set" by the provision of variety, to influence frequency of seafood consumption (Richardson *et al.,* 1993). Food consumption reflects the weekly combination of dinner meals, which are normally limited to seven dinners a week.

 Beliefs about food and health. Beliefs about food and health are subjective internalized norms (Manstead, 2000; Sparks & Guthrie, 1998). In the present study, they were measured by questions about women's beliefs regarding their own health status, beliefs about the relationship between diet and health, and desired weight loss.
Health status. Participants' own health status was measured in terms of perceived as well as actual health problems and medical treatments regarding cardiovascular diseases, diabetes and pain, physical activity, smoking and body mass index (BMI^2).
Socioeconomic background variables. These variables cover the historical and present characteristics of the respondents, measured in terms of region of birth, seafood consumption habits during childhood, age, level of education, household income, household size, presence and age of children in the household. Region of birth and seafood consumption, habits during childhood reflect that, although learning about food and eating continues throughout the life span, much occurs during the first five years of people's lives (Nestle *et al.,* 1998). Age and level of education reflect that more experience and knowledge may influence the perception of the relationships between food, health and after meal feelings (Nestle *et al.,* 1998; Martinez Gonzalez *et al.,* 1998 and Shi, 1998). Household income is expected to influence food choices, especially costly food such as fish, fresh fruit and vegetables (Nestle *et al.,* 1998.). Household size, presence and age of children are expected to change food consumption patterns, for example due to conflicting preferences within the household and difficulties of preparing fish dishes (Myrland & Trondsen *et al.,* 2000).

Analysis
Both the SAS software package (version 6.12) and the SPSS software package (version 9.0) were used in the 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 performed statistical analyses, in which odds ratios (OR) with corresponding *p* values were calculated through estimation of the maximum likelihood (Hosmer and Lemeshow, 1989). A stepwise variable selection procedure generated the significant associations at the 5% significance level. For each model, a Hosmer and Lemeshow goodness-of-fit measure was calculated to evaluate the adequacy of the model. A goodness-of fit test evaluates how well the model can predict the outcome variable: the higher the *p* value, the better the fit. Although frequencies of fish consumption for dinner were originally measured using an eight- point categorical response format, the number of predictors, combined with several levels of the response variable, might have resulted in an excessive number of empty cells and hence unstable parameter estimates. To avoid such estimation problems, fish consumption variables were converted to binary responses.

Results
Sample Characteristics
Table 1a shows that 90% of the responders were born in northern Norway and 5% in the western and middle (Trøndelag) coastal regions. There were 65% respondents with low and very low income. The level of education was low, since 67% of the respondents reported less than 10 years of education. More than half of the respondents lived in two-person households, and 16% were single. Of the households, 17% included teenager children.

Regarding health issues, 13 % of the respondents reported their health to be poor or very poor; 22% reported problems with migraine, and 17% were regular users of medication for cardiovascular disease. There were 77% of the women who stated that food was important or very important for their health and 55% had the desire to lose weight. Table 1b shows that 49% of the women were defined as overweight, with a body mass index (BMI) of 25 or more (WHO, 1998). Physical activities were rather high; 45% reported middle or high physical activity, in terms of both physical work and sport/leisure activity. Among the women 33% were regular smokers.

Table 1b shows that almost 80 % of the respondents consumed fish dinners three times or more per week, on average 15 dinners per month shared (3.6 times a week), among 1.8 meals of fatty fish, 8 meals of lean fish and 5.2 meals of processed fish (Table 2). The proportions of women eating fish dinners once or more per week were

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^{2} Weight in kg divided by (length in meter)^2

distributed as follows: 83% lean fish, 73% processed fish and 18% fatty fish. Of the women 74% considered that they consumed enough fish.

Table 2. Average consumption of different food items per

Month (mean number of times)

Variable	n	Mean	SD
Lean fish (cod, haddock, etc.)	7199	8.00	4.96
Processed fish (cakes, sticks, puddings, etc.)	7199	5.20	3.69
Fatty fish (salmon, trout, mackerel, etc.)	7199	1.81	2.72
Cut of meat	7199	3.92	2.96
Minced meat	7199	3.69	2.83
Fish oil	7519	13.32	16.27
Pizza	7488	1.00	1.39
Vegetables and fruit	7379	106.7	44.81
Pasta and rice	7270	4.81	3.90
Porridge	7289	2.10	1.57
Shrimp and crab	7216	0.40	0.74
Glass of vine	7449	2.07	4.12

The women consumed meat at 7.6 meals per month (Table 2). Table 1b shows more than a third of the respondents took fish oil daily, and 25% of the women had daily food supplements. However, only 24% did not use fat spreads on bread and 14% followed 5-a-day recommendations concerning vegetables and fruit intake.

Table 3a. The odds ratios for consuming fatty fish; lean fish and processed fish at least once a week for dinner described for different socioeconomic variables mutually adjusted for all explanatory variables presented in 3a-3c

	Fatty 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	1.14	1.24	0.83
• 55–59	1.35*	1.57**	0.91
• 60–64	1.41*	1.88***	0.98
• 65–69	1.55*	1.81**	0.87
Education			
• <10	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)
• 10–12	1.23*	1.01	1.00
• 13+	1.26	0.98	0.90
Income			
• Very low	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)
• Low	0.91	0.91	1.09
• Medium	0.78	0.85	0.85
• High	1.16	0.90	0.82
• Very high	1.86*	0.76	0.89
Persons in household (number)			

• 1	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)
• 2	0.88	1.64***	1.60***
• 3	0.88	1.77**	1.83***
• 4	0.98	1.76**	1.77**
• 5+	0.75	1.79*	1.53
Children in the household			
• None	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)
• 0–7 years	1.06	1.24	2.90*
• 8–12 years	0.99	1.06	1.48*
• 13–19 years	0.84	0.91	1.05
3 fish meals per week as child	1.22	2.11***	1.25*
Childhood region of residence			
• Central inland	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)
• Central east	2.19	1.55	1.41
• South east	1.86	1.25	1.95
• West coast/Mid	2.62*	1.01	1.43
• Northern	1.98	0.87	1.47
• Abroad	2.74	0.79	1.05

*p≤0.05, **p≤0.01, ***p≤0.001

Table 3b. The odds ratios (OR) for being a consumer of fatty fish; lean fish and processed fish described for different food consumption variables mutually adjusted for all explanatory variables presented in 3a–3c

	Fatty fish 1+ meals/week	Lean fish 1+ meals/week	Processed fish 1+ meals/week
	OR	OR	OR
FOOD CONSUMPTION PATTERN			
Healthy food			
• Fat spread on bread	0.80*	0.87	0.97
• "Five-a-day" vegetables and/or fruit	1.71***	1.16	1.15
• Fish oil daily	1.22*	1.20	0.95
• Wine weekly	1.24*	0.94	0.81*
Non-seafood (1+ times a week)			
• Minced meat	1.47***	1.42***	2.37***
• Cuts of meat	1.37***	1.96***	1.21**
• Pasta and rice	1.15	0.79*	1.23*
• Porridge	0.94	1.11	1.12
FISH CONSUMPTION ATTITUDE			
• "I'm eating enough fish"	1.42***	5.86***	1.68***

*p≤0.05, **p≤0.01, ***p≤0.001

Table 3c. The odds ratios (OR) for being a consumer of fatty fish, lean fish and processed fish described for health related variables mutually adjusted for all explanatory variables presented in 3a–3c

	Fatty fish 1+ meals/week	Lean fish 1+ meals/week	Processed fish 1+ meals/week
	OR	OR	OR
PERCEIVED HEALTH STATUS			
• Migraine problems	0.90	1.04	1.28**
• Cardiovascular medicine user	1.30*	0.99	0.87
Body mass index			
• <20	1.13	0.58**	0.92

• 20–24	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)
• 25+	1.10	0.79*	0.91
• *Current smoker*	1.31**	0.90	0.88
FOOD AND HEALTH BELIEFS			
• "Food important for health"	1.24*	1.38**	1.10

*$p \leq 0.05$, **$p \leq 0.01$, ***$p \leq 0.001$

Table 4. The odds ratios for the beliefs that food is important for health, BMI>25 and the desire to reduce weight described for different socioeconomic, and food consumption and health factors. All variables adjusted for each other

	Food important for health	Overweight	The desire to reduce weight
	OR	OR	OR
SOCIOECONOMIC PATTERN			
Age (years)(45–49 = 1.00)			
• 50–54	0.98	1.59***	0.69***
• 55–59	1.43**	1.56***	0.85
• 60–64	0.88	1.20	0.60***
• 65–69	1.06	1.22*	0.51***
Income (very low = 1.00)			
• Low	0.94	0.98	1.19
• Medium	1.00	0.83	1.25
• High income	1.12	0.60***	1.20
• Very high income	1.95	0.43**	2.14**
Years of education (<10 = 1.00)			
• 10–12	1.55***	0.97	0.97
• 13+	2.49***	0.87	0.96
Persons in household (number) (1= 1.0			
• 2	1.01	1.28*	1.21
• 3	0.82	1.59***	1.06
• 4	0.83	1.43*	1.00
• 5	0.65	2.47***	1.28
Children in the household (0=1.00)			
• 0–7 years	1.26	0.55	0.87
• 8–12 years	1.19	0.81	1.09
• 13+ years	1.40**	0.79*	0.91
3 fish meals per week as child	1.30**	1.19*	0.98
FOOD CONSUMPTION PATTERN			
Healthy food			
• Fat spread on bread	0.90	0.74***	0.43***
• "5-a-day"	1.67***	1.11	1.53***
• Fish oil daily	1.43***	0.77***	0.90
• Other food supplements	1.37***	0.81**	1.00
• Wine weekly	1.05	0.64***	1.09
Non-seafood			
• Porridge	1.21*	0.79**	1.13
Consumption of fish dinners			
• Fatty fish once a week	1.30*	1.17	0.87
• Lean fish once a week	1.37**	0.94	0.82*
FOOD AND HEALTH BELIEFS			
Perceived health (poor/very poor)	0.72**	1.01	1.13
PERCEIVED HEALTH STATUS			
Have you had diabetes?	1.91*	1.91**	1.62
Do you use of pain relievers	0.97	1.16	1.41**
Cardiovascular medicine user	0.95	1.96***	1.44**
High physical activity	1.50***	0.61***	0.89
Current smoker	0.82*	0.49***	0.64***
BMI (20–24= 1.00)			

• <20	0.85		0.07***
• >25	1.07		9.45***
Hosmer & Lemoshow Goodness of fit statistics	p = 0.82	p = 0.78	p = 0.28

Table 3 shows the direct association between fish consumption and each of the explanatory variables in the model. Table 4 shows the association of indirect seafood consumption with explanatory variables through their association with health factors that we expected to be associated with fish consumption: (1) belief that food is important for health, (2) overweight and (3) the desire to lose weight. The associations are presented in Table 4.

Perceived health, beliefs about food and health and overweight
Table 3c shows that the belief that food is important for health is the most important health factor influencing fish consumption. This belief discriminates products because of positive associations with consumption of fatty fish (OR = 1.2) and of lean fish (OR = 1.4), but not with processed fish. The pattern of fish consumption was not directly associated with reporting poor or very poorly perceived health, diabetes diagnosis, or the desire to lose weight or physical activities, so this was excluded from the final model (Table 3). Overweight was negatively associated with lean fish consumption (OR = 0.8) and the strongest predictor of the desire to reduce weight (OR = 9.5) although it had no significant association with the beliefs that food is important for health (Table 4).

The role of age
Table 3a shows that the probability of weekly consumption of lean fish increased strongly with increasing. On the other hand, there is no age effect for consumption of processed fish. Increased age from 45–49 to 50–59 years has a positive association to the beliefs that food is important to health (OR=1.49) and BMI > 25 (OR = 1.6). The desire to reduce weight was less important among the oldest compared to the youngest women.

The role of education
Consumption of fatty fish, but not consumption of lean and processed fish, was positively associated with length of education. The belief that food is important for health, but not overweight, had a positive association with length of education (≥13 compared to <10 years of education; OR = 2.5) (Table 4).

The role of income
Consumption of fatty fish was associated with very high family income (OR = 1.9). High or very high income is negative associated with overweight. Very high income was also associated to the desire to lose weight (OR = 2.1) (Table 4).

The role of household characteristics
Generally, the probability of consuming lean or processed fish increased significantly (from OR= 1,6 to OR= 1,83) if two or more people lived in the household. Living in a five-person household size has a positive association to overweight (OR = 2.5). The consumption of processed fish products once or more per week was strongly associated to the presence of children in the household. Compared to households without kids OR were 2.9 for kids <7 years and 1.48 for kids 8-12 years). Teenagers in the household was not associated to changes in fish consumption compared to household without kids, but teenagers in the household was undirected associated to fish consumption through the belief that food is important for health (OR =1.4).

The role of eating fish in childhood
Those women who had fish for dinner three or more times in childhood had increased beliefs that food is important for health (OR = 1.3) and showed a high significant higher consumption of both lean fish (OR = 2.1) and processed fish (OR = 1.3).

The food consumption pattern
Table 3b shows the complementary pattern between consumption of fatty, lean and processed fish and consumption of other food products. The consumption of all fish categories had significant associations with consumption of minced meat and cuts of meat, but not with consumption of more processed food products such as pizza and pasta. Only lean fish and processed fish were associated with the traditional Norwegian porridge dinner. The consumption of processed fish had a strongest positive association to minced meat (OR = 2.4), and also had a positive association with cuts of meat and rice/pasta (OR = 1.2).

There was positive relationship between consumption of fatty fish and of healthy food (Table 3b). Both the consumption of lean and fatty fish are associated with the perception that food is important for health "5-a-day" consumption, and consumption of porridge, fish oil and other food supplements have an indirect association with fish consumption because its associations of the belief that food is important for health (Table 4). "Fat spread on bread" is negatively associated to consumption of fat fish (OR=0.8), to overweight (OR=0.7) and to the desire to reduce weight (OR=0,43). "5-a-day" consumption is positive associated to fat fish consumption (OR= 1,7), to the perception that food is important for health (OR = 1.7) and to the desire to reduce weight (OR=1.5). Consumption of fish oil was also positively associated with eating fatty fish (OR = 1.2), the perception that food is important for health (OR=1,4) and negative associated to overweight (OR= 0.8).

Wine drinking has a positive association with consumption of fatty fish (OR 1.2), and a negative one with processed fish (OR = 0.8) and overweight.

Discussion

The response rate in this study was 56% and vulnerable to non-response bias. 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 and Gram, 1998). The study includes women only, but earlier studies of the at-home consumption of seafood in Norway and the USA have shown no difference between the sexes (Nayga and Capps, 1995; Myrland, 1998; Fagerli & Wandel, 1999). The study did not include available products and prices, which might be important barriers for consumptions in other markets with limited local catch and supply. This study shows that the traditional consumption of fish in the coastal Northern Norwegian region is strongly related to of the availability of fresh cheap fish. People in this region have fish for dinner on average every other day. Lean fish such as cod and haddock is the main fish species available in this region, and traditionally is also the most common type of fish to appear on the dinner table. Processed fish products, mainly made from lean fish, are the second most important product with a positive relationship with lean fish consumption.

The data show, however, that the increasing supply of fatty fish – mainly farmed salmon – is becoming an important product in this regions dinner table. This cross-sectional study indicates that different social forces influence product choices, which are dependent on the stage in the product's life cycle and the size of the market.
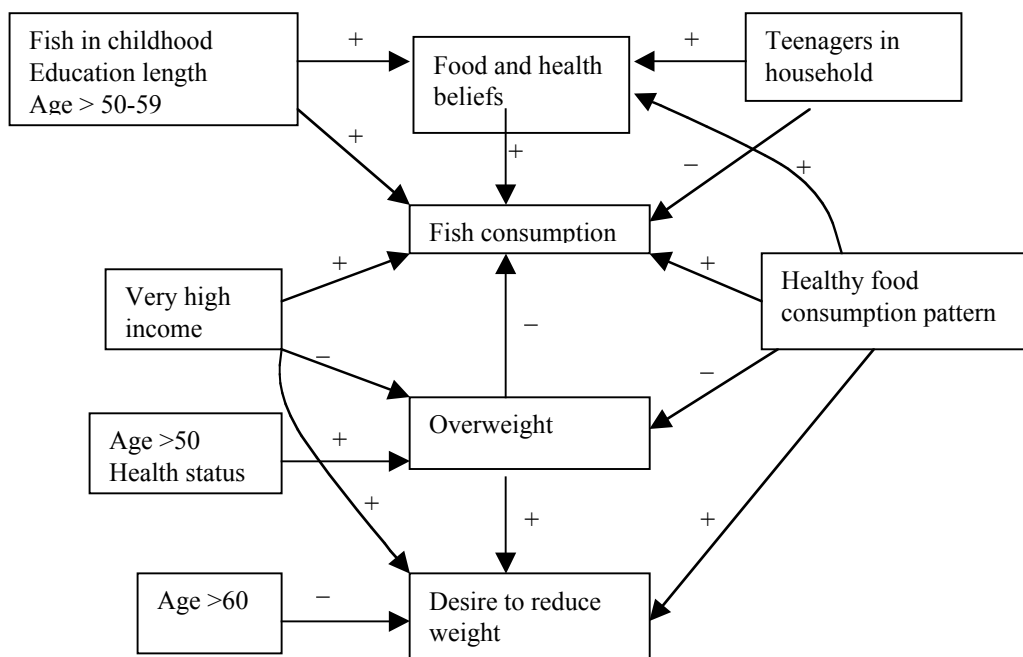

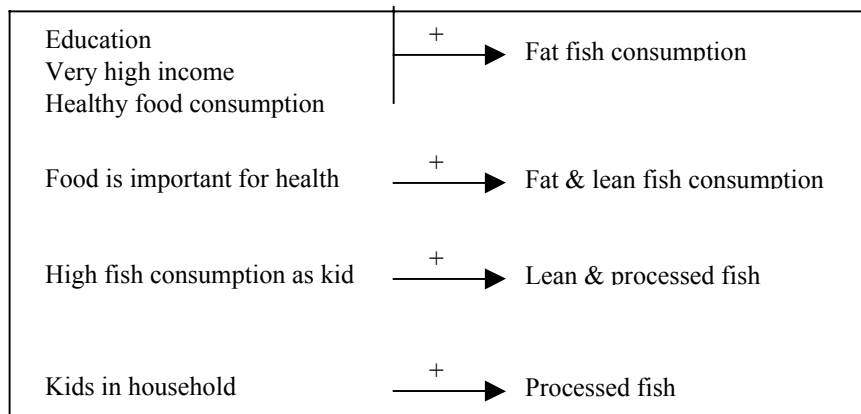Figure 2: Health, overweight and seafood consumption

Figure 3. Discrimination factors for choice of fish product

Figure 2 and 3 summarize the findings about the associations between fish consumption and health factors. The discussion is related to 6 hypotheses.

H1. Fat and lean fish, but not processed fish consumption, are associated with the perception that food is important for health
This hypothesis is supported of earlier findings of the positive association between seafood consumption and products that contain healthy components as polyunsaturated fatty acids (Foxall *et al.,* 1998). It is interesting to note that the perception that food is important for health is not associated to processed fish consumption but to the natural unprocessed fish meat dined in cutlet or fillet form. Processed fish is more associated household with children (see H6).

H2. Fish consumption is lower among overweight women than among normal weighty, but fish is not on the weight reducing diet.
Overweight women consume less of the low calorie lean fish than normal weighty. This means that they consume more of other kinds of food, which might influence their BMI. 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; Hjartaker and Lund, 1998).

The desire to reduce weight did not influence seafood consumption either, even though 46% were overweight and 55% wanted to reduce weight. The figures for the population-based sample of Norwegian women in the same age group were 39% and 53% respectively (Hjartaker *et al*., 2001), meaning that these women are more overweight than the average Norwegian woman, and do not regard increased or high seafood consumption as a mean of controlling or losing weight. This finding indicates lack of a conscious attitude of seafood as low calorie food, even if normal weight is associated to higher lean fish consumption.

For those who want to lose weight, seafood consumption increases is not a strategy, but "5-a-day" vegetable and fruit consumption and smoking. Hjartaker *et al.* (2001), however, found significantly lower calculated energy intake for Norwegian women who said that they were trying to lose weight than for those who did not. The weight reduction method was to reduce the consumption of fat spreads on their bread and increase the consumption of dietary fiber, fruit and vegetables. This lack of a relationship between a woman's desire to lose weight and the consumption of low-calorie fish products might be explained by the fact that fat, in the form of butter, sauces, bacon and liver, is part of the traditional north Norwegian fish dinner.

H3.Fish consumption increases among consumers changing to a healthy food consumption pattern.
The lower, although growing, consumption of fatty fish (mainly salmon and trout) is associated more with the broader current consumption pattern of healthy food, directly positively associated to education, consumption of other healthy food and physical activities, but also smoking and cardiovascular medication. The health oriented

consumer group is also associated with perception that food is important for health and is less likely overweight and they increase the desire to reduce weight.

The fact that health variables were associated with fatty fish confirms fish choices as a part of a broader food consumption pattern (Altekruse *et al.,* 1995). Earlier studies have shown a positive association between socioeconomic status, exercise, weight control, and healthy diet and behavior (Jeffery *et al.* 1991; Tucker *et al.,* 1995; Uitenbroek *et al.,* 1996; Hjartåker and Lund, 1998; Johansson *et al.,* 1999).

H4. Fish consumption increases with increasing age and education length.
Length of education was not a directly significant predictor for the consumption of lean fish and processed fish, but had slight positive association with consumption of fatty fish. It does, however, plays a strong indirect role through its positive association with the belief that food is important for health, which is positively related to the consumption of both fatty and lean fish. The strength of the association between length of education and fish consumption is weaker than in earlier studies of Norwegian women aged 30–44 years where the level of education had a direct positive association with consumption of the same fish product groups (Myrland & Trondsen *et al.,* 2000). However, the difference may be understood by the fact that there are large differences in the length of education between these populations. Only 18% of women aged 45–69 years had 13 years or more at school, compared with 57% of women aged 30–44 years. Length of education might be most important for diet in cases where emerging knowledge about food and health has to be considered, adopted and implemented into new consumption practice. The size of the higher educated population increases also according to diffusion theory the group pressure to adopt healthy diet practices (Rogers 1983). The strong association among the beliefs that food is important for health, education, and healthy diet habits such as the consumption of "5-a-day", fish oils and other food supplements, and lean and fatty fish supports this hypothesis.

The positive association between seafood consumption and education length support the earlier been Nauman *et al.* (1995) and Huang (1995) and supports the relationship between healthy food and education level (Martinez Gonzalez *et al.,* 1998 and Shi, 1998). The differences between generations in linking education and seafood consumption, however, support the hypothesis offered by Myrland & Trondsen *et al.* (2000) that the importance of education in explaining seafood consumption may have increased since the late 1980s and will grow by increasing the level of education in society. The market share of fatty fish and other healthy foods in Northern Norway might move closer to the national level as the level of education increases.

The positive association between the respondent's age and the consumption of fatty and lean fish is earlier supported by the same findings among younger Norwegian women (Olsen, 1989; Myrland and Trondsen et al., 2000). This finding is also supported by studies indicating that women adhere to better nutrition as they grow older and gain weight (Renner et al., 2000).

H5. Fish consumption increases when families grow into very high-income levels
Household income had no direct association with the consumption of lean and processed fish, but very high-income households (2% of the population) did influence consumption of fatty fish. This finding may support the

hypothesis that income appears to play a smaller role in explaining the total frequency of seafood purchases for at-home use than it does in explaining consumption patterns or expenditure (Herrmann *et al.,* 1994; Nauman *et al.,* 1995). When considering lean fish, the findings support those of Myrland &Trondsen *et al.* (2000), where no relationship was found between the income level and seafood consumption among women aged 30–44 years. Most seafood, especially lean and processed fish, is cheap in northern Norway where people also catch their own fish, and income does not represent a barrier for consumers' choice of preferred seafood.
Less overweight and the desire to reduce weight among the high-income group might indicate social norms of slimness, which we do not find between the education groups.

H6. High fish consumption in childhood increases both lean and fat fish consumption as adult, while children in household increases the consumption of processed fish.
Those with a high consumption of all three fish categories had high fish consumption as children and are associated with the perception that food is important for health. Processed fish is positive associated with children in the present household. There are negative associations between lean fish and to pasta/rice and between processed fish and wine drinking, which indicates that rice, pasta and wine is not a part of everyday traditional lean fish product dining. The strong relationship between processed fish and Northern Norway underscores the fact that those living in this region in childhood also had a significantly increased consumption of processed fish. The importance of the

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region of birth for seafood-eating habits in adulthood supports the fact that learning about food and food habits happens in the first years of life (Nestle *et al.,* 1998; Hursti, 1999).

Processed fish is the traditional "fast food" of Northern Norway: it is consumed as a complement to lean fish and meat products, but also with pasta, rice and porridge, e.g. families with children aged less than 7 years had processed fish for dinner three times more often than families with no children, which support similar findings in Myrland & Trondsen *et al.* (2000). The traditional role of lean fish is underscored by the strong increasing consumption with increasing age, and where education and income do not have a direct significant role to play. Lean fish is a cheap food in northern parts of Norway, partly because many people catch their own fish.
These findings about the regional influences on seafood consumption patterns are consistent with earlier research (Olsen, 1989; Wessells & Anderson, 1992; Johnston, 1995; Myrland & Trondsen *et al.*, 2000).

Teenagers in the household were not related to fish consumption, but to the beliefs that food is important to health. It means that fish looses its position among teenagers in competition with other food items, but parents have still their concerns regarding developing healthy diet norms. Children in household mean also bigger household, which significant increases consumption of cheaper lean and processed fish and lower calorie intake. Overweight increases with increasing age, but the desire to reduce weight decreases for those more than 60 years, when most kids have left home.

Conclusion
The main question in this study was: How is seafood consumption influenced by overweight and health beliefs in a region of traditional high-level fish consumption? The findings show that overweight in itself can be predicted by increasing age and health status, household structure, physical activity and the food consumption pattern.

Overweight women consume less lean fish than normal weight women. Consumption of vegetable and fruit (5-a-day), smoking and physical activity, and not fish consumption, predict for the desire to reduce weight. A broader healthy food consumption pattern is also a strong predictor for increasing fish consumption supported by the belief that food is important for health, less overweight and for the desire to reduce weight. Very high family income predicts high fish consumption together with low probability for overweight and high desire to reduce weight. Traditional consumption pattern measured as high fish consumption in childhood predicts high lean and processed fish consumption and also the beliefs that food is important for health which is a predictor for both high lean and fat fish consumption. Processed fish consumption is also predicted by children in household but not by beliefs that food is important for health, which is predicted by teenagers in the households. Education length and age are predictors for fish consumption directly and indirectly through its influence of the belief that food is important for health. We can therefore predict higher lean and fat fish consumption the more consumers' believe and behave according to food importance for health in general and by high consumption of seafood in childhood, increasing level of education, income and age in the population. Beliefs regarding seafood as a low calorie healthy food and improvements of the healthy aspects of processed fish products may increase seafood consumption. The consumption effect will most probably be strongest among consumers with highest education and income. The level of fish consumption in childhood may improve seafood consumption as adult. The strength of these predictions is constrained by other market barriers as relationship between purchasing power and available seafood product values.

Marketing implications
Even if seafood consumption in Northern Norway is high compared with other regions, this study shows several important potentials for both health authorities and the seafood industry to improve seafood consumption and sales in market sectors where the benefit of seafood as a lean healthy food has not been fully utilized and where 74% stated that they are eating enough fish. All promotion and health information that strengthen the knowledge about the positive relationship between food and health will increase seafood consumption. This study has shown a missing link in the consumer's mind between seafood consumption as a low-calorie food and being overweight – a predictor for health problems such as diabetes and cardiovascular diseases. Promotion linking seafood consumption, being overweight and health is an important common task for both health authorities and the seafood industry. Health promotion might be a profitable business investment. Health-promotion elasticities, e.g. in the US poultry market, are found to be higher than price elasticities (Kinnucan *et al.,* 1997). This means that investment in positive food-health information results in more sales than using similar percentage price reductions Alliances between health authorities and the seafood industry may therefore have the potential to increase healthy eating. The marginal effect of information about healthy food for men may be most effective through the mass media and direct advice from physicians (Mcintosh *et al.,* 1995; Turrell, 1997; Fagerli & Wandel, 1999). In Northern Norway,

the marginal effect of marketing and promotion effort will probably be highest by focusing on the 55% of the population who expressed the desire to lose weight.

This study shows that people with higher levels of education and high income are important segments for promoting belief that seafood is low calorie healthy food, which can contribute for the desire to lose weight. Successful implementation of health-oriented strategies among consumers is conditioned by diffusion and adoption of messages for change and of changes in consumption habits; first among the innovators and later among the followers (Rogers, 1983). When the level of education and income in this population increases, an increased demand may arise for convenience products that fit into the changing lifestyle. A recipe for success might be a further development of high-quality healthy and low calorie processed fast seafood products, which is compatible with the traditional diet beliefs and values. Seafood might be marketed together with other healthy foods such as fruit, vegetables, vegetable oils and fish oils. In the long term, it is also important to improve marketing of seafood towards children that we have shown will carry on these consumption values as adult, but also to satisfy the diversity of demand from different age groups in the households. To design, target and get a high response rate to marketing and health-information campaigns, it is necessary to understand why people who want to eat more fish do not do so. What kinds of barriers do they experience to satisfy their beliefs and preferences? Are the main barriers the lack of a local supply of fresh and tasty products at an affordable price, or are they in the consumers' preferences, family attitudes or skills in preparation of seafood meals? These are important questions for further investigations.

References

Altekurse, SF., BB. Timbo, ML. Headdrick and KC. Klontz (1995). Associations between diet and health behavior-Results from the 1992 Rhode Island behavior risk factor survey. *Journal of Behavioral Medicine* **18**: 225–232.

Bredahl, L. and KG. Grunert, (1997). Determinants of the consumption of fish and shellfish in Denmark: An application of the theory of planned behavior. In J.B. Luten, T. Børresen and J. Oehelenschlager (eds) *Seafood from Producer to Consumer, Integrated Approach to Quality*, pp. 21–30. Amsterdam, Elsevier.

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

Cox, DR. and EJ. Snell (1989). *Analysis of Binary Data,* 2nd edn. London: Chapman & Hall.

Fisbein, M. and I. Ajzen (1975). *Beliefs, Attitude, Intention and Behaviour*. Don Mills, NY: Addison Wesley.

FAO (2002): Statistical databases. http://www.fao.org/fi/statist/statist.asp

Fagerli, RA. and W. Wandel (1999). Gender differences in opinions and practices with regard to a "healthy diet". *Appetite* **32**: 171–190.

Foxall, G., S. Leek and S. Maddock (1998). Cognitive antecedents of consumers' willingness to purchase fish rich in polyunsaturated fatty acids (PUFA). *Appetite* **31**: 391–402.

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

Harel, Z., S. Riggs, R. Vaz, L. White and G. Menzies (2001). Omega-3 polyunsaturated fatty acids in adolescents: Knowledge and consumption. *Journal of Adolescent Health* **28**: 10–15.

Martinez Gonozalez, MA.. I. Lopez Azpiazu, J. Kearney, M. Keraney, M. Gibney and JA. Martinez (1998). Definition of healthy eating in the Spanish adult population: a national sample in a pan-European survey. *Public Health* **112**: 95–101.

Herrmann, RO., G P. Rauniyar, GD. Hanson and G. Wang (1994) Identifying Frequent Seafood Purchasers in the Northeastern U.S. *Agricultural and Resource Economics Review* 1994: 226–235.

Hjartåker, A. and E. Lund (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.

Hjartaker, A.& P Laake & E. Lund (2001). Body mass index and weight change attempts among adult women. The Norwegian Women and Cancer Study. *European Journal of Public Health* 11(2).

Hosmer, DW. and S. Lemeshow (1989). Applied Logistic Regression. New York: John Wiley & Sons, Inc.Huang, C.L. (1995). Socio-demographic determinants of seafood consumption patterns in the United States. In: DS. 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* **31**: 26–32.

Jeffery, RW., SA. French, JL. Forster and VM. Spry (1991). Socioeconomic status differences in health behaviors related to obesity – the healthy worker project. *International Journal of Obesity* **15**: 689–696.

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

Johansson, L., DS. Thelle, K. Solvoll, GEA. Bjorneboe and CA. Drevon (1999). Healthy dietary habits in relation to social determinants and lifestyle factors. *British Journal of Nutrition* **81**: 211–220.

Johnston, RS. (1995). Developments in seafood markets and marketing research. In: DS. 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., H. Xiao, CJ. Hsia and JD. Jackson (1997). Effects of health information and generic advertising on US meat demand. *American Journal of Agricultural Economics* **79**: 13–23.

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

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

Mcintosh, W.A., R.D. Fletcher, K.S. Kubena and W.A. Landman, (1995). Factors associated with sources of influence information in reducing red meat by elderly subjects. *Appetite* **24**: 219–230.

Manstead, A.S.R. (2000). The role of moral norm 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: Lawrence Erlbaum.

Myrland, Ø. (1998). *Factors affecting seafood consumption in Norway: Lifestyle and perceptions* (Working paper, Department of Economics and Management, Norwegian College of Fishery Science). Tromsø: University of Tromsø.

Myrland, Ø., T. Trondsen, R.S. Johnston and E. Lund (2000). Determinants of seafood consumption in Norway: Lifestyle, revealed preferences, and barriers to consumption *Food Quality and Preferences* **11**: 169–188.

Nayga, RM. (2000). Schooling, health knowledge and obesity. *Applied Economics* **32**: 815–822.

Nayga, RM. Jr and O. Capps 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* **27**: 161–171.

Nestle, M., R. Wing, L. Birch, L. DiSogra, A. Drewnowski, S. Middleton, M. Sigmnan-Grant, J. Sobal, M. Winston and C. Economos (1998). Behavioral and social influences on food choice. *Nutrition Reviews* **56**(5).

Nauman, FA., CM. Gempesaw, JR Bacon and A. Manalo (1995). Consumer choice for fresh fish: factors affecting purchase decisions. *Marine Resource Economics* **10**: 117–142.

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

Sparks, P. and CA. Guthrie (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., N. Knoll and R. Schwarzer (2000): Age and body make a difference in optimistic health beliefs and nutritional behavior. *International Journal of Behavioral Medicine* **7**: 143–159.

Richardson, NJ., R. Shepherd and NA. Elliman (1993) Current Attitudes and Future Influences on Meat Consumption in the U.K. *Appetite* **21**: 41–51.

Rickertsen, K. (1996). Structural change and the demand for meat and fish in Norway. *European Review of Agricultural Economics* **23**: 316–330.

Rogers, E. (1983). *Diffusion of Innovations*. The Free Press.

Shi, LY. (1998). Socioeconomic characteristics and individual health behaviors. *Southern Medical Journal* **91**: 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* **4**(2): 79–99.

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

Trondsen, T. and RS. Johnston (1998). Market orientation and raw material control. *Journal of Market Focused Management* **3**: 193–210.

Tucker, K., A. Spiro and ST. Weiss (1995). Variation in food and nutrient intakes among older men – age, and other socio-economic factors. *Nutrition Research* **15**: 161–176.

Turell, G. (1997). Determinants of gender differences in dietary behavior. *Nutrition Research* **17**: 1105–1120.

Turrell, G. (1998). Determinants of healthy choice in a population-based sample. *American Journal of Health Behavior* **22**: 342–357.

Uitenbroek, DG., A. Kerekovska and N. Fetchieva (1996). Health lifestyle behavior and socio-demographic characteristics. A study of Verna, Glasgow, and Edinburgh. *Social Science and Medicine* **43**: 367–377.

Variyam, JN., J. Blaylock and D. Smallwood (1998). Informational effects of nutrient intake determinants on cholesterol consumption. *Journal of Agricultural and Resource Economics* **3**: 110–125.

Verbeke, W., J. Viaene and O. Guiot (1999). Health communication and consumer behavior on meat in Belgium: From BSE until dioxin. *Journal of Health Communication* **4**: 345–357.

Wessells, CR. and JL. Anderson (1992). Innovations and progress in seafood demand and market analysis. *Marine Resource Economics* **7**: 209–228.

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