Fish consumption across generations – a life cycle approach

Geir Wæhler Gustavsen[1*], Kyrre Rickertsen[1,2] & Arnstein Øvrum[1]

1 Norwegian Agricultural Economics Research Institute, Oslo, Norway.
2 School of Economics and Business, Norwegian University of Life Sciences, Ås, Norway.

Abstract in English:
Fish consumption differs with age, over time, across generations, and across socioeconomic groups. Age effects reflect biological and social processes across the life cycle of an individual, period effects reflect variation over years that influence all age groups simultaneously, and generational effects reflect changes across a group of people who experienced an initial event in the same year. We use Norwegian Monitor Survey data to estimate logistic regression models. The estimated models are used to simulate how the probabilities of eating fish for dinner at least once a week changes as the generations' age. The probabilities are simulated for four groups: females with and without college education and males with and without college education. The probabilities increase with age for all the groups. Except for males without college education, the older cohorts have lower probabilities of eating fish than the younger cohorts.

Abstract in Norwegian:
Forbruket av fisk varierer med alder, over tid, mellom generasjoner og mellom sosioøkonomiske grupper. Alderseffekter reflekterer biologiske og sosiale prosesser over livsløpet til et individ. Periodeeffekter reflekterer variasjoner over år som påvirker alle aldersgruppene samtidig. Generasjonseffekter reflekterer endringer som påvirker en gruppe, som er født i samme tidsrom, og derfor gjennomlevde viktige hendelser når de var på samme alder. Vi bruker data fra Norsk Monitor til å estimere logistiske regresjonsmodeller. De estimerte modellene er deretter brukt til å simulere endringene i sannsynligheten for å spise fisk til middag minst en gang i uken etter hvert som generasjonene eldes. Sannsynlighetene er simulert for fire grupper: Kvinner med og uten høyere utdanning og menn med og uten høyere utdanning. Sannsynlighetene for å spise fisk minst en gang i uken øker med alderen for alle gruppene. Eldre kohorter har også lavere sannsynligheter for å spise fisk minst en gang i uken enn yngre kohorter med unntak for menn uten utdanning.

Introduction

Fish is an important source of nutrients such as proteins, essential fatty acids, vitamin D, vitamin B12, dietary selenium, and iodine. Sufficient fish consumption is an important part of a healthy diet. There is convincing evidence for the protective effect of fish, especially fish that are rich in omega-3 polyunsaturated fatty acids, against coronary heart disease (e.g., Kris-Etherton *et al.*, 2002). Fish consumption may also reduce the risk of stroke (e.g., Chowdhury *et al.*, 2012) and certain types of cancer (e.g., Szymanski *et al.*, 2010). However, there may be different health effects of fish consumption between males and females. Differences may exist in the general population (Wenneberg *et al.*, 2012), but specific health effects are most likely for females during pregnancy. Maternal fish consumption during pregnancy seems beneficial for the cognitive development of offspring (e.g., Oken *et al.*, 2005). On the other hand, some fish species have a relatively high uptake of contaminants such as methyl mercury, which represents a potential health risk if consumed in excessive quantities (e.g., Marette *et al.*, 2008). However, for most people, the health benefits of fish consumption clearly exceed the potential risks (e.g., Mozaffarian & Rimm, 2006). Thus, food and nutrition authorities typically recommend that adults should eat two or three servings of fish per week (The Norwegian Directorate of Health, 2012).

Fish consumption differs with age, over time, and across generations or cohorts. We investigate the gender-specific variation in fish consumption with age, over time, and across generational cohorts to gain further insight into groups that consume fish less frequently than the recommendations established by The Norwegian Directorate of Health (2012). Fish consumption was found to be particularly low among adolescents and young adults (e.g., Olsen, 2003). In general, such age effects in consumption reflect biological and social processes across the life cycle of an individual, such as reduced food intake among older people. Period effects in fish consumption reflect variation over years that influence all age groups simultaneously, such as increased consumption because of new information about the health benefits of eating fish. Cohort effects, in general, reflect changes across a group of people who experienced an initial event in the same years, for example, birth during the Second World War. Substantial cohort effects have been found in the consumption of several food and beverages such as milk (Gustavsen & Rickertsen, 2013), fruits (Mori *et al.*, 2006), vegetables (Stewart & Blisard, 2008), and fish (Mori & Clason, 2004).

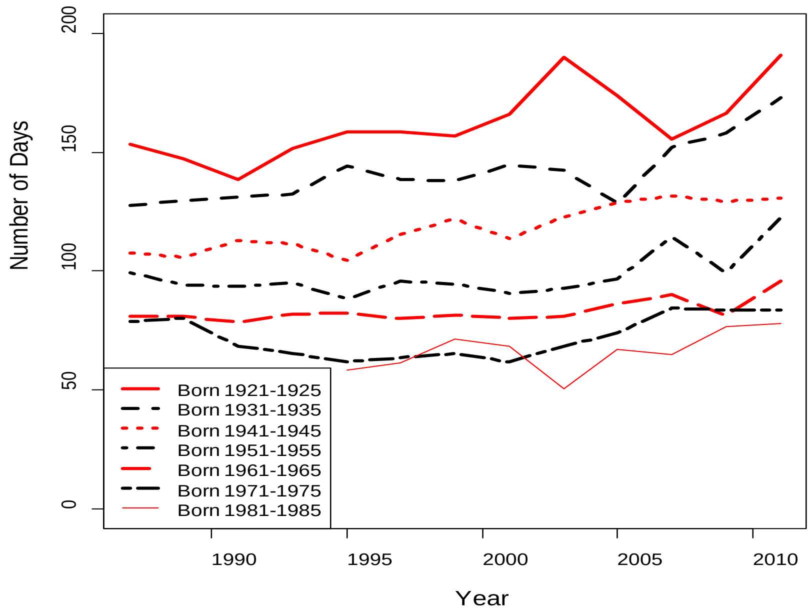

Figure 1 Average number of fish dinners in different birth cohorts over time

Figure 1 shows the average annual frequencies of eating fish for dinner among different cohorts of Norwegians over the period 1987 to 2011 identified with the Norwegian Monitor Survey database (Ipsos-MMI, 2013). We define a cohort as individuals born in the same five-year period. The oldest cohort was born between 1921 and 1925. Over the entire period, the oldest cohort consumed fish for dinner more frequently than other cohorts did, and the frequency increased from 138 days in 1991 to 191 days in 2011. The cohort born between 1931 and 1935 had the second highest frequency. The consumption in this cohort also increased over time from 128 days in 1987 to 173 days in 2011. In general, the frequency of fish consumption increases with the age of the cohort. However, among the younger cohorts there has been no increasing trend in the frequency of consumption. The youngest cohort was born between 1981 and 1985, and this cohort had fish for dinner between 58 and 78 days per year.

In Figure 2, the frequencies of fish consumption are plotted against the age of the individuals. The upper rightmost curve represents the oldest cohort who was born between 1921 and 1925. The average age of this cohort was 64 years in 1987, 66 years in 1989, and so on. The second oldest cohort is represented by the curve to the left of and below the oldest cohort. The average age of this cohort was 54 year in 1987, 56 years in 1989, and so on. The leftmost cohort was born between 1981 and 1985 and was included in the data for the first time in 1995.Figure 2 shows that older people eat fish more frequently than younger people. Furthermore, when the cohorts overlap, the older generation usually has a higher frequency of consumption than the younger generation. This pattern suggests cohort effects in fish consumption. However, there are also other potentially important explanatory variables. Fish are a healthy food and there is a large literature concerning the social gradient in health (e.g., Smith, 2007). Well-educated people live longer, exercise more, and live healthier lives than people with less education. In addition, high income, which is strongly correlated with high education, gives individuals opportunities to buy high-quality food more frequently. Furthermore, marriage is often linked to a healthy lifestyle, including healthy eating.

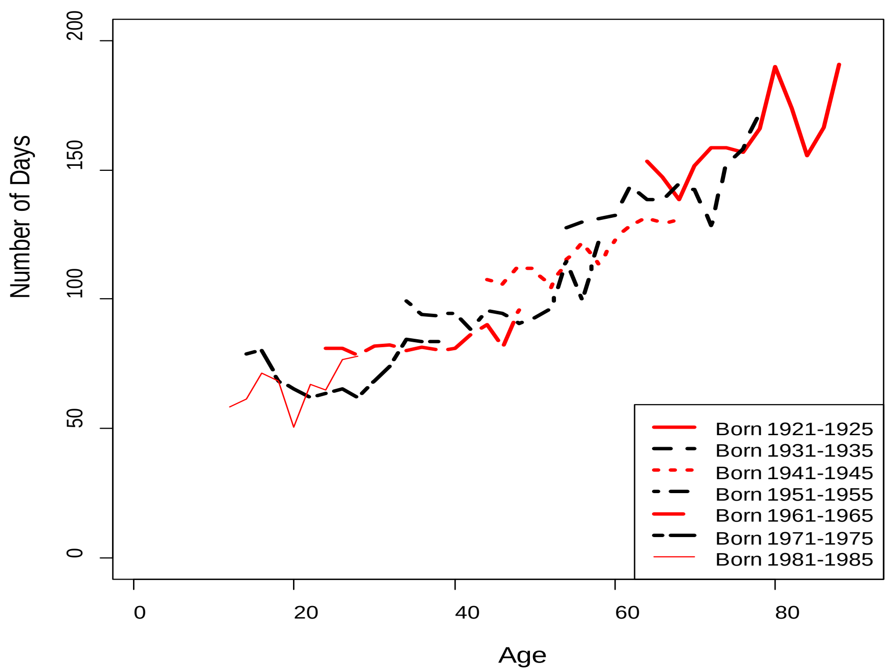

Figure 2 Average number of fish dinners in different birth cohorts and average age of cohort

We have three objectives for this article. First, we investigate the effects of age and cohort on the probability of eating fish for dinner at least once per week among males and females. Second, we investigate the effects of social inequality in fish consumption by investigating the effects of income and education on the probability of eating fish for dinner at least once per week among males and females. Third, we investigate future fish consumption by simulating the changes in probabilities of eating fish for dinner at least once a week for different cohorts as they age. To pursue these objectives, we use Norwegian Monitor Survey data (Ipsos-MMI, 2013), estimate logistic regression models, and use the estimated models in the simulations.

Model, estimation, and data

To model the probability of eating fish for dinner at least once a week, we use the binary logit model (Cameron & Trivedi, 2005). This model is specified with the probability function:

$$\Pr(y=1\,|\,x)=\Lambda(x'\beta)=\frac{e^{x'\beta}}{1+e^{x'\beta}},$$

where y is a binary variable indicating if an individual has fish for dinner at least once a week (y = 1) or not (y = 0), Λ is the logistic distribution function, x is a vector of explanatory variables, and β is the vector of coefficients to be estimated. This estimation can be done with maximum likelihood and the likelihood function is:

$$L=\prod_{i=1}^{n}\left(\frac{e^{x'\beta}}{1+e^{x'\beta}}\right)^{y_i}\left(1-\frac{e^{x'\beta}}{1+e^{x'\beta}}\right)^{1-y_i}$$

where n is the number of observations.

We follow Lynch (2003) and include age as a second-order polynomial, cohort as a first-order polynomial, education as an indicator variable of college education, and interaction terms of age, education, and cohort in the logit model:

$$\Pr(y=1\,|\,x)=\Lambda(\beta_0+\beta_1A+\beta_2A^2+\beta_3C+\beta_4AC+\beta_5E+\beta_6AE+\beta_7A^2E+$$
$$\beta_8CE+\beta_9ACE+\beta_{10}I+\beta_{11}I^2+\beta_{12}M+\sum_{t=1}^{4}\gamma_tP_t)+\varepsilon,$$

where $\Lambda(\cdot)$ is the logistic distribution function, ε is a stochastic error term, and the subscripts denoting individuals are deleted for notational simplicity. The outcome variable y = 1 if the individual ate fish for dinner at least once a week, A is the age of the individual (from 30 to 80 years), C is the cohort (year of birth from 1921 to 1985), E = 1 if individual has college education and 0 otherwise, I is income deflated by the consumer price index and the square of number of household members as recommended by OECD (2008), M = 1 if the individual is married, and P1 to P4 are four period dummy variables taking the value of 1 for the periods defined in Table 1.

The Norwegian Monitor Survey is a nationally representative and repeated cross-sectional survey of adults aged 15 to 95 years. The survey has been conducted biannually since 1985 and is one of Norway's most comprehensive consumer and opinion surveys. The survey covers a broad range of topics, including demographic and socioeconomic information, political preferences, stands on moral and ethical issues, self-perceived happiness, health, and eating habits including the frequency of fish consumption (Ipsos-MMI, 2013).

The model is estimated with the generalized linear model function (glm) in the statistical program package R (R Development Core Team, 2011).

Results

The model is estimated separately for males and females, and the results are shown in Table 1.

For males, the age and the cohort variables have insignificant effects by themselves. However, in interaction with education they have positive and significant effects. As a college-educated male ages, the more probable is it that he will eat fish for dinner at least once a week. Furthermore, for college-educated males, the probability of eating fish for dinner at least once a week increases for younger cohorts. The higher the income, the more probable it is that a male will have fish for dinner on a weekly basis. Marriage also increases the probability of eating fish among males. All the period dummies are negative relative to the year 2011, but only the dummy for the period 2005 to 2009 is significantly negative.

The pattern of results for females is similar, with two exceptions. First, in addition to the positive interaction effect with education, the age variable has a significant and positive effect by itself, and the total effect of age is higher than for males. However, this age effect is somewhat modified by the negative and significant effect of the interaction variable "Age·Cohort·Education," which suggests that the positive effect of education and age is lower in younger cohorts. Finally, we note that the effect of being married, somewhat surprisingly, is higher for females than for males.

The empirical results are used to simulate the probabilities of having fish for dinner for five different cohorts. This is done by letting age sequentially increase from 30 to 80 years for the different cohorts, and for each cohort using the average deflated income in the sample. We simulate the outcomes for married males and females with and without college education. The five cohorts included in our simulation were born in 1950, 1960, 1970, 1980, and 1990. The simulations of the consumption probabilities were performed for individuals aged from 30 to 80 years. These age groups are likely to have completed their education and still have several more years to live.

Table 1 Parameter estimates from the logit models: Probability of eating fish at least once a week

Symbol	Variable	Males	S.E.	Females	S.E.
	Intercept	–0.05	0.13	–0.05	0.13
A	Age (years)	0.27	0.14	0.55*	0.14
A^2	Age^2	–0.03	0.05	0.02	0.04
C	Cohort (birth year)	–0.20	0.15	0.06	0.14
AC	Age·Cohort	–0.04	0.05	0.07	0.05
E	Education (=1 if college)	0.26*	0.05	0.24*	0.05
AE	Age·Education	0.35*	0.07	0.24*	0.07
A^2E	Age^2·Education	–0.01	0.07	–0.08	0.08
CE	Cohort·Education	0.33*	0.07	0.26*	0.08
ACE	Age·Cohort·Education	0.03	0.08	–0.09*	0.08
I	Income (in NOK)	–0.01	0.02	–0.01*	0.02
I^2	Income^2	0.02*	0.01	0.02*	0.01
M	Married (=1 if married)	0.21*	0.04	0.40*	0.04
P_1	Period = 1987–1991	–0.02	0.25	0.17	0.24
P_2	Period = 1993–1997	–0.09	0.18	0.05	0.18
P_3	Period = 1999–2003	–0.24	0.13	–0.20	0.12
P_4	Period = 2005–2009	–0.27*	0.08	–0.28*	0.07
n	Number of observations	15,004		16,421	

Note: Results from logit estimation. The period dummies are relative to the year 2011. Continuous variables are standardized. An asterisk indicates statistical significance at the 0.05 level.

The results from the simulations are shown in Figure 3. The figure reveals several interesting effects of age, cohort, and education for males and females. In all four gender-education groups, the probability of having fish for dinner at least once a week increases with age. However, the magnitudes of the age and cohort effects are different across the four groups. In all four groups, the probability of eating fish for dinner at least once per week is around 0.4 when the individuals are around 30 years of age. For all groups, except men without college education, the probability increases gradually to above 0.8 at 80 years of age. For men without college education, the probability at the age of 80 years varies between 0.45 and 0.65 in the different cohorts. Also, for all the groups, except men without college education, the oldest cohort has a lower probability of eating fish than the younger cohorts throughout the adult life course. For men without education, the cohort effects are opposite, and the oldest cohort has the highest probability of eating fish for dinner at all ages.

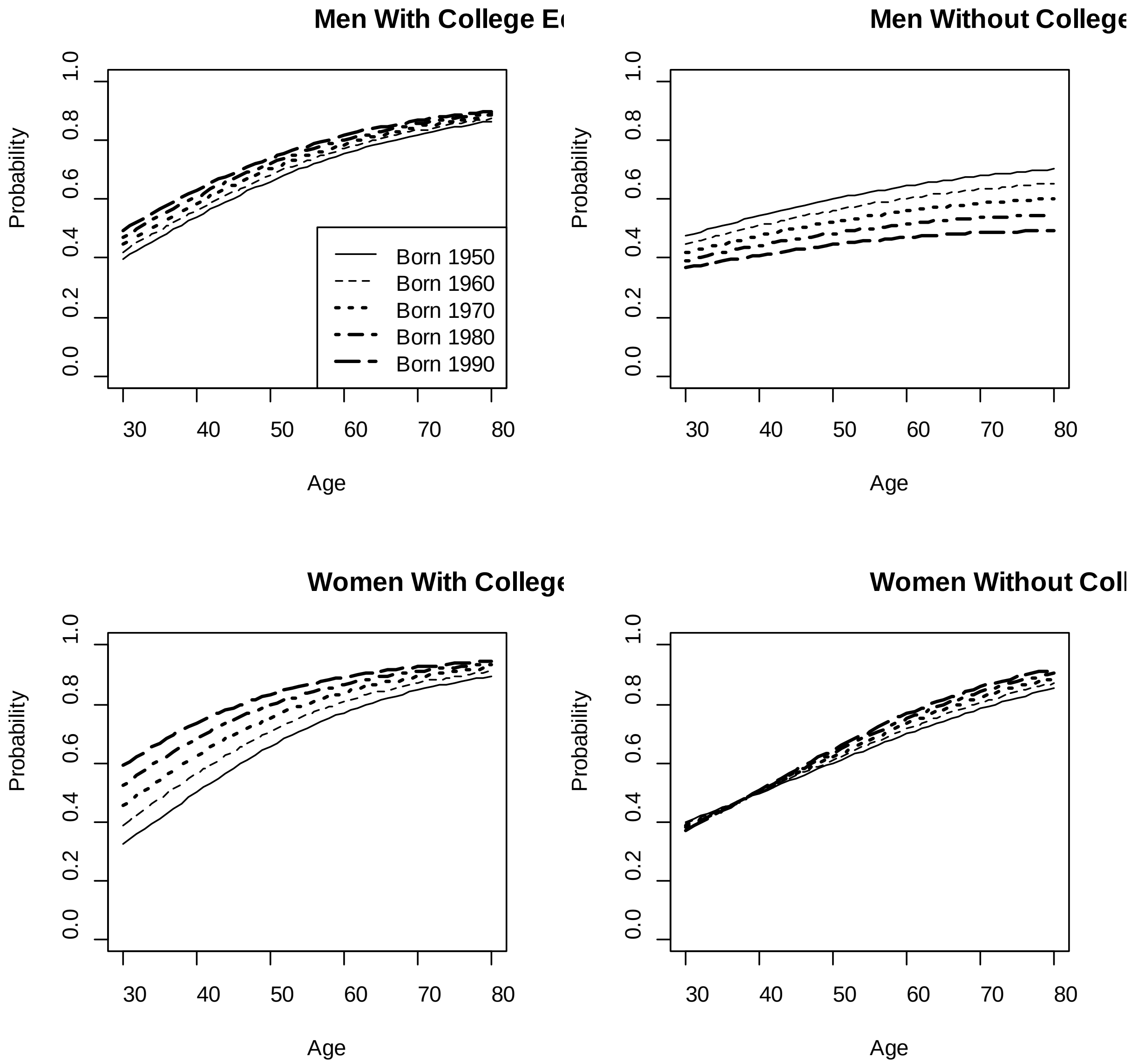

Figure 3 Simulated probabilities of eating fish at least once a week for different groups

Discussion and conclusions

Given time series of repeated cross-sections of different households, it is impossible to estimate the dynamics of fish consumption in individual households. However, the selected cohort approach uses both the cross-sectional and time-series structure of the data to better predict future fish consumption in Norway. The difference between generations is emphasized, and the consumption over the life cycle of different cohorts is simulated.

In Figure 2, the observed age and cohort effects without any control variables were presented, while the simulated age and cohort effects shown in Figure 3 control for gender, education, income, periods, and marital status. Both figures suggest a positive age effect on the probability of eating fish for dinner. Fish is a healthy food, and it is expected that people are more likely to have increasing frequencies of fish consumption when they age as discussed by Olsen (2003) and Pieniak *et al.* (2010).

However, in some respects, the effects of belonging to different cohorts are different in the two figures. Figure 2 suggests a positive effect on the frequency of consumption of belonging to the older cohorts. This figure also suggests that when older and younger cohorts are shown at the same age, the older cohorts usually have a higher frequency of fish consumption than the younger cohorts. However, the estimation results in Table 1 and the simulation results in Figure 3 indicate that the cohort effects may be confounded with the effects of education. As suggested by the literature concerning returns to education, education is important for good health (e.g., Wolfe & Haveman, 2002; Grossman, 2006).

Figure 3 shows that, except for men without college education, younger cohorts have a higher probability of eating fish for dinner than older cohorts when the cohorts are measured at the same age. One possible explanation for this somewhat surprising result may be that the emphasis on nutrition and health, including information about the importance of fish consumption, was higher when the younger cohorts grew up than when older cohorts grew up. Another possible explanation may be product development. In recent years, many new fish products have emerged at the market. These products may appeal more to younger than older cohorts.

Finally, we find that being married increases the probability of having fish for dinner. This result is in line with Umberson (1987) who found that mortality rates are higher among unmarried than married individuals. One of the reasons for increased mortality rates may be the lack of social control that exists inside the family and is likely to contribute to regulate healthy behavior. Spouses and children may tell or remind one another to engage in healthy behavior or to avoid taking risks. In addition, the spouse who makes dinner may control the type and quantity of food available. This result is also confirmed by Yannakoulia *et al.* (2008) who found that married Greeks generally have healthier eating patterns than unmarried Greeks.

Figure 3 shows that for three of the four groups, the frequency of fish consumption is higher in younger than older cohorts. Given that new generations continue to behave according to our simulation model, this result suggests that the total number of people who will eat fish for dinner at least once per week will increase as younger cohorts slowly replace older cohorts. Such a development is in accordance with the nutritional goal of the Norwegian food and nutrition authorities.

References

Cameron, A.C. & P.K. Trivedi (2005). Microeconometrics: Methods and Applications. New York: Cambridge University Press.

Chowdhury, R., S. Stevens, D. Gorman, A. Pan, S. Warnakula, S. Chowdhury, H. Ward, L. Johnson, F. Crowe, F.B. Hu & O.H. Franco (2012). Association between fish consumption, long chain omega 3 fatty acids, and risk of cerebrovascular disease: systematic review and meta-analysis. *British Medical Journal*, **345**: e6698.

Grossman, M. (2006). Education and non-market outcomes. In *Handbook of the Economics of Education* Vol. 1. Hanushek, E. & F. Welch (eds.). Amsterdam, North-Holland: Elsevier Science, pp. 577–633.

Gustavsen, G.W. & K. Rickertsen (2013). Consumer cohorts and purchases of nonalcoholic beverages. Empirical Economics, forthcoming. DOI: 10.1007/s00181-013-0688-3.

Ipsos-MMI (2013). Norsk Monitor Survey database.

Kris-Etherton, P.M., W.S. Harris & L.J. Appel (2002). Fish consumption, fish oil, omega-3 fatty acids, and cardiovascular disease. *Circulation*, **106**, pp. 2747–2757.

Lynch, S.M. (2003). Cohort and life course patterns in the relationship between education and health: a hierarchical approach. *Demography*, **40**, pp. 309–331.

Marette, S., J. Roosen & S. Blanchemanche (2008). Health information and substitution between fish: lessons from laboratory and field experiments. *Food Policy*, **33**, pp. 197–208.

Mori, H. & D.L. Clason (2004). A cohort approach for predicting future eating habits: the case of at-home consumption of fresh fish and meat in an aging Japanese society. *International Food Agribusiness Management Review*, **7**, pp. 22–41.

Mori, H., D.L. Clason & J. Lillywhite (2006). Estimating price and income elasticities in the presence of age-cohort effects. *Agribusiness*, **22,** pp. 201–217.

Mozaffarian, D. & E.B. Rimm (2006). Fish intake, contaminants, and human health: evaluating the risks and the benefits. *The Journal of the American Medical Association*, **296**, pp. 1885–1899.

OECD (2008). Growing Unequal? Income Distribution and Poverty in OECD Countries. Paris: OECD..

Oken, E., R.O. Wright, K.P. Kleinman, et al. (2005). Maternal fish consumption, hair mercury, and infant cognition in a US cohort. *Environmental Health Perspectives*, **113**, pp. 1376.

Olsen, S.O. (2003). Understanding the relationship between age and seafood consumption: the mediating role of attitude, health involvement and convenience. *Food Quality and Preference*, **14**, pp. 199–209.

Pieniak, Z., W. Verbeke, S.O. Olsen, K.B. Hansen & K. Brunsø (2010). Health-related attitudes as a basis for segmenting European fish consumers. *Food Policy*, **35**, pp. 448–455.

R Development Core Team (2011). R: A Language and Environment for Statistical Computing. Vienna, Austria: R Foundation for Statistical Computing. http://www.R-project.org.

Smith, J.P. (2007). The impact of socioeconomic status on health over the life course. *Journal of Human Resources*, **42**, pp. 739–764.

Stewart, H. & N. Blisard (2008). Are younger cohorts demanding less fresh vegetables? *Review of Agricultural Economics*, **30**, pp. 43–59.

Szymanski, K.M., D.C. Wheeler & L.A. Mucci (2010). Fish consumption and prostate cancer risk: a review and meta-analysis. *American Journal of Clinical Nutrition*, **92**, 1223–1233.

The Norwegian Directorate of Health (2012). Small actions, big differences – Advice for a more healthy diet. (In Norwegian: Små grep, stor forskjell – råd for et sunnere kosthold.) Report no. IS-2028. Oslo, Norway: The Norwegian Directorate of Health.

Umberson, D. (1987). Family status and health behaviors: social control as a dimension of social integration. *Journal of Health and Social Behavior*, **28**, pp. 306–319.

Wenneberg, M., A. Tornevi, I. Johansson, et al. (2012). Diet and lifestyle factors associated with fish consumption in men and women: a study of whether gender differences can result in gender-specific confounding. *Nutrition Journal*, **11**, pp. 101.

Wolfe, B.L. & R.H. Haveman (2002). Social and non-market benefits from education in an advanced economy. In Education in the 21st Century: Meeting the Challenges of a Changing World. Kodrzyki, Y.K. (ed.). Boston: Conference Series 47, Federal Reserve Bank of Boston, pp. 97–131.

Yannakoulia, M., P. Demosthenes, C. Pitsavos, Y. Skoumas & C. Stefanidis (2008). Eating patterns may mediate the association between marital status, body mass index, and blood cholesterol levels in apparently healthy men and women from the ATTICA study. *Social Science & Medicine*, **66**, pp. 2230–2239.