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FOOD RISK MANAGEMENT AND CONSUMER INFORMATION: EXAMPLE OF METHYL-MERCURY IN FISH

More and more frequently, consumer information is used as a management tool for health risks, through labelling, prevention or consumption recommendation programmes. We took a special interest in the tool used at an international level for the management of risk linked to the presence of methyl-mercury in fish. In this case, a recommendation aims to modify consumption behaviours in order to reduce the consumption of methyl mercury contaminated species, while providing enough intakes of Omega-3 fatty acids through consumption of other species. Via a "field" experiment, this paper shows the limited efficacy of such a recommendation.

Consumption recommendations and management of risk linked to methyl-mercury

Methyl-mercury is a neurotoxin compound specially concentrated in predatory fish at the end of food chain. There is epidemiological evidence that it is responsible for the development of neurological backwardness in infants (the Faeroe island cohort case), while other cases show this correlation (the Seychelles cohort case). Therefore, as a precaution, in 2003, the *joint FAO/WHO expert Committee on Food Additives* reduced the weekly tolerable amount recommended for women of childbearing age, pregnant or breast-feeding women as well as for young children.

Limiting risk at the production level is often very costly, even technically difficult. In this specific case, where only one part of the population is concerned, communicating about the risk can provide an interesting cost/advantage result, even though we have few quantitative assessments on induced effects. At the international level, the dissemination of information was chosen to manage that risk. As a precaution, the Unites States in 2001, Canada in 2002, Great Britain in 2003, and Australia and New Zealand in 2004 made recommendations distributed by gynaecologists and obstetricians in maternity hospitals, or even broadcast by the media like in the United States. In 2002 in France, the French Agency for Food Sanitary Safety (AFSSA) made a recommendation available on its internet website and in July 2006, the French Food General Directorate of the French Ministry for Agriculture and Fisheries issued a press release.

These recommendations differ from one country to the next according to national consumptions, but also to the precaution level selected by risk managers. They present the risks and benefits of fish consumption, as well as details on the quantities not to exceed per week according to species. They globally aim at limiting total consumption to twice or three times a week. The public health issue consists in reducing the consumption of the fish most contaminated in methyl-mercury (swordfish, shark, tuna, and so on) for a group at risk, while letting it benefit from nutritional fish intakes, notably Omega-3 unsaturated fatty acids.

With the intention of helping public decision makers, we assessed the efficacy of such a recommendation by analysing the consequences of this information on consumption behaviour, via to a field experiment which allows extremely precise monitoring of individual consumption.

A field experiment to assess changes in household consumption behaviour

The aim of this experiment is to assess the short and long term consequences of information on the consumption behaviours of a whole household, and to evaluate how efficient a consumption recommendation based on the rationality of consumer behaviours may be. We carried out the experiment with 201 households including a total of 803 individuals, in the Nantes area (West of France). They were selected according to risk criteria defined in the recommendation, that is to say the presence of a child under fifteen years, and women of childbearing age who consume fish at least twice a week.

We monitored these households over the 5 months between May and September 2005. Each household member's fish and seafood consumption was recorded in a notebook and checkout receipts were kept. At the end of every month, an interviewer came in to collect all the data and give a questionnaire on food behaviours.

At the end of May, (first month of the experiment), the households were randomized into treatment and control groups. Every female-head of the household from the treatment group was given a consumption recommendation to read (99 households including a total of 400 individuals). The control group (102 households including 403 individuals) did not receive any information and kept on recording consumptions until the end of the experiment. In addition, during the month following the revelation about the

existence of methyl-mercury in fish and at the end of experiment, the treatment group households answered a questionnaire on memorization of the recommendation and their knowledge of fish consumption risks and benefits. With this type of experiment, the revelation of information is very strictly controlled. Here are the main results of the experiment.

A low information impact

Table 1 shows the weekly consumption frequency of women and young children according to recommended amounts (frame 1). At the end of the experiment, the average weekly consumption frequency (taking all species together) for women and children under 6 years of age is higher than the recommended frequency of twice a week. Even though some women reduced their consumption, this reduction was not enough to be under the advised frequency. In total, 4 months after receiving the recommendation, 34% of women from the treatment group (as in the control group) did not exceed the twice-weekly consumption of fish.

The fish that were to be consumed once a week or avoided altogether were not consumed much. Their consumption, on average, is below these thresholds.

From a statistical point of view regarding the consumption frequency of all fish species (frame 2 and table 2, first column), the information, measured by parameters linked to Treat.June and Treat.Sept variables, has a significant impact. We can conclude that revealing the information about methyl-mercury leads to a reduction of 0.860 in the consumption frequencies of all types of fish in June, and 0.659 in September, by the treatment group members compared to those of the control group. This reduction in consumption frequencies is greater in June (-0.860) than in September (-0.659). Therefore, after the recommendation, the drop in fish consumption is statistically significant, but lessens as time passes.

In table 2, second column, from a statistical point of view the information measured by parameters linked to Treat.June and Treat.Sept variables, also has a significant impact on the probability of consuming fish that should be limited to once a week (this concerns nearly almost all canned tuna).[1] The information effect lessens as time passes, because the drop in June is greater (-0.941) than in September (0.851). However, the information has no effect on the consumption of fish to be avoided (table 2, third column), because of the very occasional nature of that consumption.

Poor memorization of information

In September, at the end of the experiment, few women managed to recall the species mentioned in the recommendation, as table 3 shows. The correlation between the percentage of fish remembered in September and consumption habits in the first month (May) is very close. 50% of women cite fresh tuna, and 43% cite canned tuna, which was the most consumed species in May, and the one showing a significant drop in consumption. Conversely, other species are much less often cited. In addition, only a minority of them correctly remember consumption frequencies associated with species. While 50% of women recall that fresh tuna featured in the recommendation, only 10% of them remember that they must avoid it altogether (see table 3).

This poor memorization partly explains the minor change in consumer behaviours. Indeed, the drop in consumption mainly concerns the most consumed species, particularly canned tuna, and no longer the most contaminated species which are only occasionally consumed (indicated by * in table 3). Furthermore, women who consume very little of the species mentioned may have the feeling that they are following the recommendation even though, taken as a whole, they exceed the limit of two consumptions a week.

Positive nutritional values of fish firmly rooted

The recommendation describes the dangers and nutritional benefits of methyl- mercury so that individuals adopt appropriate behaviour. In order to make their decision (here, to follow or not to follow the recommendation), individuals make their own evaluation of risks and benefits. The month following the recommendation (June), 50% of women consider that methyl-mercury presents major risks to their health; 3 months later (September), only 39% feel this. The negative value given to mercury lessens as time passes. On the other hand, the positive value attributed to omega-3 fatty acids in fish does not lessen and, at the end of experiment, 70% of women think that omega-3 fatty acids are beneficial to them and the other members of the household. This is consistent with the previous result which shows that the drop in consumption is observed during the month following the recommendation, only to attenuate over the following months. The first behaviour change (relatively small, let us remember) comes as an immediate reaction to the information. Later, individuals give greater value to the benefits provided by consumption, which leads them not to modify it.

This positive valuation comes from individuals' earlier knowledge of the benefits of fish consumption - the "roots" from which individuals make their own assessment. Experimental economics literature indeed shows the tendency of judgements to be rooted in prior values which can be given during the experiment, either learned by the subject or already known to the subject. The final judgement results from an adjustment starting from this point of reference, which in most cases remains insufficient. This strong root may be linked to nutritional campaigns widely broadcast in France for many years, describing the positive effects of fish on the health. At the end of the experiment, we interviewed women on their knowledge of the risks and benefits of fish consumption before the experiment: 64% knew that consuming fish was good for the health, 51% knew the omega-3 positive effects, and 87% were aware that it is recommended to consume fish twice a week. Conversely, only 12% among them knew that certain fish contained methyl-mercury. Due to positive-value rooting, when women are informed about the negative effects of fish consumption, they have a tendency to underestimate those risks.

[1] An additional experiment carried out in a laboratory (see Roosen et al., 2007) accurately showed the information effect with regard to methyl mercury risks and omega-3 benefits. The revelation of this information led to a significant reduction in the selected quantities of canned tuna, confirming the latter.

Conclusion

In terms of assessment of the management measure, we may conclude that the efficacy of information on consumption behaviour is low. However, the results must be considered as experimental and certain limits must be borne in mind, such as the fact that we did not take into consideration social and family networks which are particularly mobilized in consumption behaviours.

The low impact of the recommendation leads to several comments on the information itself, in particular, the number of species cited and their associated frequencies, for which showed poor memorization. Today, risk managers have elaborated contents which differ according to countries. For instance, the United States mention 10 fish species while France, in a 2006 press release, cites 3 species to avoid (swordfish, marlin, siki) and refers to the Ministry of Agriculture and Fisheries for the list of the 28 wild predator fish whose consumption must be avoided.

Some alternative solutions, such as a more succinct distribution of information (especially in terms of species) targeted at pregnant women through the obstetrician hospital system, could be taken into consideration. On the other hand, a label on the packaging of the most contaminated species, with wording such as "this product is not recommended for pregnant women and young children", could be envisaged as a way to counter the poor memorization of different species. These research results show that the methods and conditions for revealing information must be precisely analyzed. Furthermore, experimental methodologies may be useful in order to improve the efficacy of public management regarding food risks.

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For further information

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Table 1: Reported weekly consumption frequencies for women and children

	Treatment			Control		
	May	**June**	**Sept.**	**May**	**June**	**Sept.**
Female household head						
All fish species (up to twice a week)	3,23	2,82	2,83	2,93	2,82	2,65
Species limited to once a week	0,51	0,43	0,34	0,53	0,53	0,40
Fish species to avoid	0,10	0,10	0,10	0,08	0,09	0,09
Children under age of 6						
All fish species (up to twice a week)	2,17	1,90	2,07	2,08	2,04	2,13
Species limited to once a week	0,27	0,22	0,26	0,28	0,31	0,27
Fish species to avoid	0,04	0,04	0,05	0,05	0,05	0,07

Nota Bene: Here we do not mention consumption by men and children over 6 years, which is strongly correlated to women's

Table 2: Consumption by all individuals and impact of the information

Categories	**All fish**	**Once a week**	**To avoid**
Constant	-0,328	-1,103	-2,465***
Treat	0,240***	-0,151	0,150
June	-0,045	-0,089	-0,175
Sept	-0,139	-0,445***	0,208**
Treat.June	-0,860***	-0,941*	0,746
Treat.Sept	-0,659**	-0,851*	0,369
SOCIO-DEMOGRAPHIC VARIABLES [a]			

Nota Bene: *, **, *** mark significance at the threshold of 10%, 5%,1%, respectively.

[a] taken into account in the regression but not detailed in this document: age, education, sex, number of children significantly influence consumptions in the first two columns of this table.

Table 3: Recollection of fish species and associated frequencies in the recommendation, at the end of experiment

Species mentioned in the message	**% women in treatment group**	
	Species spontaneously recalled	**Frequencies correctly recalled****
Fresh tuna*	50 %	10 %
Canned tuna	43 %	27 %
Shark*	28 %	14 %
Swordfish*	19 %	13 %
Grouper*	13 %	9 %
Rock salmon	10 %	13 %
Grenadier	4 %	10 %
Ling	4 %	14 %
Marlin*	3 %	6 %

Nota Bene: * mentioned as 'fish to avoid' in the recommendation

** after recalling each species.

Frame 1: **Elements of the recommendation given to households**

In order to simulate already-broadcast international recommendations, the message given to the treatment group is based on the maximum number of weekly portions for the most contaminated species. It mentions the population at risk (women who might become pregnant, pregnant women or nursing mothers, young children) and gives a reminder of the benefits relating to omega-3. It explains in details the risks linked to methyl-mercury. it then describes the number of portions to respect, according to species:
- limit the fish and sea-food consumption as a whole to 2 portions a week,
- among these two portions, limit to once a week the consumption of: canned tuna, rock salmon or grenadier or ling (blue ling),
- do not consume any fresh tuna, shark, swordfish, marlin, or grouper.
We followed the international recommendations which make a distinction between fresh tuna (red tuna) and canned tuna, among which listao and albacore are not so contaminated in methyl-mercury.

Frame 2: Measurement of the impact of information on consumption

In table 2, the econometric estimation of all the 803 individual consumption frequencies in May, June and September 2005 helps isolate the information effect. As information is revealed to the treatment group at the end of May, various indicative variables are used to measure the impact of information on that group in June and September. The indicative variable June (September, respectively) is equal to 1 for consumptions in June (September, respectively) and zero otherwise. The effect of information in June and September is measured by "crossing" the previous variables, that is to say Treat.June and Treat.September. If, for these last variables, the regression parameter is statistically significant, then information does indeed influence consumption.
Table 2, first column explains fish consumption frequencies through the ordinary least square method. Both other columns explain the consumption probability of fish mentioned in the recommendation with the probit method, because of the numerous frequencies, either positive though varying very little, or equal to zero (respectively 34.4% and 79.2% of the observations in columns 2 and 3).