

Review Article

Fish advisories in the USA and Japan: risk communication and public awareness of a common idea with different backgrounds

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Some countries have established fish advisories to manage fish consumption to minimize methylmercury exposure. Our objective was to compare the fish advisories and the resultant consumer behavior in the United States of America (USA) and Japan. Both countries have national consumption guidelines, but American states enjoy greater independence in issuing guidelines for local water bodies and vary in the information that is provided for the public. The proportion of the American public that has heard of state fish advisories is thought to be close to 30%. There is a concern that this low level of awareness extends to pregnant women. In Japan, the current problem is the lack of comprehensive studies on the public awareness of fish advisories. Nonetheless, there is evidence that fish consumption has decreased in both countries. In USA, there is a possibility that the strong emphasis on mercury toxicity drives the general population towards a trend of lower fish consumption. In Japan, the fish advisory encourages seafood consumption for nutritional benefits. Consequently, the decrease may be due to the shift towards a "Western diet". Also, the Japanese fish advisory seems to be less active in advocating the issue of fish consumption and mercury exposure, which may be partly responsible for the possible lesser attention of the consumers. Cultural factors may explain for the baseline difference in consumption and account partly for the change in Japanese consumer behavior. However, the dissimilarities in fish advisories may also be responsible for the variations in consumer behavior.

Key Words: fish advisory, fish consumption, mercury, public awareness, risk communication

INTRODUCTION

Mercury contamination of aquatic life and the possible consequences on human health through consumption of aquatic organisms are a global issue. Following large cohort studies conducted in the Faroe Islands,¹ Seychelles,² and in northern Japan,³ fish consumption has become an important topic in public health policy. Subsequently, policy makers in many countries, including Japan, Korea, Canada, the United States of America (USA), France, and the United Kingdom, have responded by issuing fish advisories.

We have witnessed efforts put into the study on mercury toxicity and nutritional benefits from seafood consumption and the resulting policies to regulate consumption. Minamata disease is by far the most well-known medical condition caused by acute exposure to methylmercury. It is characterized by neurological defects such as ataxia, disturbances to hearing and sight, and weakening of the muscles. On the other hand, chronic exposure to methylmercury, mainly occurring through the consumption of some of the fish species, has been associated with much milder damage to the central nervous system and cardiovascular diseases, but the focus has been put on the adverse effects on the neurodevelopment of the fetus and young children. The scientific findings that support the policies are important but as is the intended message and the actual response of the public. One of the key

issues regarding fish advisory is the need to consider the balance of risks of contaminants and benefits of nutrients in aquatic food. Using hypothetical scenarios of consumer behavior, Cohen *et al*⁴ showed that the net benefit and risk of seafood consumption vary substantially, depending on consumer behaviors towards the fish advisory. Consumer behaviors represent the integrated outcome of sequential factors, including the advisory per se, how it is publicized, as well as how each individual becomes aware of it and weighs the message according to his or her own values. Each of these preceding factors has to be carefully examined to derive an accurate overview of consumer behaviors.

In this paper, we reviewed existing reports and examined each of the aforementioned factors in Japan and USA, where the baseline consumption of aquatic food is distinctly different. We predicted that there is a difference in consumer behavior due to the dissimilarities in the fish advisories of the two countries.

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DIFFERENCE IN FISH CONSUMPTION BETWEEN JAPAN AND USA

Fish consumption of the two countries shows a substantial difference. As previously reported, Japan has a high rate of fish consumption on the global market;⁵ a Japanese consumes four to five times more fish/seafood than an American.

In the USA, daily per capita consumption of commercial fish and shellfish averaged 19.8 g from years 2000 to 2009 (Figure 1).⁶ The National Health and Nutrition Survey conducted by the Japanese government indicated that fish consumption varied between 90 g and 100 g per day from 1980 to 1996;⁷ this is consistent with the result from another report.⁸ According to the national survey, daily per capita fish consumption decreased from 94.3 g in year 1999, to 78.5 g in 2008.⁹⁻¹⁸ Interestingly, a recent survey conducted on Japanese ($n = 106$) who have been living in the USA for more than 6 months revealed the per capita fish and shellfish consumption to be as high as 60 g and 14 g per day, respectively, much higher than the USA

average. These figures suggest a robust preference of Japanese for marine products.¹⁹

DERIVING THE GUIDELINES – ADVISORY AT THE NATIONAL OR FEDERAL LEVEL

The aim of fish advisories in both countries is to minimize the risks of methylmercury exposure through fish consumption in the population, especially for the identified high-risk group.

USA has a federal fish advisory, released by the Environmental Protection Agency (EPA) and the Food and Drug Administration (FDA) in 2004. The advisory contains three recommendations for the high-risk groups – i.e., women who may get pregnant, women who are pregnant, and nursing children (Table 1, left column).²⁰ The Japanese government released its fish advisory twice, the first in 2003, followed by 2005. The advisory targets only pregnant women and excludes children from the high-risk group, and focuses mainly on ocean fish species (Table 1, right column).²¹

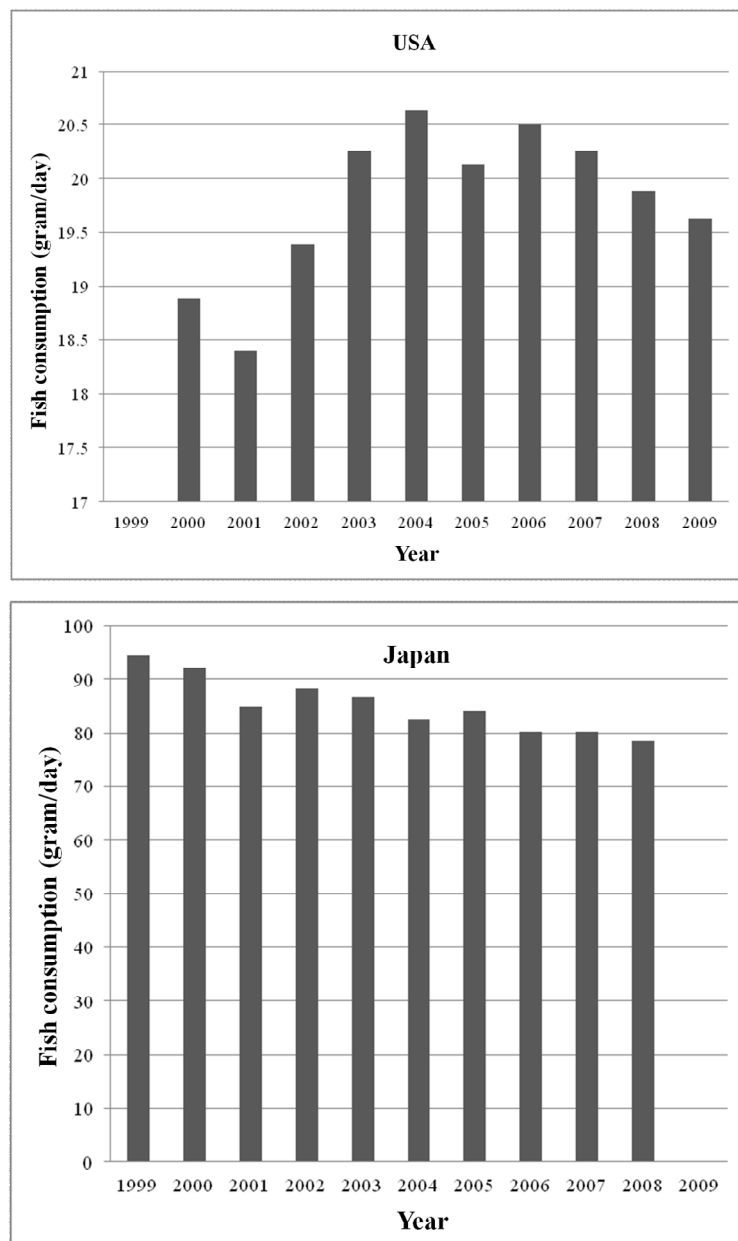


Figure 1. Comparison of per capita fish consumption in USA and Japan

Table 1. Comparison between American and Japanese fish consumption guidelines for pregnant women

USA	Japan
Recommendations for species to be avoided	
1) Avoid shark, swordfish, king mackerel and tilefish.	1) Avoid short-finned pilot whale and bottlenose dolphin.
Quantitative recommendations	
2) 340 g/week (2 average meals) for species that contain lower mercury levels.	2) Species under “1 unit” of mercury: splendid alfonsino, Baird’s beaked whale, swordfish, Pacific bluefin tuna, bigeye tuna, Finely-Striate buccinum, sperm whale.
170 g/week for self-caught fish or check with local advisories.	Species under “half unit” of mercury: yellowback seabream, striped marlin, Hilgendorf’s saucord, southern bluefin tuna, blue shark, Dall’s porpoise, Japanese bluefish.
	80 g/week of “1 unit” of mercury e.g. 160 g/week of species from “half unit” category or 40 g/week of species from ‘one unit’ category plus 80 g/week from ‘half unit’ category.
	No restriction for species with low mercury content.
Coverage of fish advisories	
3) All states have fish advisories: 43% of the nation’s total lake acreage, 39% of the nation’s total river miles, and most of the Atlantic and Gulf coast.	3) 21 out of 47 prefectures do not have consumption guidelines; 14 prefectures provide a link to the national government website; and 12 prefectures have their own information page.

In Japan, two institutions are mainly responsible for the advisory. The Food Safety Commission (FSC) under the cabinet is responsible for risk assessment, and the Ministry of Health, Labour and Welfare (MHLW) is in charge of risk management. The tolerable weekly intake (TWI) is established by the FSC, and MHLW uses it for practical and administrative purposes. The website of MHLW provides a range of information and a tentative English translation of the advisory can be found at: <http://www.mhlw.go.jp/topics/bukyoku/iyaku/syoku-anzen/suigin/dl/051102-1en.pdf>.

Basic information in deriving the guidelines was based on the cohort studies conducted in the Faroe Islands and/or Seychelles. A reference dose (RfD) of 0.1 µg/kg body weight/day is used in the USA,²² while the resultant TWI of 2.0 µg/kg body weight/week (equivalent to 0.29 µg/kg body weight/day) is used in Japan.²³ Differences in the derivation of the RfD could be observed between the two countries. EPA based the RfD on the Faroese cohort, while FSC considered both Faroese and Seychelles studies; EPA used an uncertainty factor of 10 while FSC used 4. Other differences included variations in fish tissue residue criteria and relative source contribution.

ADMINISTERING THE GUIDELINE – ADVISORIES AT THE STATE AND PREFECTURE LEVEL

While the federal or national government is responsible for issuing the national fish advisory, the local government has more direct influence on how it is conveyed to citizens. Local governments are also able to manage the advisory better by changing guidelines with respect to fish species and contamination levels present in local water bodies.

When compared to Japanese prefectures, American states are more independent in establishing their fish advisories to cover specific areas and fish species. The states generally follow the federal advisory but most issue advisories for local freshwater and sports fish species, which may vary from the federal advisory. For example, definition of “children” in the high-risk group is different among the states; many states use 8 oz as consumption

limit rather than the 12 oz as stated in the federal guidelines. According to the EPA, American fish advisories have a wide coverage over the country’s water bodies as of year 2008. The number of consumption guidelines increased from 20 in 1993 to 874 in 2008,²⁴ and it actually increased by 164 in 2002 and 827 in 2004 (other years had increases of under 100).²⁵ The increases may be attributed to the release of the 2001 methylmercury report by EPA,²² and the 2004 federal guideline respectively. Health, environmental, and/or the wildlife department(s) are in charge of the state advisory, and usually collaborate with organizations such as representatives of a particular water body, as well as those involving waterworks, wildlife, and fishery. As a result, many of the local water bodies are under a network of close surveillance on contamination in fishes. In Japan, about half of the prefectures do not provide any guidelines for fish consumption. In fact, when we searched for information on fish advisories using the keywords “fish” and “mercury”, 21 out of 47 prefectures do not have a hit. Most prefectures that provide guidelines use the one issued by the national government.

American state advisories vary in the type and amount of information provided as compared to Japanese prefectures. Upon doing an online search on all the state advisories, we realized that presentation of the guidelines differ even among states in the USA. Almost all state advisories provide information on the effects of mercury on human health but only some states make the consumption guidelines very clear. For example, Mississippi lists the bans and local advisories but does not seem to have any clear consumption guidelines for the public. Maine provides a balanced mix of easily comprehensible brief information for the public and technical reports for the scientific community. Florida has wallet cards with summarized and easy-to-understand information for pregnant women. On the other hand, there are states that present information for fish tissue monitoring programs but have little to no advertising priority to the general public. For instance, Colorado provides a highly technical report on the advisory, including information such as derivation of reference dose, but does not have any brochures designed

for download by the general public. In contrast, 14 out of the 26 Japanese prefectures that provide a fish consumption guideline merely have a link to national governmental websites. Of the 12 prefectures that have their own information page, only 6 provide additional information, such as power point slides of lectures by experts or a list of webpages relevant to mercury issues. The remaining 6 prefectures extracted information having direct relevance to the consumers, such as the number of fish meals per week according to fish species, from the national governmental websites and posted it on their websites.

Risk communication to the public is also an important part of information dissemination. This again depends greatly on the presentation of information to the public. The Japanese advisory emphasizes more the benefits of fish consumption than the federal and most state advisories in the USA. Many American states have diagrams to show how fish should be prepared to minimize the mercury intake. However, few state advisories refer to the benefits of fish consumption. Only a few states, including Washington and New Jersey, have a separate section on the website to explain the benefits of fish and omega-3 fatty acids, or post articles on the benefits of fish consumption. The federal website and brochures contain only one paragraph that mentions omega-3 fatty acids. Greiner *et al*²⁶ examined risk-and-benefit messages in 310 news articles relating to fish consumption and reported that risk messages outweighed benefit messages by four to one. However, there appears a shift in US policy towards the emphasis on the benefits of fish consumption in recent years. In 2006, the Institute of Medicine published a report on balancing the risks and benefits of fish consumption. This report provided recommendations to federal agencies in policy making and release of guidelines to the public.²⁷ Additionally, FDA released a draft risk and benefit assessment report in 2009, which mentioned that the future focus will be on the net effect of fish consumption.²⁸ In contrast, the Japanese advisory highlights the importance of fish consumption and refers to the nutritional value of fish, such as its abundance of omega-3 fatty acids. The Ministry of Health, Labour and Welfare's disseminated information urges pregnant women not to discontinue eating fish but to pay attention to some species that may contain high mercury levels.

In addition, some consideration needs to be paid to the inadequacy of information to cover all population groups, which can lead to a "spill-over" effect i.e. the non-risk group may decrease its consumption or stop eating fish altogether due to fears that fish may be toxic. Many American states do not have information on fish consumption for the general population. California stands out as an exception because its advisory states clearly that there are two sets of guidelines, one for the high-risk group and one for everyone else. In Japan, MHLW makes an effort to have guidelines that cover the entire population, including pregnant women, children, and women who are planning to become pregnant.

ROLE OF MEDIA

Mass media appears to be the most important source of fish advisory information for the public in USA and Japan.

A previous study in the USA stated that the FDA used

TV press releases and newsprints in 2001 with less intensive follow-ups in 2002 to educate the public about the advisory.²⁹ Studies also showed TV and newspapers as the major sources of information among the anglers,³⁰ or among participants to a nutrition-supplement program in California,³¹ as well as among more than 3,000 women of childbearing age in more than 10 states across US.³² In addition, Shimshack *et al*³³ suggested that the observed reduction in fish consumption may be associated with newspaper readership.

In Japan, a survey by the Tokyo Metropolitan Municipality (TMM) was conducted three months after the release of the first fish consumption guidelines in 2003. A questionnaire was sent to the maternal and child health section of the municipality offices in Tokyo area (n=70). A majority of the respondents were aware of the advisory via "governmental notification" (n=65), newspaper (n=55), or TV (n=42). A second survey conducted one month after the first one involved 101 residents who participated in the Food Safety Forum. Of these, 83% of the participants said they were aware of the advisory via newspaper (61%) or TV (54%).³⁴ Another survey conducted three years (2007) after the release of the second fish consumption guideline involved 209 pregnant women attending antenatal health monitoring in the western part of Japan. It was reported that 86% of the participants obtained their information from TV and newspaper.³⁵

PUBLIC AWARENESS

It is equally important to look at public awareness so as to understand how widely or well the general population and/or target groups have accepted the messages intended by fish advisories. This has been examined more extensively in the USA than in Japan (Table 2).

Surveys have been conducted in the USA to examine public awareness towards the federal or local advisories. We performed a literature search on Web of Knowledge. Input of "fish consumption guideline" as the topic yielded 317 search results, while "fish advisory" yielded 524 results and "fish consumption public awareness" yielded 48 results. We selected potential articles that examined fish consumption and public awareness/behavior in the USA based on the article titles and ended up with slightly over 20 of them.

It could be observed from previous studies that the proportion of the American public that have heard of state fish advisories may not exceed 30% (Table 2, left column).^{32,36-39} Interestingly, it was reported that the younger participants (the potential childbearing age group), were less aware of fish consumption issues as compared to the older participants.^{32,37} Karouna-Renier *et al*³⁹ reported that fewer pregnant women knew about the Florida Fish Consumption Advisory than non-pregnant women. Considering that only a portion out of the 30% who have heard of the fish advisories understands and applies the information to his or her diet (e.g. avoiding consumption of fish species that contain high mercury level), substantially less than 30% of the public may be carrying out the fish advisories' recommendations in reality. There is also a concern that pregnant women and group of childbearing age may actually have a lower awareness than the general population. This will mean that fish advisories' messages

Table 2. Results from previous studies on public awareness towards fish advisories in USA and Japan

USA	Japan
Knobeloch <i>et al.</i> ³² reported that 20% of 3015 women aged 18 to 45 from 12 states were aware of state fish advisories. Mean number of fish meals was 46 per year (less than half of the restriction of 2 meals per week as recommended by federal fish advisory).	Tokyo Metropolitan Government ³⁴ reported that 100% of 101 participants from food forum surveys have heard of the fish consumption guidelines and 84% have seen an excerpt from the guideline.
Burger ³⁶ reported that 30% and 20% of 180 college students and staff in New Jersey have heard of FDA/EPA and New Jersey state advisories respectively.	Yoshida <i>et al.</i> ³⁵ reported that 75% of 209 pregnant women knew about issue between mercury exposure and pregnancy; 55% were informed about mercury intake from fish; 25% knew about classification of fish species according to mercury contents.
Burger ³⁷ reported that 45% and 25% of 460 college students and staff in New Jersey have heard of FDA/EPA and New Jersey state advisories respectively. 75% of the participants who have heard of warnings regarding fish consumption trusted the information.	
Burger and Gochfeld ³⁸ reported that 50% of 174 college students and staff in New Jersey did not know about advice for fish species that contain high levels of mercury and could not name fish species in guidelines. 95% of the participants heard about health benefits of fish consumption as compared to 76% who heard of associated risks.	
Karouna-Renier <i>et al.</i> ³⁹ reported that 31% of 600 women of childbearing ages in Florida were aware of the Florida Fish Consumption Advisory. Hair mercury level was significantly higher in participants who were unaware of fish advisories.	
Silver <i>et al.</i> ³¹ reported that 31% of 500 low-income women in California knew about the state advisory. 29% of participants consumed fish in excess of FDA/EPA guidelines.	

Table 3. Change in fish consumption in USA and Japan

USA	Japan
In New Jersey, Burger ^{36,37} reported a decrease from 7.9 meals/month in 2004 to 6 meals/month in 2007 among college student and staff.	Tokyo Metropolitan Municipality ³⁴ stated that 30% of 101 participants of a diet forum reported a control in the consumption of swordfish and splendid alfonsino, 4 months after the release of the 2003 guideline. Among this group of individuals, 17% continued with the controlled consumption even eight months after the release of the guidelines (at the time of interview). 70% of the participants responded that they have not been controlling their consumption of other species.
In California, Silver <i>et al.</i> ³¹ reported 40% lower fish consumption among pregnant women than non-pregnant women, and 20% lower consumption among women who knew about the state advisory than those who did not.	
In Massachusetts, Oken <i>et al.</i> ⁴⁰ reported a decrease in the consumption of canned tuna, dark meat fish, shellfish and white meat fish from 7.7 servings/month (1999-2000) to 6.4 servings/month (2001-2002) among 2235 pregnant women who visited obstetric offices.	

are not reaching their intended target groups.

Surveys conducted by TMM on maternal and childcare staff and food safety forum participants revealed high public awareness (Table 2, right column).³⁴ However, it must be noted that the groups of participants are not true representatives of the general public and there is a good chance that the participants already harbor a higher awareness towards recommended fish consumption practices than the general public. The only reliable study as of current was conducted by Yoshida *et al.*³⁵, which reported low awareness among pregnant women towards fish species classification (Table 2, right column). This demonstrates that the percentage of the high-risk group that actually understands and utilizes fish advisory information may not be high in Japan. However, the bigger concern at current is the apparent scarcity of studies in Japan on public response towards fish advisory. The lack of studies itself may be associated with the blunted response of pub-

lic and thus confounds a closer examination of public awareness towards the national fish advisory.

CHANGE IN FISH CONSUMPTION

The change in fish consumption may indicate a response towards the fish advisories. Both the USA and Japan seem to be experiencing a drop in fish consumption. While the decrease in USA may be due to fish advisories, this may not be the case for Japan.

Fish consumption in the USA has gradually diminished since 2004, after the release of the FDA/EPA guidelines in the same year. This may imply an impact of the guidelines on the public's perception towards fish consumption (Table 3, left column). Shimshack *et al.*³³ examined the effects of the FDA's announcement on canned fish purchase by using the US Consumer Expenditure Survey two years before (n=5287) and after the announcement (n=5240). They found that the largest decrease in the pur-

chase of canned fish was from college-educated individuals in the target group (women who are pregnant or at risk of pregnancy; young children). Households with young and nursing children also manifested a 50% decrease in their expenditure on canned fish. There was no statistically significant decline in less educated consumers but a decrease was observed in newspaper/magazine readers in the non-target group. Therefore, the relationship between fish advisories and public awareness and response looks like a complex one that is affected by a multitude of factors, such as information presented by the authorities and risk communication, but that is also confounded by factors such as education^{32,33} (newspaper readership, exposure to news on TV, etc) and ethnicity^{31,32} (does information reach all ethnic groups of different mother tongue, how much fish is normally consumed in the diet, etc). There is a possibility that the messages from fish advisories have driven not only the high-risk groups but also the general population towards a trend of lower fish consumption.

The major evidence of a decrease in the fish consumption in Japan is the national survey as shown in Figure 1. However, we could only identify the survey conducted by TMM on the 101 forum participants as the only study related to the change in fish consumption rate in the Japanese public (Table 3, right column).³⁴ The sharp but transient decrease in the consumption of swordfish and splendid alfonsino right after the release of the first advisory might indicate a failure in risk communication and at the same time, the nature of response by the Japanese population to the national fish advisory – a short-term one. However, the response of the Japanese population towards the national fish advisory remains unclear due to the dearth of studies on this issue. It is plausible that the change in pattern of fish consumption is due to the shift of the average Japanese diet from the traditional form rich in aquatic organisms towards the “Western diet”, which is one of high consumption of red meat (of terrestrial animal), saturated fats and carbohydrate-rich snacks..

DISCUSSION

It can be assumed that cultural variations contribute significantly to the baseline difference in seafood consumption between the general American and Japanese populations, and the “stricter” American consumption guidelines may simply not be acceptable by the Japanese population. On the other hand, the shift from a traditional Japanese diet to that of a “Western” one may partly account for changes in consumer behaviors in Japan. Although the American and Japanese fish advisories have a common goal in minimizing the risks of methylmercury exposure through fish consumption in the population, they differ in terms of their administration and derivation of guidelines. Judging by the public awareness and responses, it is unclear whether the fish advisories in both countries have achieved their common aim. Nevertheless, it is at least clear that the change in consumer behaviors in the USA is at least partly due to fish advisories. One major problem lies in the type of information and method in which it is presented may not exactly represent the essence of the intended message; the messages on mercury toxicity outweighs that on nutritional benefits from seafood, which

may have resulted in a decrease in overall fish consumption in the general population. In Japan, there is an absence of fish advisories for local water bodies and fish species, but the main problem is that there has been almost no effort in determining the public response to the advisories. Therefore, whether or not the public has reacted to the fish advisory remains nebulous. One main difference that could be observed for the Japanese fish advisory from its American counterpart is the emphasis on benefits from seafood consumption. This may partly explain the “less active” attitude and action towards the issue of fish consumption and mercury exposure in Japan. This study on the differences in American and Japanese fish advisories (with culture exerting a confounding effect) and the resulting consumer behaviors implies that it may be important to review the fish advisories in various countries, so as to identify the positive and negative impacts before drawing policies to fit a particular region or population group.

The greatest limitation when examining fish advisories is the lack of data on their effects on the population. In USA, large-scaled surveys that have been conducted in several states provided an overall picture of fish consumption in the general population. In Japan, there is currently almost no data. Public awareness in various regions and subpopulations (especially pregnant women and children of different ethnic groups) is to be examined if the fish advisory-fish consumption relationship is to be scrutinized closely. This is especially the case as previous studies conducted in USA have shown that confounding factors such as education, ethnicity, income and subpopulation groups influence fish consumption. Priority for data collection should be given to regions known to be contaminated by mercury or have high fish consumption, and population groups such as pregnant women who are at greatest risk of adverse health effects from methylmercury exposure.

Conclusion

Changes in consumer behaviors are affected by cultural practices and fish advisories. Just as one should adopt a “holistic approach” when examining data of mercury health effects collected from different populations,⁴¹ the same approach should be applied when considering public health policies. It is evident that fish advisories in different countries have varying policies. Similarly, people from various backgrounds have dissimilar diets and attitudes towards the fish advisories. Therefore, it is significant to examine the mechanics of fish advisories in different geographical or cultural backgrounds. When fish advisories understand their impacts on fish consumption in the population, efforts should be made to fine tune the policies such that they will be able to bring forth relevant information to specific target groups in a particular region.

AUTHOR DISCLOSURES

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Review Article

Fish advisories in the USA and Japan: risk communication and public awareness of a common idea with different backgrounds

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美國及日本的魚類公告：不同背景下對共通理念的風險溝通及公眾意識

有些國家已經建立魚類公告以管理魚類攝取，進而減少甲基汞的曝露。本文的目標為，比較美國及日本的魚類公告及其導致的消費者行為。兩個國家都有國民消費指南，但是美國各州有較高的獨立性，可針對當地水域發布指南，且能提供給民眾特異的資訊。美國民眾有聽過各州魚類公告者大約接近30%。值得關注的是這樣低度的認知意識還包括懷孕婦女。在日本，目前的問題是缺乏完整的針對魚類公告的公眾意識之相關研究。在美國，有可能由於非常強調汞毒性而使得大眾傾向減少魚類攝取。在日本，魚類公告鼓勵為了營養益處而攝取海鮮食物。因此，魚類消費降低或可歸因於飲食型態轉趨“西方飲食”所致。而且日本的魚類公告似乎較少宣導魚類攝取與汞暴露的主題，這或許可解釋為什麼消費者較少去注意的部分原因。文化因素可解釋兩國在魚類攝取的基本差異及日本消費者行為改變的部分原因。然而，魚類公告內容的差異或許也是造成消費者行為不同的緣由。

關鍵字：魚類公告、魚類攝取、汞、公眾意識、風險溝通