Published in final edited form as:

Environ Res. 2009 April ; 109(3): 343–349. doi:10.1016/j.envres.2008.12.002.

Perceptions of the risks and benefits of fish consumption: Individual choices to reduce risk and increase health benefits

Joanna Burger^{a,b,c,*} and Michael Gochfeld^{b,c,d}

^aDivision of Life Sciences, Rutgers University, 604 Allison Road Piscataway, NJ 08854-8082, USA

^bEnvironmental and Occupational Health Sciences Institute, Piscataway, NJ, USA

^cConsortium for Risk Evaluation with Stakeholder Participation, Piscataway, NJ 08854, USA

^dEnvironmental and Occupational Health, UMDNJ-Robert Wood Johnson Medical School, Piscataway, NJ, USA

Abstract

Studies of fish consumption often focus on awareness of and adherence to advisories, how much fish people eat, and contaminant levels in those fish. This paper examines knowledge and accuracy of risks and benefits of fish consumption among fishers and other recreationists in the New York Bight, indicative of whether they could make sound dietary decisions. While most respondents knew about health risks (70%) and benefits (94%) of consuming fish, far fewer could name specific risks and benefits. Less than 25% of respondents mentioned mercury and less than 15% mentioned that pregnant women and children were at risk. Far fewer people mentioned polychlorinated biphenyls (PCBs). Nearly 70% said it was healthy to eat fish, and 45% were aware that fish were rich in healthful oils. Despite the lack of details about what specific risks and benefits of fish, well over a third did not feel they needed more information. Other respondents had basic questions, but did not pose specific questions about the fish they caught or ate that would have clarified their individual risk-balancing decisions. Knowledge of which fish were high in contaminants did not match the mercury or PCB levels in those fish. There was a disconnect between the information base about specific risks and benefits of fish consumption, levels of mercury and PCBs in fish, and the respondent's desire for more information. These data indicate that respondents did not have enough accurate information about contaminants in fish to make informed risk-balancing decisions.

Keywords

Recreational fish; Consumption; Fish; Mercury; Risk balancing; Benefits and risks of fish consumption; New York Bight

*Corresponding author at: Consortium for Risk Evaluation with Stakeholder Participation, Division of Life Sciences, Rutgers University, 604 Allison Road, Piscataway, NJ 08854-8082, USA. Fax: +1732 445 5870. burger@biology.rutgers.edu (J. Burger).

1. Introduction

Fish are an important source of protein, and their importance in the diet has increased among health-conscious Americans. Fishing is a popular pastime, and for many, provides protein not otherwise available (Burger, 2002; Burger and Gochfeld, 2006; Knuth et al., 2003; Toth and Brown, 1997). Fishing is important not only in rural regions and for Native Americans, but for subsistence people and recreationists in more urban areas (Burger, 2004; Burger et al., 1999a, b, 2001a, b, 2007; Dellinger, 2007; Hamrick and Smith, 2003; Harper and Harris, 2008, in press; Harris and Harper, 1997, 2000; Ramos and Crain, 2001; Silver et al., 2007; Stumpff, 2006). Recreationists may eat more fish than subsistence fishers; the key factor is how much fish people eat, not whether they are subsistence consumers (normally defined to include economic need).

Fish, an excellent, low-fat source of protein, provide many health benefits, such as omega-3 (n-3) fatty acids that reduce cholesterol levels and the incidence of stroke, heart disease, and pre-term delivery, and enhance cognitive development (Bouzan et al., 2005; Cohen et al., 2005a, b; Daviglus et al., 2002; Konig et al., 2005; McMichael and Butler, 2005; Patterson, 2002; Willett, 2005). However, contaminants, such as polychlorinated biphenyls (PCBs) and mercury, are sufficiently high in some fish and seafood to pose a potential health risk to consumers, particularly susceptible adults, fetuses, neonates, and developing infants (Gochfeld, 2003; Hightower and Moore, 2003; IOM, 2006; NRC, 2000). Methylmercury (MeHg) counteracts the cardioprotective effects of omega-3 fatty acids (Guallar et al., 2002). Fish consumption is the most significant source of methylmercury exposure for the public (Rice et al., 2000).

Consuming fish and shellfish is a classic case of risk balancing (comparing alternative risks and benefits), particularly when alternative protein sources (such as red meat) pose their own health risks (see papers in Am. J. Prev. Med., vol. 29, 2005, and above). Yet individuals cannot make informed dietary decisions without access to information on the benefits and risks of particular fish (not just fish in general), as well as about a wide range of other protein sources. The risks and benefits of red meat and poultry have been mentioned in the media and literature, but much less attention has been devoted to the trade-offs among fish species. States respond to the potential risk from contaminants in fish by issuing state advisories for self-caught fish (usually freshwater), and the US Food and Drug Administration (FDA) has issued advisories for four species of commercial fish (Burger and Gochfeld, 2004; US FDA, 2001, 2003, 2005, 2006), but little attention has been devoted to self-caught saltwater fish, or to the knowledge base of people fishing in coastal waters (despite the importance of recreational fishing to the economies of coastal states).

In this study, the knowledge and perceptions of people fishing, walking, and engaging in other recreation in three coastal regions of the New York Bight (Barnegat Bay in New Jersey, the New York/New Jersey harbor, and Long Island) were examined regarding their general and specific knowledge of the risks and benefits of fish consumption, and what other information they would like to know about the health risks and benefits. Knowledge of both risks and benefits is essential for individuals to make informed decisions about fish consumption, and to select particular fish. While many studies have examined perceptions

about warnings, they have not examined either specific warnings or specific benefits. We also compared their knowledge about risks with data on mercury and PCB levels in the fish people believed posed a risk.

2. Methods

This study was approved as exempt by the Rutgers University Institutional Review Board, because no individual identifiers were obtained. All interviewers were trained, had practice sessions, and had interviewed people using the same questionnaire in previous studies; this study included a Spanish-speaking interviewer. From early April to the late November 2007 people fishing, walking, or engaged in other recreational activities in Barnegat Bay (New Jersey), in the New York/New Jersey harbor estuary, and along the north shore of Long Island were interviewed ($N = 329$). Parks, fishing piers, beaches, and other open-access places along the shore were visited regularly, on weekdays and on weekends, at all times of the day (from 6 AM until 9 PM). The interviewers identified themselves as being from the Rutgers University and asked permission to interview. Respondents were assured that their identity was not being recorded. Only 8% of those approached refused to be interviewed, largely because they had small children, were leaving shortly, or were talking to friends.

The questions discussed in this paper were embedded within a larger questionnaire that included questions about fish consumption, fishing behavior, fish populations, and natural resource damage assessment. Open-ended questions relevant to the present study included: do you think there are risks to eating fish (and if so, what); do you think there are benefits to eating fish (and if so, what); what additional information would you like to know about either the risks or benefits of eating fish; and do you think the fish are contaminated (and if so, what species, with what contaminant)? Demographic information (age, gender, educational level, household income, and self-identified ethnicity) was asked at the end of the questionnaire, and people were told that they did not have to answer. The survey took from 20 to 40 min, depending upon how many questions people asked.

Of the 329 people interviewed, 56% were college graduates, 84% were white, 82% were male, the average age was 46 years ($SE = 0.9$), and the average household income was \$80,900 ($SE = \3500). Although there were no locational differences in ethnicity and mean age, there were significant differences in education ($\chi^2 = 18.3$, $P < 0.001$) and income ($\chi^2 = 17.4$, $P < 0.0002$). Interviewees living in the NY/NJ harbor included fewer college graduates and lower mean incomes than those from elsewhere.

Information on mercury levels is based on an on-going study of mercury levels in fish obtained from fishermen (Burger and Gochfeld, 2008, unpublished data), and analyzed in the Environmental and Occupational Health Sciences Institute laboratories. Analytic methods and results can be found in Burger et al. (2007). Information on PCB levels was obtained from Kennish and Ruppel (1996) and Horwitz et al. (2006).

Non-parametric one-way analysis of variance was performed using the Statistical Analysis System (PROC NPAR1WAY with the Wilcoxon option, SAS, 1995), which yields a χ^2 statistic. A probability level of 0.05 was accepted as significant.

3. Results

Overall, 94% of respondents said there were benefits to fish consumption, but there were geographical differences; a higher percentage of people from Barnegat Bay and Long Island believed there was health benefits (over 96%) compared with the harbor (86%) ($\chi^2 = 16.8$, $P < 0.0002$). About 30% simply said fish were generally healthy, and 45% said fish were high in omega-3 oils or that 'fish oils' are healthy (Fig. 1). Only 5% said that eating fish lowers cholesterol. Seventy percent of people said there were risks to eating fish, and there were no significant regional differences. Mercury was the main risk that respondents mentioned (Fig. 1). Others mentioned contaminants in general, PCBs, and that fish posed health risks.

Despite the lack of specific information about the risks and benefits of consuming fish, over a third of respondents said they did not need any additional information (Fig. 2), and there were significant differences by region ($\chi^2 = 112.4$, $P < 0.0001$). A higher percentage of people interviewed in Barnegat Bay and Long Island did not want more information (over 37% for each), compared with those interviewed in the NY/NJ harbor (only 18% did not want additional information). Overall, only 10% wanted information about which fish are safe to eat (not which fish are unsafe to eat), and less than 5% wanted to know which places were contaminated. Only 4% asked how much fish is safe to eat (but not for specific fish species), and 3% asked if the data on contaminants in fish were recent (but they did not ask about specific contaminants or specific fish).

Of the people interviewed, 97% fish, and they fished an average of 42 times a year. Mean monthly consumption was about 4.9 ± 0.3 meals per month (three highest values of 30, 20, 19); the median was 4. Respondents ate 2.1 ± 0.3 meals of self-caught fish (three highest values of 20, 12, 11) and 2.9 ± 0.2 meals of fish purchased in restaurants or stores (three highest values of 19, 16, 16). Consumption patterns varied by income ($\chi^2 = 5.6$, $P < 0.02$), but not by education (Fig. 3). Knowledge varied by consumption patterns: a higher percentage of people who ate over 4 fish meals per month were aware of warnings about contaminants in Bluefish, compared with those who ate less (Fig. 4). That is, knowing about warnings for Bluefish did not deter their consumption rates. Respondents averaged 36.3 ± 1.7 meals per month of other, non-seafood meat meals.

One of the main study objectives was to determine if the information people did possess was correct. When asked which fish were contaminated (people could mention as many types as they wanted). There were significant differences in their responses ($\chi^2 = 8.4$, $P < 0.05$, Fig. 5). Bluefish and striped bass were mentioned the most often, although some people mentioned 'bigger fish' (4%), and that 'it depends upon the location' (4%), but many people stated that they did not know (15.6%).

The percent of people identifying specific fish as contaminated was then compared with mercury levels in fish collected from this region from 2005 to 2008 (Fig. 5). There was a disconnect. Although shark had the highest mercury levels, and levels were similar for bluefish, striped bass and tuna, most respondents mentioned bluefish (commonly caught from shore) as the species of most concern. Comparing perceptions to PCB levels is more difficult because different laboratories do not analyze the same congeners, PCB analysis is

expensive (so fewer species are analyzed), and few data are recent. In the 1990s in New Jersey, PCB levels were higher in striped bass (mean of 1.51 ppm) than in bluefish (1.09 ppm; Kennish and Ruppel, 1996). However, recently, Horwitz et al. (2006) reported total PCB levels ranging from 0.15 to 0.28 ppm for striped bass and 0.14–0.97 ppm for bluefish. PCB levels were higher in bluefish from Raritan Bay than elsewhere, but no striped bass were taken from these same waters, illustrating the importance of comparing fish from the same geographical region. The Horwitz et al. (2006) PCB study included 33 striped bass samples and 27 bluefish samples, compared with 147 striped bass and 156 bluefish samples analyzed for mercury (Burger and Gochfeld, 2008). Both mercury and PCB levels increased with fish body size (Horwitz et al., 2006; Burger and Gochfeld, 2008).

4. Discussion

4.1. Knowledge of risks and benefits of fish consumption

Overall, more respondents believed that there were health benefits from eating fish than believed there were risks. That is, 25% of respondents believed there were benefits from eating fish, but no risks. While there were no regional differences in perceptions of risk, there were differences for benefits, with fewer people from the NY/NJ harbor believing that there were health benefits. While the message that there are both risks and benefits of consuming fish has reached the public, the depth of knowledge about both the risks, and to a lesser extent, the benefits, is limited. Less than 25% mentioned mercury, and less than 5% mentioned PCBs, the two contaminants of concern for fish from this region (Burger et al., 2005; Gobeille et al., 2006; NYSDOH, 2005). Although nearly half of the respondents mentioned the health benefits of fish related to omega-3s or fish oils, few knew why these oils were healthful or could name the specific benefits. This lack of specific information about the risks and benefits of fish consumption was also noted for consumers in Belgium (Verbeke et al., 2005).

Further, people asked whether the fish were safe to eat, but did not ask which fish are not safe to eat, indicating that risk assessors and managers need to spend more time analyzing the contaminant levels in fish expected to have low levels so that this information can be provided to the public. That is, when the FDA and states provide consumption advisories or warnings on which fish to avoid, similar information on fish low in contaminants should be provided, particularly for fish that can be caught or purchased locally.

These data indicate that risk managers have succeeded in making some of the recreational public aware of the fact that there are risks and benefits to fish consumption, but have not made them aware of the specific chemicals that pose a risk, the potential effects, or the most vulnerable populations (pregnant women and young children). The lack of specific information about the risks is remarkable since the people interviewed were mainly fisher people and those who engage in other recreational activities in coastal regions where fishing provides an important economic benefit to their regions. The relatively low level of curiosity for additional information (Fig. 2), contrasted with our previous studies (Burger, 2004, 2005; Burger et al., 1999a, b), and within the current study where they asked questions, but not when asked if they had questions.

4.2. Risk balancing

Methylmercury is the main risk from fish consumption, and a quantitative risk–benefit analysis concluded that replacement of fish high in mercury with those low in mercury among women of child-bearing age yields substantial developmental benefits (for fetuses) and few negative impacts (Cohen et al., 2005b). However, reducing fish consumption generally, both for women of child-bearing age and for other adults, results in a net public health loss (Cohen et al., 2005b).

For people to make informed decisions about whether to eat fish, what fish to eat, and how much fish to eat, they need to be aware of both the benefits and risks from eating specific kinds of fish. The data from this study indicated that less than half the people could list the species with levels of contaminants that are of concern, and their responses did not match the actual contaminant levels. Although shark had the highest levels of mercury, few people mentioned this as a species of concern; fewer people fish for shark because it requires ocean-going boats. More surprising was the fact that more people mentioned bluefish than mentioned striped bass, despite the relatively high levels of both mercury and PCBs in striped bass.

Finally, it should be noted that there are reasons people might not focus on either the risks or benefits from fish consumption, including a lack of interest in health generally, consumption of low levels of fish generally, lack of specific relevance (they are not women of child-bearing age), or inability to believe they are at risk. While risk balancing is not a new innovation, considering the risks and benefits of consuming one type of food (e.g. fish) may be a new approach for some people, and Roger's (2003) theory of the diffusion of innovation may apply. That is, it takes longer for some people to adapt to new ideas and concepts (risk balancing for a food once considered only to be nutritious) than others.

4.3. Communication and management implications

The data presented in this paper clearly indicate that the fishing public recognizes that there are risks and benefits of consuming fish, but has very limited knowledge about the specific risks and benefits. Further, people are less aware of the specific information necessary to make informed, risk-balancing decisions, such as what are the contaminants of concern, which fish have the highest levels, which locations have fish with high contaminant loads, and what population is most at risk. Without addressing the controversy about whether public health is increased by eating (or avoiding) fish (see *Am. J. Prev. Med.*, vol. 29, issue 4), it is clearly acknowledged that there are high risk populations who consume large quantities of fish (e.g. Native Americans, subsistence fishers, recreational fishers, and high-end health enthusiasts; Burger et al., 1999b, 2001b, 2007; Harris and Harper, 1997, 2000; Hightower and Moore, 2003; Ramos and Crain, 2001; Stumpff, 2006). Further, some of the respondents in this study consumed several fish meals a week, which if they included fish high in mercury, would pose a clear risk to pregnant women, and perhaps others.

Until source reduction and environmental remediation can reduce the environmental burden of mercury below levels of concern, sport and commercial fish advisories will remain the primary method of reducing exposure to methylmercury (Anderson et al., 2004). The lack of

specific information about risk (and benefits) indicate the need for a risk communication campaign that provides detailed information about risks and benefits that allow people to make informed decisions. Freshwater fishers can be targeted when they purchase fishing licenses, but these are not required for coastal waters of New Jersey. Fish are clearly an excellent source of protein and provide a range of health benefits, but the public should be aware of the fish species that are both high in mercury and other contaminants, as well as which fish provide the highest levels of omega-3 and other important fish oils.

Some very basic information about which species are high in contaminants was lacking. Respondents generally did not mention that predatory fish have higher levels of contaminants, or that contaminant levels increase with age and size of fish (Bidone et al., 1997; Burger et al., 2001; Green and Knutzen, 2003; Lange et al., 1994; Pinho et al., 2002). These two observations would arm the public with information that would allow them to reduce their exposure to contaminants. Another method of informing the public would be to provide them with site-specific, fish species-specific information. The data suggest that there is a need to publish a short list of the local recreational and subsistence fish along with the levels of mercury and PCBs, and if possible, the levels of omega-3 and other fish oils. Information could also be provided on safe consumption levels for pregnant women and children, and for other adults. This information could be provided on a small card that could be carried by fishermen, and given to the people responsible for cooking fish. Armed with this information, people could make informed decisions.

Acknowledgments

We thank S. Shukla, C. Jeitner, and M. Donio for help throughout the research. This research was partly supported by the Division of Science, Research and Technology, New Jersey Department of Environmental Protection, the Jersey Coast Angler's Association, a National Institute of Environmental Health Sciences Center (P30ES005022), a Hatch grant, the Jersey Coast Angler's Association, and the Consortium for Risk Evaluation with Stakeholder Participation (DE-FC01-06EW07053).

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Fig. 1.
Percent of respondents providing specific answers for the risks and benefits of eating fish.

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.