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A community-based assessment of seafood consumption along the lower James River, Virginia, USA: Potential sources of dietary mercury exposure ☆ ☆☆

Erica L. Holloman*, Michael C. Newman

Department of Environmental and Aquatic Animal Health, The College of William and Mary, Virginia Institute of Marine Science, PO Box 1346, Gloucester Point, VA 23062, USA

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A B S T R A C T

The use of community-based participatory research (CBPR) methods to conduct environmental exposure assessments provides valuable insight about disparities in seafood consumption and contaminant exposure. Ninety-five community-specific seafood consumption surveys were administered to low-income African–American women (ages 16–49) residing in the Southeast community of Newport News, VA, USA, for the purpose of assessing potential dietary mercury exposure. Only the results of the seafood consumption surveys are presented in this manuscript. Approximately 65% of the women surveyed do not fish; however, 83% had consumed seafood within the last 7 days. Whiting, shrimp, and canned tuna were the three items most frequently consumed. Ninety-three percent of the women surveyed stated that grocery/seafood markets were the main sources of the seafood items generally consumed. The mean seafood consumption rate for the women surveyed was 147.8 g/day (95% CI: 117.6–185.8), a rate substantially higher than the mean seafood consumption rate reported for US women (1.8 g/day 95% CI: 1.51–2.04). Shrimp, croaker, and blue crab were the top three seafood items with the highest summed amount (g/day) consumed. There was no significant association between demographic variables (age, income, education, and weight) and total number of seafood items listed, ingestion rate (g/meal), exposure frequency (meals/year), and seafood consumption rate (g/day). By using CBPR to assess seafood consumption in this community, we learned that even though women in Southeast Newport News, Virginia are not subsistence fishers, they consume seafood at a subsistence fisher rate. Of the three seafood items most frequently consumed, canned tuna potentially plays a significant role in dietary mercury exposure for women in this community. Future work includes determining mercury concentrations in seafood items consumed and generating community-specific statements of dietary mercury risks.

1. Introduction

The environmental justice movement consistently advocates that people of color and the poor have greater participation in research and decision-making as it relates to contaminant exposure because they often bear the burden of adverse effects (National Environmental Justice Advisory Council (NEJAC), 2002). However, exposure information used to set environmental health standards is often not reflective of many minority and low-income communities (NEJAC, 2002). The integration of community-based participatory research (CBPR) techniques with conventional exposure assessment methods provides the poor and people of color opportunities to equitably participate in environmental research and decision-making that generates exposure information more reflective of their communities. Fundamental principles of CBPR: (1) recognizes community as a unit of identity, (2) builds on strengths and resources within the community, (3) facilitates collaborative, equitable involvement of all partners in all phases of the research, (4) integrates knowledge and intervention for mutual benefit of all partners, (5) promotes a co-learning and empowering process that attends to social inequalities, (6) involves a cyclical and iterative process, (7) addresses health from both positive and ecological perspectives, (8) disseminates findings and knowledge gained to all partners, and (9) involves a long-term commitment by all partners (Israel, 2000). It is understood that the degree to which

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* Corresponding author. Fax: +1 804 684 7186.
E-mail address: elhollom@vims.edu (E.L. Holloman).

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any research effort achieves one or any combination of these principles is dependent upon the context, purpose and participants involved (Israel, 2000).

At the heart of successful models of CBPR, a clear distinction is made between conducting research "in" a community where community members have limited, if any, involvement and is mainly researcher-driven (Israel, 2000) versus participatory research where community members, organizational representatives, and researchers operate as equal partners in all phases of the research process (Israel et al., 1998; Minkler, 2000; O'Fallen and Dearry, 2002; Leung et al., 2004; Minkler et al., 2006; Terrell et al., 2008; Nelson et al., 2009). Therefore, attempts of integrating CBPR with traditional exposure assessments should strive for equability between researchers and communities in the problem definition, information collection, data analysis, and dissemination of contaminant exposure information. The use of CBPR methods to investigate seafood consumption and risk of contaminant exposure has generated scientifically sound, socially relevant and community-specific exposure information that provides greater insight about exposure disparities. For example, in the Greenpoint/Williamsburg neighborhood of Brooklyn New York, CBPR methods used to investigate cumulative exposures and subsistence fishing revealed a potentially serious cancer risk that would have likely been ignored by the US Environmental Protection Agency (US EPA) if it was not for the community specific data (Corburn, 2002).

Disparities in seafood consumption and contaminant exposure may exist because of the consumption of more seafood annually and more seafood meals of larger servings (Burger et al., 1999, 2001; Sechena et al., 1999; NEJAC, 2002; Corburn, 2002; Gibson and McClafferty, 2005). Such disparities may also be greatly influenced by cultural and lifestyle factors that ultimately determine which seafood items are consumed and how it is prepared (Judd et al., 2004; NEJAC, 2002). Minority targeted seafood consumption assessments generally focus on Asians, Pacific Islanders, or Native Americans (e.g., Toy et al., 1996; Sechena et al., 1999, 2003; Duncan, 2000; Judd et al., 2004). African–Americans also experience higher exposures to contaminated seafood than the average US consumer (Burger et al., 1999, 2001; Center for Disease Control (CDC), 2001, 2005; Schober et al., 2003; Gibson and McClafferty, 2005). However, peer-reviewed publications focused exclusively on African–American seafood consumption patterns and contaminant exposures are scarce (Weintraub and Birnbaum, 2008) and cultural and lifestyle factors influencing such exposures are rarely defined (Beehler et al., 2001; Cecelski, 2001; Weintraub and Birnbaum, 2008).

The consumption of seafood is the most common exposure pathway for mercury (National Research Council (NRC), 2000; Mahaffey et al., 2008). The amounts and types of seafood consumed vary among geographical locations of the United States (NRC, 2000; Mahaffey et al., 2009). Hence, variations in mercury exposure are most likely due to individual seafood consumption patterns (NRC, 2000). Studies have found mercury concentrations in the blood and hair of African–Americans to be higher than other populations (Schober et al., 2003; CDC, 2001, 2005; Mahaffey et al., 2009). Considering that investigations focused exclusively on African–American seafood consumption patterns and contaminant exposure are not well established in peer-reviewed literature, assessments addressing seafood consumption and potential dietary mercury exposure and risks are warranted.

This work applied CBPR techniques with traditional exposure assessment methods to generate scientifically sound and socially relevant seafood consumption and dietary mercury exposure information for low-income, African–American women (ages 16–49) residing along the southern portion of the James River in Virginia, USA. Findings are summarized of only the community-specific seafood consumption survey administered during April–May 2008 to 95 African–American women (ages 16–49) residing in the Southeast community of Newport News, Virginia. Of particular interest was determination of ingestion rates (IR, g/meal) and exposure frequencies (EF, meals/year and meals/day) in order to estimate seafood consumption rates (CR, g/day), as well as the major sources (grocery/seafood market, self-caught, restaurant) of the seafood items consumed. This information, coupled with mercury concentrations, will be used to probabilistically define daily mercury intake (mg/kg bw-day) and generate risk statements for low-income African–American women residing in Southeast Newport News, Virginia.

2. Materials and methods

2.1. Community partnerships

Located along the southern portion of the James River, Newport News has 180,150 residents of whom 54% are White and 39% African–American (US Bureau of Census, 2000). African–Americans make up approximately 87% of the population residing in the Southeast community of Newport News (US Bureau of Census, 2000). Partnerships were created with the Moton Community House and Heal-Thy Generations: A Southeast Community Health Movement, a local community center and health coalition known for its dedication to improving the health and quality of life for residents in Southeast Newport News, VA. Through these partnerships, 10 African–American women, representative of the population of interest (low-income African–American women of the Southeast community), were recruited to participate on a Community Advisory Council (CAC). The women of CAC were recruited by personal announcement and recommendations from the executive director of the Moton Community House and members of Heal-Thy Generations. The council was established to provide the necessary community-specific guidance for only this research endeavor. Members met periodically and were compensated for their time. Formal meeting procedures included agendas and an attendance policy in which women were only compensated for meetings they attended.

2.2. Survey design and implementation

The initial draft of the Southeast Seafood Consumption Survey was based on modifications to fish consumption surveys used in the Asian and Pacific Islander Seafood Consumption Study in King County, WA (Sechena et al., 1999) and the Elizabeth and Lower James River Angler Survey (Gibson and McClafferty, 2005). This draft was submitted to CAC and refined, finalized, and submitted to the Protection of Human Subjects Committee (PHSC) at the College of William and Mary. The final version of the Southeast Seafood Consumption Survey complied with appropriate ethical standards, and was exempted from a formal PHSC review.

Ninety-five surveys were administered among ten different sites located throughout the Southeast community during April and May 2008. Sites were randomly selected from a list of locations suggested by CAC and sampled during the 5-day work week between 10:00 AM to 5:00 PM. Participants were conveniently sampled and compensated for completing the survey. To prevent women from taking multiple surveys, the same individual administered the seafood consumption survey. In addition, upon completion of the survey, women were given coupons that were numbered and stamped with a raised seal that had to be redeemed in order to receive their compensation. This also assisted in preventing women from taking multiple surveys and duplicating coupons issued.

The survey was structured to gain insight about the IR (g/meal), EF (meals/day or meals/year), CR (g/day), and sources of the seafood items consumed for African–American women (ages 16–49) residing in the Southeast community. Traditionally, the amount of seafood consumed (IR) is determined by asking one to select approximately how much (generally between 1.5 and 16 oz) of a particular item is consumed. The CAC advised that the use of these amounts without some visual aid would be confusing; therefore, visual aids were used.

2.3. Visual aids

The main concepts for the visual aids were derived from the Asian and Pacific Islander Seafood Consumption Study in King County, WA (Sechena et al., 1999). The CAC provided a list of seafood items thought to be commonly consumed by women in the Southeast community. This list was divided into 13 groups based on advice that the groups must represent a similar body shape of the seafood item in question but, did not have to be the exact item to evoke recognition of portion sizes (Table 1; Sechena et al., 1999). The CAC also advised that the visuals be presented as cooked items; therefore, real items were used and prepared based on

Table 1
List of groups and seafood items used for visual aids.

Group	Description
A	Whole body, e.g., croaker, spot, perch
B	Slender fillets, e.g., whiting, trout, catfish
C	Patties/cakes, e.g., salmon, mackerel, crab
D	Scallops
E	Shrimp
F	Mussels, clams, oysters
G	Snow crab legs
H	Whole blue crabs
I	Salmon steak
J	Broad fillets, e.g., catfish, flounder
K	Tilapia
L	Canned fish, e.g., sardines, herring
M	Canned tuna

cooking methods suggested by CAC. Once prepared, items were individually vacuum sealed, labeled, and refrigerated until used. Weights (g) associated with uncanned seafood items (e.g., fresh fish) were based on the cooked weights of the items. Weights (g) associated with canned seafood items (e.g., canned tuna) were based on the weight given on the can label. All seafood items used represented individual portion sizes.

2.4. Determination of IR, EF, and CR

Participants were asked to list up to 11 seafood items they consume and select the portion size generally consumed for each item listed. Participants were then asked how many of the individual portion size selected would be consumed during one meal setting. The amount consumed (IR, g/meal) was determined by the number of individual portions consumed during one meal setting multiplied by the weight of the portion size selected. The IR used in analysis was determined by multiplying the IR obtained by percent yield (14%, 20%, 28%, and 25%, respectively) of edible meat for blue crab (Callinectes sapidus), lobster (*Homarus americanus*), snow crab leg (*Chinoecetes opilio* or *Chinoecetes bairdi*), and dungeness crab (*Cancer magister*) because weights used for portion sizes were based on whole items.

To determine EF, the women were given the option to answer how many times per week or per month they consumed each particular seafood item they listed. Depending upon how the women answered, time per week was multiplied by 52 (weeks/year) and time per month by 12 (months/year) to determine meals/year (EF_y). The EF_y was then divided by 365 to obtain the number of meals consumed daily (EF_d, meals/day). The EF_d was used in the calculation of seafood consumption rates (g/day).

For each participant, if IR or EF_y was not determined for a particular item listed, it was considered to be censored. Out the 784 seafood items listed, only 41 were censored for IR and only eight censored for EF_y. Values for all censored data were obtained by one of two methods thought to assist in reducing uncertainty in the value selected. First, if the summed frequency (total number of women) for the particular item was three or greater, a value for the censored datum was randomly selected based on probability data collected for IR or EF_y for that particular item in question. For the second method, when little or no information was available (less than or equal to three women total), the value for the censored datum was randomly selected using Crystal Ball 11.1.1.1.00 (Oracle, Redwood Shores, CA, USA) in which a uniform distribution was assumed for IR or EF_y. Information used to generate the uniform distribution was based on data collected and data reported in the peer-reviewed literature that was most reflective of the women in this community. Once values were obtained for all censored data, IR and EF_y (converted to EF_d) were used to calculate seafood consumption rates (CR).

The IR (g/meal) was multiplied by EF_d (meal/day) to determine seafood consumption rates (CR, g/day). This was done for each seafood item listed by a participant. The CR was then summed for each participant to get a total seafood consumption rate. The mean seafood consumption rate was calculated using the summed CR for each of the 95 women.

2.5. Statistical analysis

The SAS version 9.1 software (SAS Institute Inc., Cary, NC, USA) was used for all statistical analysis. The mean seafood consumption rate was presented in terms of a geometric mean because the results of seafood consumption rates for the 95 women were not normally distributed. A nonparametric Kendall τ procedure was used to assess correlations between demographic variables (age, income, education, and weight) and total number of seafood items listed, summed ingestion rate (g/meal), summed exposure frequency (meals/year), and summed seafood consumption rate (g/day).

3. Results

3.1. Study population

The response rate for agreeing to take the survey was approximately 70% (104 out of a total of 149 women). Six surveys were terminated because of age (younger than 16 years or older than 49 years), lack of parental permission, or interviewee resided outside of the area of interest. Three surveys were not included in the final analysis because it was later discovered that they did not live in the area of interest. Of the 95 women surveyed, approximately 13% (95% CI: 6–19%) had not completed high school nor received a General Equivalency Diploma (GED), 76% (95% CI: 67–85%) completed high school, GED or vocational training, 9% (95% CI: 3–15%) completed college (2 or 4 year program), and 2% (95% CI: 0–5%) completed a graduate program. Approximately, 77% (95% CI: 68–85%) of the women had household incomes of $0–$20,000, 16% (95% CI: 8–23%) had household incomes of $20,001–$35,000, and 7% (95% CI: 2–13%) had household incomes of $35,001–$45,000+.

3.2. Seafood consumption patterns:

Sixty-five percent (95% CI: 56–75%) of the participants (95 women) reported that they do not fish; however, 83% (95% CI: 75–91%) had consumed seafood within 7 days prior to being interviewed. The most common seafood items consumed within 7 days prior to being interviewed were shrimp (*Penaeus*, *I*, 24% of 168 items listed); whiting (*Merlangius*, spp., 20%); canned tuna (*Thunnus alalunga* or *Katsuwonus pelamis* 8%); blue crab (C. sapidus, 7%), and croaker (Micropogonias undulates, 7%). Eighty-five percent of the women reported consuming the most amount of seafood during the spring, summer, and fall months (Table 2).

The most commonly consumed seafood items were whiting, shrimp, tuna, snow crab legs (*C. opilio* or *C. bairdi*), blue crab and croaker (Fig. 1). Of the 784 consumed seafood items, approximately 93% (95% CI: 91–95%) came from grocery/seafood markets, 4% (95% CI: 2–5%) were self-caught, 3% (95% CI: 2–4%) were from restaurants, and 1% (95% CI: 0–1%) did not report the source. The women reported that they fillet their fish most of the time (42% of 95 women, 95% CI: 32–52%), sometime (37%, 95% CI: 27–48%) and never (21%, 95% CI: 13–29%). Eighty-seven percent (of 95 women, 95% CI: 81–94%) reported they pan/deep fry their seafood most of the time, 11% (95% CI: 4–17%) reported sometime, and 2% (95% CI: 0–5%) reported never. Over half of the women (52% of 95 women, 95% CI: 41–62%) never reuse the oil/fat from cooking although, 36% (95% CI: 26–46%) reported that they do

Table 2
The percentage of women reporting the months when the most and least amount of seafood is consumed.

	N	%	95% CI
Months that seafood items are consumed the most			
Spring–fall (Mar.–Dec.)	81	85	78–93
Winter–summer (Dec.–Sep.)	8	8	2–14
Fall–spring (Sep.–Jun.)	4	4	0.1–8
All year (Jan.–Dec.)	2	2	0–5
Total	95	100	
Months that seafood items are consumed the least			
Fall–spring (Sep.–Jun.)	44	47	37–58
Winter–summer (Dec.–Sep.)	44	47	37–58
Spring–fall (Mar.–Dec.)	5	5	0.7–10
Total	93	100	

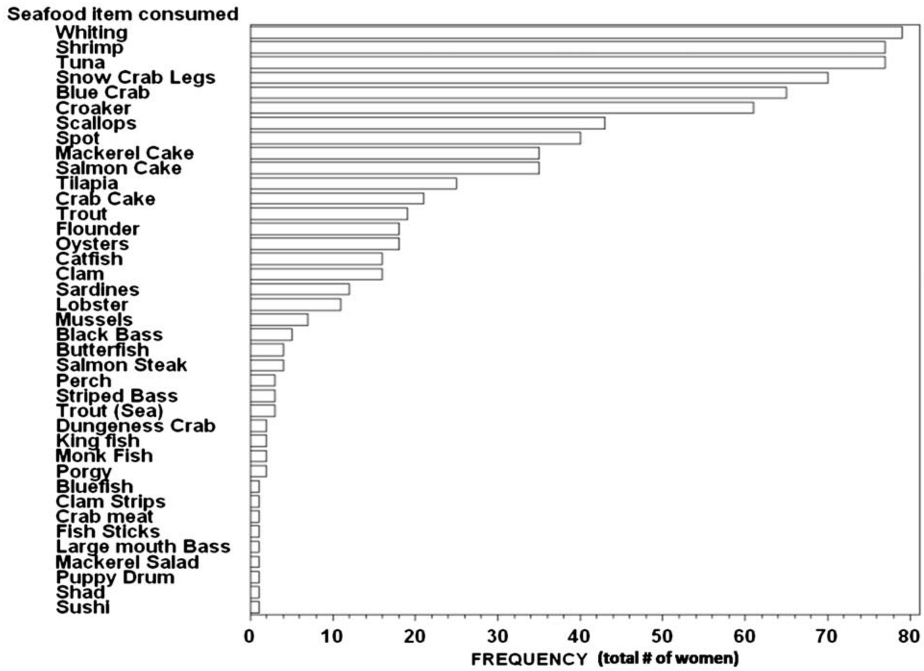

Fig. 1. Consumption frequency of the seafood items generally consumed (n=95 women). Mercury concentrations are currently being determined for whiting (*Merlangius* spp.), shrimp (*Penaeus* spp.), tuna (*Thunnus alalunga* and *Katsuwonus pelamis*), snow crab legs (*Chinoecetes opilio* or *C. bairdi*), blue crab (Callinectes sapidus), croaker (Micropogonias undulates), scallops (*Placopecten magellanicus*), spot (*Leiostomus xanthurus*), mackerel (*Scomberomorus Cavalla*) cakes, salmon (*Oncorhynchus gorbuscha*) cakes, tilapia (*Oreochromis* spp.), crab (Callinectes sapidus) cake, trout (*Oncorhynchus* spps., *Salvelinus* spp. or *Salmo trutta*), flounder (*Paralichthys dentatus* or *Pleuronectes americanus*) oysters (*Crassostrea virginica* or *C. gigas*), catfish (Ictalurus punctatus, I. furcatus, Pylodictis olivaris, or Ameiurus catus), clams (*Protothaca staminea*, *Mya arenaria*, *Saxidomus giganteus*, or *Mercenaria mercenaria*), sardines (*Clupea harengus*), lobster (*Homarus americanus*), and mussels (*Mytilus edulus*).

reuse the oil/fat most of the time and 13% (95% CI: 6–19%) reported sometime.

3.3. Seafood consumption rate

For each seafood item listed by the women, the amount consumed (g/day) was summed to estimate the total amount of seafood ingested daily (Fig. 2). The items with the largest total amount consumed (> 1000 g/day) were shrimp, croaker, blue crab, whiting, snow crab legs, tuna (canned), spot, and mackerel (*Scomberomorus Cavalla*) cakes (Fig. 2). The unadjusted consumption rates (distribution was not normal) ranged from 1.52 to 1327 g/day. The geometric mean seafood consumption rate was 147.8 g/day (5.2 oz/day) with 95% confidence intervals of 117.6–185.8 g/day (4.1–6.6 oz/day). There was no significant (α=0.05) association between demographic variables (age, income, education, and weight) and total number of seafood items listed (τ b coefficient=0.01, 0.00, 0.16, 0.06, respectively; p=0.86, 0.98, 0.06, and 0.40, respectively), summed ingestion rate (τ b coefficient = −0.02, 0.03, 0.13, 0.06, respectively; p=0.73, 0.67, 0.09, and 0.39, respectively), summed exposure frequency (τ b coefficient = −0.02, −0.02, 0.06, 0.01, respectively; p=0.73, 0.78, 0.45, and 0.85, respectively), and summed seafood consumption rate (τ b coefficient = −0.05, 0.05, 0.09, 0.04, respectively; p=0.47, 0.50, 0.22, and 0.59 respectively).

4. Discussion

The use of CBPR (community-based participatory research) techniques to conduct exposure assessements offers Federal and State agencies, as well as communities, a unique approach in generating scientifically sound, socially relevant, and community-specific exposure information. Parameter uncertainty, the most readily recognized source of uncertainty quantified in risk assessments, is caused by lack of specific knowledge and can be reduced by collecting more and higher quality data (US EPA, 2001). As it relates to fish consumption, many agencies have applied exposure characteristics, susceptibilities, and co-risk factors of the general population (NEJAC, 2002). Such applications can have significant implications for those whose exposure characteristics are markedly different then the general population. For example, Silver et al. (2007) suggested that the consumption of contaminated fish can have disproportionate impacts on low-income, non-white groups in California's Sacramento-San Joaquin Delta due to higher fish consumption and lower advisory awareness. By using CBPR techniques, exposure assessments are enhanced with community-specific knowledge that increases the quality of data collected and reduces parameter uncertainty in risk estimates.

This study employed CBPR methods to assess seafood consumption for women of child bearing age (16–49) in a coastal, low-income, African–American community. To our knowledge, this is the first study that quantified seafood (fish and shellfish) consumption exclusively in a low-income community of African–American women (ages 16–49). It should be noted, that because of the relatively small, convenient sample design, it is difficult to generalize our results to women outside of this community. In addition, we did not account for variation and difficulty of dietary recalls in this community. A verification study is underway to address these issues and quantify the uncertainty of responses obtained from the survey.

Seafood consumption in our study was similar to what has been reported for low-income women (Bienenfeld et al., 2003; Silver et al., 2007). In this study, the percentage of women consuming whiting (83%), shrimp (81%), and canned tuna (79%) was comparable to Silver et al. (2007) for shrimp (86%) and canned tuna (79%), and higher than Bienenfeld et al. (2003) for

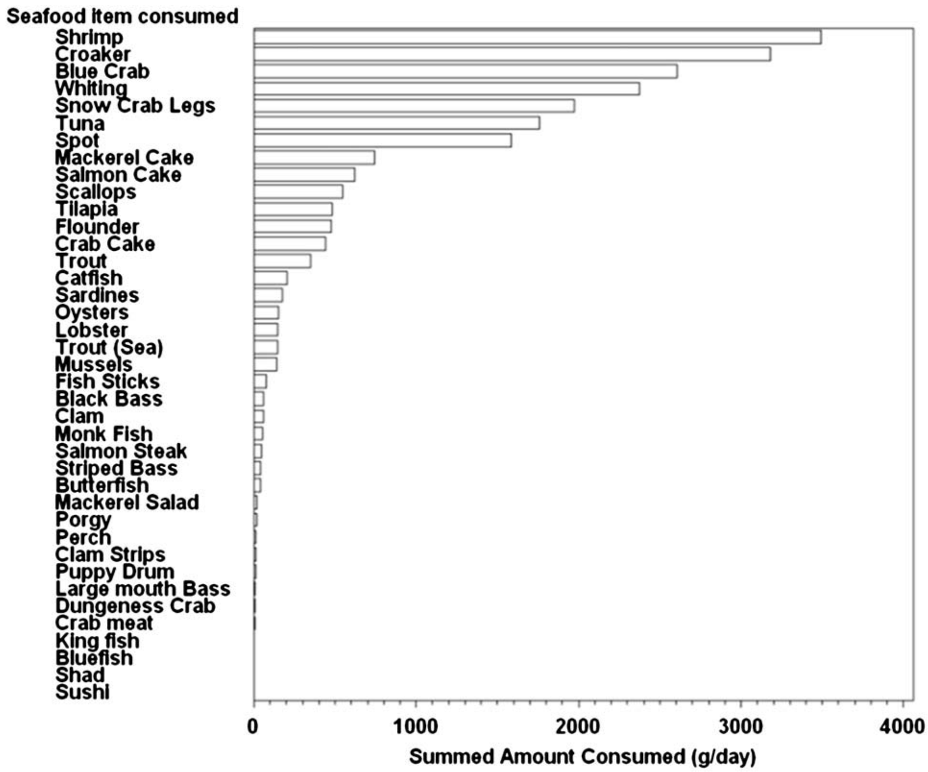

Fig. 2. The summed amount consumed (g/day) of seafood items generally consumed by the women surveyed (n=95).

whiting (45%) and tuna (fresh and canned, 38%). The high consumption of commercial seafood coincided with what was reported by Silver et al. (2007).

Burger et al. (1999) suggested that fish consumption studies take into account individual differences in the rate of fish consumption and quantity of fish consumed per meal in order to avoid a downward bias in consumption rate. It was also suggested that by only examining averages (number of meals per week and serving size), the understanding of consumption patterns of those potentially most at risk is incomplete (Burger et al., 1999). If individual differences in fish consumption rates and amounts consumed are not accounted for and averages are used, there is a greater potential for valuable information to be lost through data aggregation. This study collected information on exposure frequencies (how often, EF) and ingestion rates (how much, IR) of individual seafood items reported by each participant and then calculated a consumption rate (CR) for each seafood item listed. For each participant, the consumption rate for individual seafood items was then summed to yield a total seafood consumption rate. By collecting and analyzing consumption information in this manner, consumption rates are more accurate and representative of the individual and hence the distribution in the population. It should be noted however, that our model for determining EF and IR assumes regular and consistent seafood consumption. Such an assumption possibly overestimated our consumption rates.

The geometric mean seafood consumption rate (147.8 g/day) determined in this study is the highest mean seafood consumption rate that has been reported for African–American women: 47.7 g/day (Burger et al., 2001), 2.4 g/day (Mahaffey et al., 2004), and 41.2 g/day (Silver et al., 2007). The higher consumption rate is most likely due to how consumption rates were calculated. Accounting for individual differences in exposure frequencies and ingestion rates, and not using averages, could have resulted in the higher estimate. Additionally, the way in which ingestion rates (g/meal) were calculated could have resulted in the higher estimate.

To estimate ingestion rates, many studies first define portion sizes then, have participants select the size generally consumed (Burger et al., 1999; Gibson and McClafferty, 2005; Harris et al., 2009, Silver et al., 2007). The same was done in this study but, a necessary adjustment was made based on recommendations from CAC. Members of CAC stated the total amount ingested for a particular item was not only the portion size, but also how many individual portions were consumed during one meal setting. Therefore, a more accurate reflection of ingestion was the portion size selected multiplied by the number of individual portions consumed during one meal setting. Not making this adjustment would result in underestimation of ingestion rates for this community. Such an adjustment should be considered when determining ingestion rates and is potentially one of the reasons why the consumption rate in this study was higher than rates reported in the literature for African–American women (Burger et al., 2001; Mahaffey et al., 2004; Silver et al., 2007).

In comparison to seafood consumption rates reported by Mahaffey et al. (2004) for the general US women (ages 16–49) and African–American women (ages 16–49) populations, the consumption rate in this study was approximately 82 and 62 times higher, respectively (Fig. 3). If either of the consumption rates reported by Mahaffey et al. (2004) were used to determine health risks associated with seafood consumption for women in this study, the risk would be grossly underestimated. The same would be true if EPA's default value for the general population (17.5 g/day; US EPA, 2000) or recreational fishers (17.5 g/day; US EPA, 2000) was used (Fig. 3). The mean seafood consumption rate for this study (147.8 g/day) most closely resembles EPA's default value for subsistence fishers (142.4 g/day; US EPA, 2000) and that of other minority populations (Fig. 3).

EPA (2000) defines subsistence fishers as fishers who rely on noncommercially caught fish and shellfish as a major source of

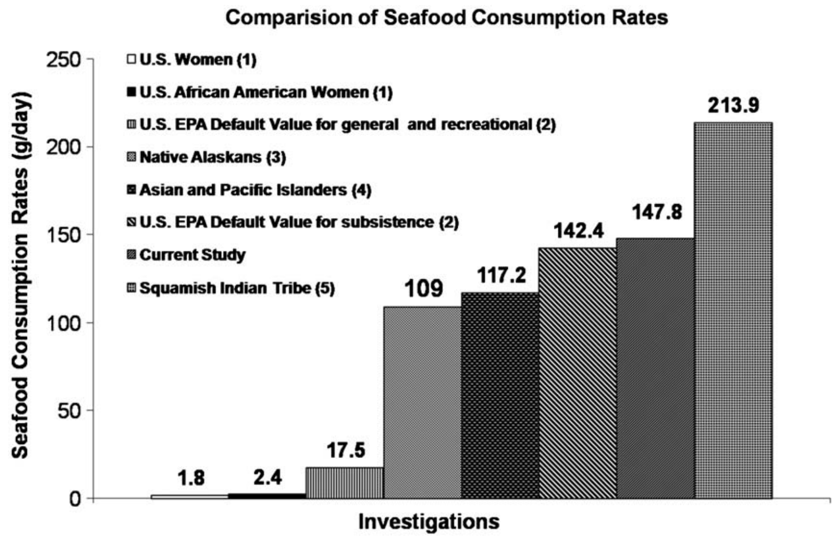

Fig. 3. Comparison of seafood consumption rates between current study and other investigations.

protein in their diets. Asian, Pacific Islander, and Native American communities are often identified as subsistence fisher communities (Judd et al., 2004; NEJAC, 2002; Sechena et al., 1999; Toy et al., 1996; US EPA, 2000). The narrow definition of subsistence and fish consumption (US EPA, 2000) could lead to incorrect assumptions about other populations where fish consumption (be it commercially purchased or self-caught) occurs at a subsistent rate. Based upon EPA's definition, women in this study would not be considered subsistence fishers because, 65% of the women do not fish and 93% of the seafood items consumed come from grocery/seafood markets. However, 83% of the women had consumed seafood within 7 days prior to being interviewed, suggesting that even though they are not fishing, seafood is still a major source of protein in their diets. Therefore, we identify women in this study as subsistence fish consumers.

We define subsistence fish consumers as people who rely on noncommercially caught or commercially purchased fish and shellfish as a major source of protein in their diets. The high consumption rate obtained supports the idea that women in this study are subsistence fish consumers. Especially, when compared with mean consumption rates of other subsistence fishing population (Fig. 3): Squamish Indian Tribe (213.9 g/day; Duncan, 2000), Asian and Pacific Islanders in King County, Washington (117.2 g/day; Sechena et al., 1999), and Native Alaskans (109 g/day; Nobmann et al., 1992).

The strengths of using CBPR to guide this research was that it helped to establish trust between the community and researchers involved and provided invaluable community knowledge that has enhanced our understanding of our work. Through the partnerships established, the executive director of the Moton Community House and members of CAC equitably participated in the problem definition, information collection and data analysis for this investigation. Results of this work were discussed with CAC to explore possible lifestyle and cultural explanations. Members of CAC conveyed that one possible lifestyle explanation for the high rate of seafood consumption may be due to the promotion of seafood as a healthy alternative to meats high in fat (i.e., pork or beef) usually consumed by women in this community. Culturally, it was suggested that prior the Trans-Atlantic slave trade, many African–Americans were part of coastal communities along the Western coast of Africa and that a culture of fishing and seafood consumption already existed and was brought with them. In addition, during slavery many African–Americans joined indigenous communities (Johnson, 2001) where a culture of fishing and seafood consumption also existed. Members of CAC also noted that in the US, during periods of slavery and Jim Crow, fishing provided free food and places of solitude and peace from the inhumane acts of people, the laws, and the regulations of the time. Interestingly, CAC noted that the high rate of purchased commercial seafood may be because it is easily accessible and more convenient for a single mother than actually fishing. As one women stated, "Even though I do not have a lot of money, my time is still valuable and often used towards work. I don't have the time to fish to feed my family. For me, it is easier and more efficient to purchase fish than spending the time attempting to catch (or not) dinner"

As it relates to dietary mercury exposure and any potential risk, results of this study imply that even though women in this community consume a lot of seafood (147.8 g/day) their risk of mercury exposure may be low. Except for canned tuna, the most common seafood consumed within 7 days prior to being interviewed (shrimp, whiting, blue crab, and croaker) and in general (whiting, shrimp, snow crab legs, blue crab, and croaker) have the least amount of mercury of seafood caught and sold commercially (National Research Defense Council (NRDC), 2009). This would suggest that consumption of these items would not place women in the community at high risk of dietary mercury exposure. On the other hand, according to the NRDC (2009), mercury concentrations in canned tuna range from moderate to high, depending on the type (light or albacore (white)) and could potentially play a significant role in dietary mercury exposure for women in this community. Future work includes determining mercury concentrations in seafood items consumed and generating community-specific statements of dietary mercury risks.

The results obtained in this study are potentially bias toward African–American women (ages 16–49) in the Southeast Community of Newport News, Virginia with low incomes. Because the surveys were administered during normal business working hours (9 AM to 5 PM), the results may also be bias toward women who do not work. Finally, the seasonality in seafood consumption may have biased consumption rates upwardly. Participants in this study were surveyed during April and May, months that correspond to when the women consumed the most amount of seafood. If the survey was administered during months that corresponded to when the women consumed the least amount of seafood, the mean seafood consumption rate may have been lower. Currently, surveys are being administered to define this potential bias.

5. Conclusion

The use of CBPR greatly improves exposure assessments by providing community-specific information. Community-specific information increases data quality and reduces parameter uncertainty for those estimating risk. Through the CBPR approach we learned that ingestion rates (g/meal) are not only the selected portion size but, more importantly, how many of the individual portions are consumed during one meal setting. In addition, even though women in this study are not subsistence fishers, they are subsistence fish consumers.

Women in this community have high seafood consumption rates which could have significant implications for exposure of contaminants associated with seafood (i.e., mercury or polychlorinated biphenyls) With the exception of canned tuna, seafood items commonly consumed suggest that women in this community are at low risk of dietary mercury exposure. However, the consumption of canned tuna could potentially place women in this community at a higher risk. Future work will determine mercury concentrations in seafood items consumed and generate community-specific statements of dietary mercury risks.

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