Can Nutrition and Health Information Increase Demand for Seafood among Parents? Evidence from a Choice Experiment

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Abstract:

While federal rules require specific meat and poultry products to carry nutrition information labeling, these rules do not extend to fresh seafood products. This paper focuses on the extent to which the provision of nutrition information could impact consumer demand for seafood, with a special focus on parents with children, who influence the food preferences of future generations. Using a choice experiment, we found that providing nutrition information similar to the nutrition facts panel increased the marginal willingness to pay (MWTP) for all types of seafood studied; whereas information on the health benefit of Omega-3 fatty acids increased the MWTP for some types of seafood. This finding can inform the industry and policy-makers on the potential impact of introducing nutrition labels for raw seafood.

Key words: seafood, nutrition information, health information, Omega-3 fatty acids, choice experiment

JEL Codes: Q13, Q18, M31, C35, C90

Introduction

Scientific evidence shows that consumption of seafood has positive health benefits for all age groups, with significantly higher benefits for people with certain medical conditions (Sidhu 2003). Specifically, the Omega-3 fatty acids found in seafood are heart-healthy for all people, including those at high risk of cardiovascular diseases. For these reasons, consuming fish at least twice per week is recommended by groups such as the American Heart Association (2010). Omega-3 fatty acids are also beneficial to children, since they help in the development of the brain, nerves, and eyes (Kris-Etherton and Hill 2008).

Despite these benefits, annual per capita consumption of seafood in the United States is only 15.8 pounds, or 4.8 ounces per week (NMFS 2012), which falls below the minimum recommendations of 7 ounces by the American Heart Association and 8 ounces by the United States Department of Agriculture (USDA 2010). Research indicates that low levels of seafood consumption are typically associated with food habits (Honkanen, Olsen, and Verplanken 2005); belief that seafood is difficult or inconvenient to prepare; aversion to seafood odors; and unfamiliarity with the preparation, handling, and storage of seafood (Weinstein, Bisogni, Frongillo, and Knuth 1999; Olsen 2003; Krutulyte, Grunert, Scholderer, Hagemann, Elgaard, Nielsen, and Graverholt 2008). Because food habits are developed early in life, low seafood consumption may be partially due to fish not being part of a child's diet (Kluger 2010). Another factor for low seafood consumption might be related to dietary nutrition and health information. For example, it has been shown that there exists a significant gap between consumer perception and scientific evidence on the health benefits of seafood even though seafood is considered a healthy alterative to other meats (Verbeke, Sioen, Pieniak, Camp, and De Henauw 2005).

One of the policy instruments used to provide consumers with nutrition information is the nutritional facts labels on food packaging. Before 2012, nutrition facts labels were required for processed and commercial foods, but not for raw meat and seafood. Since 2012, the USDA has expanded the rule on nutrition facts labels to include popular cuts of raw meat and poultry products, but not seafood (https://federalregister.gov/a/2010-32485). These labels include the number of calories and the grams of total fat and saturated fat that a product contains. While the industry is not required to provide nutrition labels for seafood, it should be of interest to the seafood industry and policy makers to understand how introducing nutrition labels may influence consumer preferences, especially since many consumers are not fully aware of the nutrition and health benefits of seafood.

Although important to all consumers, seafood consumption in children is of particular interest. First, seafood has been shown to benefit brain development, making it an important component in children's diets. Second, one of the main hurdles identified in seafood consumption studies is taste preference, therefore introducing children to seafood at younger ages might increase consumption in their adulthood. Third, with almost one in three children being overweight and 17 percent obese in the United States (Centers for Disease Control and Prevention 2011), encouraging more seafood consumption may be one way for parents to prevent their children from becoming overweight, because seafood is a protein that is low in calories and saturated fat.

The objective of this paper is to determine how providing information about the nutritional content and health benefits of seafood affects seafood choice. Specifically, we focus on parents with minor-aged children between the ages of 6 to 16 years old, and we examine the extent to which their demand for seafood (finfish and shellfish), relative to other meats, would change if provided with information on the health benefits of Omega-3 fatty acids and general nutrition information. To our knowledge, no previous work has examined the effects of nutrition and health information on raw (fresh) seafood commonly found in grocery stores, with specific attention on the effects for parents with children. We focus on parents with children instead of children themselves because children's food preferences are closely related to their parents' preferences (Kluger 2010) and parents are the primary grocery shoppers.

To achieve our objectives, we conducted an online survey of parents with minor-aged children between the ages of 6 and 16 years old. Our study is different from existing studies on seafood consumption and health information in survey design and implementation. First, we presented a realistic scenario in the choice experiment by including other proteins as substitutes to seafood, which allowed us to examine the impact of nutrition information on other types of protein in addition to seafood. Additionally, we designed three types of information treatments that were of interest to consumers, policy makers, and the seafood industry: 1) the health benefits of Omega-3 fatty acid in seafood; 2) a seafood nutrition facts panel; and 3) a combination of the Omega-3 benefits and nutrition facts panel. Additionally, we had a large sample size (1,000 participants) and used a between subjects design where we randomly assigned survey participants into one of four groups (one control group and three treatment groups). Marginal Willingness to Pay (MWTP) was estimated for each group, and the effects of the information treatments were identified through comparing the MWTP between the control and treatment groups.

Related Literature

Early studies that examined the effects of health information on food demand found that exposure to health information decreases demand for less healthy food such as eggs and red meat (Chern, Loehman, and Yen 1995; Chang and Just 2007; Yen, Lin, and Davis, 2008) and increases the demand for chicken and fish (Kabbia, Angulo, and Gil, 2001; Rickertsen, Kristofersson,and Lothe ,2003).

Several studies also examined the effects of both nutrition information and health information (claim) on food choices. Kozup, Creyer and Burton(2003) found that heart-healthy claims and nutrition facts panels both increased consumer's evaluations and purchase intentions. Gracia, Loureiro and Nayga Jr. (2009) found that Spanish consumers valued both nutrition claims and nutrition facts panels, but the nutrition facts panel label was valued more than a specific nutrition claim. Barreiro-Hurle, Gracia, and de-Magistris (2010a) found that most of their survey participants used both nutrition labels and health claims to form purchase decisions. However, the use of nutrition information depended on consumer's nutrition knowledge, which was influenced by their demographic characteristics. Barreiro-Hurle, Gracia, and de-Magistris (2010b) further investigated the extent to which providing nutritional and health information simultaneously could increase consumer's willingness to pay and found that the effects depended on the product and information. For example, if the product was already considered healthy, and the health benefit was well known, providing a health claim in addition to nutrition facts panel did not significantly increase consumer's willingness to pay.

Specifically on seafood, recent evidence using laboratory and field experiments indicated that health information could change consumers' preferences for seafood products (Roosen, Marette, Blanchemanche, and Verger, 2007; Marette, Roosen, and Blanchemanche, 2008; and Marette, Roosen, Blanchemanche, and Verger, 2008; Roosen, Marrette, Blacnchemanche, and

Verger, 2009). Their health information treatments focused on the benefits and risks associated with consuming Omega-3 fatty acids and methylmercury. In particular, providing information on health benefits of Omega-3 fatty acids increased consumer's valuation for sardines and information on methylmercury reduced valuation on tuna. Changes in consumer's valuation also depended on the order in which health benefit and risk information were presented. Furthermore, complex information on risk only weakly decreased consumption of the most contaminated fish.

In sum, existing literature suggest that consumers' choices and preferences for food can be influenced by nutrition and health benefit information. The direction and impacts vary by the product, type of information and the order of information presented. Our study seeks to improve the understanding of the effects of information in the following ways. First, existing studies have focused on processed seafood or packaged food (with the exception of Roosen, Marrette, Blacnchemanche, and Verger, 2008). We examine the effects of nutrition and health information on raw seafood that is increasingly common in grocery stores. Second, our online survey used choice experiments with a larger sample (1,000 participants) than previous studies to evaluate the effects of health information on seafood consumption. Third, we used a between subject design to eliminate the order effect in within subjects design in which consumers were exposed to both control and information treatments. Instead of asking participants to repeat the same set of choice experiments before and after the information treatments, we randomly assigned participants to either a control group that received no information or to one of three treatment groups that each received one type of seafood nutrition information, a strategy commonly used in the literature (Moon, Balasubramania, and Rimal, 2011; Liaukonyte, Streletskaya, Kaiser, and Richard, 2013). Fourth, in our choice experiment, we included five types of seafood products, along with other proteins, such as chicken breast, beef steak, and pork loin, to represent a more realistic shopping scenario. Finally, our experiment was conducted with participants in the United States, where nutrition information labeling already exists for raw meats; thus setting the tone to consider the impact of such information on other raw protein demand.

Survey and Choice Experiment Design

A consumer survey with a choice experiment was designed to develop an understanding of the impact of nutrition and health benefit information on seafood consumption and preferences of parents with minor-aged children between the ages of 6 to16 years old. A random sample of 2,325 participants in the southern region of the United States (Region 3, U.S. Census Bureau, 2013) was recruited for an online survey through a national panel hosted by a market research firm (Research Now), of which 1,000 successfully completed the survey. To participate in the survey, participants were required to (1) have a child between the ages of 6 and 16 years living in the household; (2) be responsible for preparing meals for the household; (3) have no household members who are vegan or vegetarian or allergic to any seafood (fish and shellfish); (4) have no household members who work in the fishing industry; (5) have no household members with religious restrictions on consuming any seafood (finfish and shellfish), beef, and pork.

Upon completing the background information on consumption and purchasing patterns of meat and seafood, participants answered questions on their perception and knowledge about the health and nutrition benefits of meat and seafood. Next, they were randomly assigned to one of four information treatment groups (included a control group with no information) before proceeding to the choice experiment questions. All participants were presented with the same sets of choice questions, except for the information treatments presented before the choice sets. To reduce the order effect the choice sets in the choice experiment and the choices in each choice set were randomized. At the end of survey, participants completed information related to demographics.

The choice experiment was designed to have participants select a protein to prepare for a family dinner at home. We focused on two types of shellfish and three types of finfish that are commonly consumed, vary in Omega-3 fatty acids, and are economically important to the seafood industry in the southern United States. The finfish choice included salmon, mahi-mahi, and grouper, and the shellfish choice included shrimp and oyster. Shrimp was chosen because it is the most often consumed seafood among children based on previous focus group studies, and oysters was chosen because they are a natural source of Omega-3 fatty acids and are commonly consumed in the selected region. To present realistic scenarios to the survey participants, we included other protein choices (chicken breast, beef steak, and pork loin) along with the two types of seafood in the choice sets. Before participants were presented with the choice sets, we made it clear that all the protein choices were boneless so that was not a concern in the food selection. Each type of meat and seafood had three price levels: low, medium, and high. The prices reflected the current market prices at the grocery stores and experts' opinions (table 2).

Using an orthogonal factorial design (D-efficiency 91%), each participant was presented with 14 choice sets (see table 1 for an example). For each choice set, participants were asked to select the product they were most likely to choose for a family dinner with their child (age 6 to 16 years old) present. We do not include a "none" option in the choice sets, for two reasons: first, a "none" option allows participants to avoid making tradeoff decisions that is our main interest, (Carson, Louviere, Anderson, Arabie, Bunch, Hensher, Johnson, Kuhfeld, Steinberg, and Swait

1994); second, as participants all indicated they are responsible for preparing dinner for the family and there are no dietary restrictions related to meat and seafood in their household, it is reasonable to assume they will be able to choose between proteins for dinner.

The three information treatments on nutrition and health benefits are shown in tables 3 and 4. Although nutrition literature shows the health benefits of consuming seafood high in Omega-3 fatty acids, Americans often do not consume enough of this type of seafood (Kris-Etherton and Hill 2008). Yen, Lin, and Davis (2008) did not find evidence that health information increased the demand for fish and hypothesized that knowledge on Omega-3 fatty acids and mercury pollution work in opposite directions with regards to fish consumption. For this reason, we focus on the health benefits of Omega-3 fatty acids and provide examples of seafood rich in Omega-3 fatty acids in the first information treatment (referred to as "Omega-3" hereafter). For the five types of seafood examined in the study, salmon has the highest amount of fat and the highest amount of Omega-3 fatty acids. Because lean white fish (mahi-mahi and grouper) and shellfish are natural sources of Omega-3 fatty acids, but have less overall fat and Omega-3 fatty acids than salmon, we specified in the information treatment that lean white fish are excellent sources of low-fat protein in addition to the health benefits of Omega-3 fatty acids. Although a typical marketing message or nutrition claim can be shorter and simpler, we believe the contents of this message are most likely to be used by the seafood industry to promote seafood consumption.

The second information treatment focuses on general nutrition information. Because USDA requires nutrition labeling on raw meat and poultry products, we presented a similar nutrition fact panel to the survey participants. For our survey purposes, our nutrition panel is more detailed than the ones currently required by USDA. For example, current USDA requirements list the amount of total fat and saturated fat, but do not distinguish total fat with unsaturated Omega-3 fatty acids. Since several seafood products are good sources of Omega-3 fatty acids, labels only listing the total fat might mislead consumers to believe seafood with greater Omega-3 fatty acids is unhealthy. For this reason, our nutrition panel lists the amounts of protein, iron, fat, saturated fat, and Omega-3 fatty acids per serving for all the seafood and meat products included in this study (referred to as "nutrition" hereafter). Although this message provides more detailed information than USDA mandates, we believe additional information on Omega-3 fatty acids are relevant to the seafood industry, which can be used voluntarily by the seafood industry if such mandates were to be extended in the future to include raw seafood.

The third information treatment combines the first and second treatments (referred to as "nutrition and Omega-3" hereafter) to examine the compound effect of a nutrition facts panel with health benefit information, since previous studies (i.e. Kozup, Creyer, and Burton, 2003) found that when nutrition facts panel and health claim were provided jointly, consumer's evaluation and purchase intentions were further increased than providing nutrition facts panel alone.

Identification of Information Treatment Effect

Discrete choice experiments are consistent with the random utility theory (RUT) (MacFadden 1986; McFadden and Train, 2000), which assumes that a latent unobserved utility that consumer i associates with choice alternative j can be represented with a explainable component of utility V_{ij} and random component associated with consumer i and option j ε_{ij}.

$$U_{ij} = V_{ij} + \varepsilon_{ij} \qquad (1)$$

Consumer i will choose alternative j if $U_{ij} > U_{ik} \forall k \neq i$ and the probability of consumer i choosing alternative j is given by

$$P_{ij} = \text{Prob}(V_{ij} + \varepsilon_{ij} > V_{ik} + \varepsilon_{ik}), \forall k \neq i \quad (2)$$

Typically, a linear form of utility is assumed in the literature (McFadden and Train, 2000). That is:

$$V_{ij} = \beta' X_{ij} \quad (3)$$

Where X_{ij} is the vector of attributes found in option jth alternative.

For each treatment group and the control group, we specify the utility of consumer i choosing an alternative j as:

$$U_{ij} = \beta_p price_{ij} + \beta_1 chicken_{ij} + \beta_2 pork_{ij} + \beta_3 salmon_{ij} + \beta_4 shrimp_{ij} + \beta_5 mahi_{ij} + \beta_6 grouper_{ij} + \beta_7 oyster_{ij} + \varepsilon_{ij} \ (4)$$

We included seven alternatives (pork loin, chicken breast, mahi-mahi fillet, grouper fillet, salmon fillet, shrimp, and oysters) in the estimation, with beef left out as the reference case to avoid multicollinearity. To estimate (4), conditional logit models can be used under the assumption that ε_{ij} has an independently, identically distributed with type I extreme value distribution. In presence of heterogeneity in consumer preferences, mixed logit models are often used (Train, 2003). We therefore estimated equation (4) with random parameters logit models for the control and treatment groups. Following Train (2003), the probability that individual i choose the alternative j is given by

$$P_{ij} = \int \frac{e^{\beta' X_{ij}}}{\sum_j e^{\beta' X_{ij}}} f(\beta) d\beta \quad (5)$$

where the distribution of the random parameter f(.) can be specified as normal or lognormal with the mean and standard deviation to be estimated. In our case, normal distributions are assumed for the random parameters.

However, the estimated coefficients between the control and treatment group cannot be directly compared, because they may have different scaling parameters in their random-utility models (Train, 2003; Gao and Schroeder 2009). More specifically, the utility can be expressed as $U_{ij} = V_{ij} / \sigma + \varepsilon_{ij}^{*} / \sigma$, where σ (the scale parameter) is the variance of the unobserved component. As a result, the probability of consumer i chooses alternative j can be re-written as

$$P_{ij} = \int \frac{e^{(\beta^{*/\sigma})' X_{ij}}}{\sum_j e^{(\beta^{*/\sigma})' X_{ij}}} f(\beta) d\beta \qquad (6)$$

Since β^{*} and σ are not separately identified, and only the ratio of β^{*} / σ can be estimated (Train, 2003); we might encounter the situation where the scale parameters are different in the control and treatment groups. Note that the scale parameter does not affect the ratio of any two coefficients, thus we derive the marginal willingness to pay (MWTP) for each of the proteins as follows:

$$MWTP_j = -\frac{\beta_j}{\beta_p} \qquad j = 1,2,3 \ldots 7 \qquad (7)$$

To compare the MWTP between the control group and each of the treatment groups, we used a parametric bootstrap approach to simulate the MWTP values for each group. For each group, we took 250 draws(equal to the size of the sample in the group) from a multivariate normal distribution with the coefficients and their covariance from the estimated random parameters models. To test whether the MWTP values are statistically different across groups, we used t-tests on the means of the MWTP assuming normality of MWTP, and Pearson chi-squared tests on the equality of means without the assumption on the MWTP's distribution.

Survey Results

A completion rate of 43% resulted in a sample size of 1,000, with participants randomly distributed into four groups of approximately 250 each. A summary of the participants' demographic profile is provided in table 5. Because we focus on parents with minor-aged children between the ages of 6 and 16 years old in the household who are responsible for household food purchases, 75% of the participants in the survey were between 30 and 49 years old, and 82% were female. The proportion of survey participants with a college education was higher than the national statistics (35% versus 17% with a bachelor's degree, and 20% versus 9% with an advanced degree) (US Census Bureau 2011a). The proportion of survey participants with annual household income above $50,000 was also higher than national statistics (74% versus 58%) (US Census Bureau 2011b).

Although the control group and three treatment groups were randomly assigned, we further tested whether they were homogenous in terms of socio-economic characteristics using Chi-squared and Wilcoxon-Mann-Whitney tests (table 5). We found that the treatment groups were not statistically different from the control group in terms of socio-economic characteristics (age, gender, income, education, employment, geographical location, and food expenditures).

A description of participants' seafood consumption habits is shown in table 6. Regarding shellfish consumption, 30% reported never consuming shellfish at home, 35.7% consumed shellfish 1–3 times per month, and 24.9% consumed shellfish less than once a month. Regarding finfish consumption, 17.3% reported never consuming finfish at home, 39.2% consumed finfish 1–2 times per month at home, and 19% consumed finfish less than a month. The away-from-home consumption pattern was similar to the consumption pattern at home, with around 35% never ordering shellfish or finfish away from home.

We asked participants to recall the last ten times they had seafood with their children (including dining at home and away from home). Table 7 summarized the percentage of responses by types of seafood and by control and treatment groups. We used Pearson's chi-square tests and Wilonxon-Mann-Whitney tests, and found that there were no statistical differences in the reported frequency across groups. Shrimp was the most often consumed seafood across control and treatment groups, as 33.63 to 41.07 % participants had shrimp for 4 to 6 times, and 23.21 to 27.69% had shrimp for 7 to 10 times of the last ten times. The second most commonly consumed seafood is salmon, 23.26 to 37.50% participants consumed 1 to 3 times in the last 10 occasions with their children. In comparison, mahi-mahi, grouper, oyster, clams and mussels are the least common types of seafood consumed by participants with their children, as over 80% participants reported zero consumption in the last ten occasions.

We also asked participants to identify the reasons that they select seafood for a family meal with their children. The most important reason reported is flavor (taste), followed by health (nutrition), variety, protein, price, fat, calories, and preparation time (figure 1). We further asked participants to rank meat, finfish, and shellfish from the most healthy to the least healthy. For this question, 73% of the participants considered finfish to be the healthiest choice, followed by chicken (18%), shellfish (6%), beef (2%), and pork (1%) (figure 2).

While participants believed seafood to be the healthiest, there were wider gaps in perceptions of health benefits of seafood, particularly about Omega-3 fatty acids. For example, participants' perception and knowledge of Omega-3 fatty acids were tested using a series of questions (table 8). A large majority of participants (86%) agreed that Omega-3 fatty acids are beneficial to health. Similarly, about three-quarters of the participants recognized the health benefits of reducing cholesterol levels. Most (76%) agreed that seafood contains more Omega-3 fatty acids than other meats, and less than 10% believed red meat or poultry meat contains more Omega-3 fatty acids than does seafood. However, 35% and 39% of the participants neither agreed nor disagreed with the statement that red meat and poultry meat, respectively, contain more Omega-3 fatty acids than does seafood (table 8, rows 4–5), which indicates that more than one-third of the participants may not have a complete understanding of Omega-3 fatty acids. This finding resonates with the previous research by Verbeke, Sioen, Pieniak, Camp, and De Henauw (2005) that although fish is considered to be a healthy option, there was a considerable knowledge gap on the health benefits of fish.

Results of Discrete Choice Experiment

We summarized the results from estimating equation (4) for the control and treatment groups in table 9. The coefficients for meat and seafood reported represent the differences in marginal utility between choosing a particular product and beef, since we used beef as the reference case. The coefficients of price were significant and negative across all groups, indicating downward sloping price-demand relationships. We found that seafood products and pork have negative coefficients across all four groups (with the exception of grouper's coefficients not being statistically significant from zero), indicating that the marginal utility of choosing seafood or pork was relatively lower than choosing beef. In comparison, the coefficients for chicken breast were positive and significant in all groups (with the exception that the coefficient for the group of Omega-3 was not statistically significant).

For each group, we simulated a distribution of 250 observations (equal to the size of the sample in the group) for each WTP estimate by drawing from a multivariate normal distribution parameterize with the coefficients and variance from the estimated random parameter logit models. We then did pair-wise comparisons in means of MWTP between the control group and each of the treatment group using t-tests. Additionally, we also tested for equality of median using Wilcoxon-Mann-Whitney tests and for equality of variance using F-tests. For brevity, we only reported the mean MWTP and the 95% confidence interval of the control group in table 10 (column 1). The differences in means and their standard errors from the t-tests are reported in column 2 to 4 of table 10.

We found that the MWTP for all seafood were lower than beef with the exception of grouper which is not statistically significant from zero for the control group. MWTP for pork loin was also statistically lower than beef, while MWTP for chicken breast was statistically greater than beef (table 10, column 1).

Providing nutrition information similar to nutrition labels increased the MWTP for all seafood types (table 10, column 3). Meanwhile it did not affect the MWTP for chicken and pork significantly. In contrast, providing information on Omega-3 fatty acids increased the MWTP for shrimp, oyster and even pork, compared to the control group (table 10, column 2), but did not increase the MWTP for salmon significantly. One explanation could be that consumers who choose salmon have already known about salmon is rich in Omega-3 fatty acids, as Barreiro-Hurle, Gracia, and de-Magistris (2010b) found that providing information on health benefit did not significantly increase WTP if the product is considered healthy, and its health benefit is well known. While it may seem to be surprising that the MWTP for pork increased significantly due to the information on Omega-3 fatty acids, it could be due to the fact that more than one-third of the participants might not fully understand about Omega-3 fatty acids and their sources (table 7). However, when nutrition information was presented, the MWTP for pork was not significantly affected (table 10, column 4, row 8). Furthermore, we found that providing information on nutrition and Omega-3 fatty acids jointly did not always increase the MWTP more than providing nutrition or Omega-3 fatty acids information alone (with the exception of mahi-mahi).

Mahi-mahi and grouper are two types of lean fish that has a lower concentration of Omega-3 fatty acids than salmon. Grouper is more expensive than other types of protein, and is also the least likely consumed seafood species among survey participants (only 5% of participants consumed grouper with their children (at home and away from home) in our survey, whereas 44% of had consumed shrimp, 21% salmon, 8% oysters, and 7% mahi-mahi with their children). Nevertheless, we found that providing nutrition information increased MWTP for both mahi-mahi and grouper.

The MWTP for shrimp, the most commonly consumed seafood by children, was significantly positive for all treatment groups (table 10, row 4). Although shrimp is a natural source of Omega-3 fatty acids, it contains lower levels of Omega-3 fatty acids than do fatty finfish. However, consumer WTP for shrimp still increased with the information treatment, indicating that consumers may not have been selecting shrimp previously because of health benefit or nutritional benefits.

House, Hanson, and Sureshwaran (2003) showed that the decision to consume oysters was driven by personal habits and tastes, while frequency of consumption was influenced by concern over safety and not health benefits. Our results indicated that the consumption of oysters could be influenced by information treatments, particularly by nutrition information(table 10, row 5).

Conclusions and Discussion

With USDA requiring nutrition labels for raw meat and poultry products, it is of interest to determine how this information would impact seafood consumption if provided. This study is the first to evaluate the effects of nutrition and health benefit information on fresh seafood choices among parents with minor-aged children. We designed three types of information treatments: nutrition, Omega-3, and nutrition and Omega-3. While the first treatment resembles the nutrition facts panel currently required for meat and poultry products, the second resembles marketing message that could be voluntarily used by industry, and the last one is a combination of both. We found that providing nutrition information similar to the nutrition facts panel increased the MWTP for all seafood types examined. The nutrition information we provided was similar in format to the current nutrition facts panel, with one addition: the inclusion of the amount of fats from Omega-3 fatty acids. For seafood that is rich in Omega-3 fatty acids, such as salmon, information on the health benefits of Omega-3 fatty acids was expected to be an effective marketing message. However, our results indicate it is less effective than nutrition information; probably because consumers were already aware of the health benefits of consuming salmon. Since most consumers were less familiar with the varieties of white finfish, objective information from nutrition labeling could potentially increase the probability that consumers would choose them. Thus, the seafood industry and USDA can evaluate if the benefits from nutrition labels for raw seafood to increase seafood consumption outweigh the costs of labeling.

Admittedly, there are several limitations in this study. First, participants in our sample had a higher level of education and income than the national average. Since health knowledge is typically associated with education and income level (Yen, Lin, and Davis 2008), the effects of the nutrition and health information in this study may not apply to people with a lower income and education. Second, we focused on the heath and nutrition information of seafood but information on health risks associated with fish consumption have been widely available in the form of advisories issued by FDA (Food and Drug Administration), EPA (Environmental

Protection Agency), and state agencies. Future studies that combine health benefit and risk information about raw seafood could provide more insights for the seafood industry and policy makers.

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Table 1. Examples of the fourteen choice sets used in the choice experiments

Choice set #14	Beef	Chicken	Pork	Shrimp	Grouper
	Steak	Breast	Loin		Fillet
	$12.99/pound	$7.99/pound	$6.99/dozen	$12.99/pound	$13.99/pound
	☐	☐	☐	☐	☐

Note: Survey participants were to "select which product you are most likely to choose to prepare for dinner (that you would expect to give to your child)." The order in which each choice set appeared was randomized for each participant. Furthermore, the order in which each option appeared in the choice set was also randomized for each participant.

Table 2. Price levels used in the choice experiments (dollars per pound)

	Beef Steak	Chicken Breast	Pork Loin	Grouper Fillet	Mahi-mahi Fillet	Oyster	Shrimp	Salmon Fillet
Low	$6.99	$4.99	$4.99	$9.99	$6.99	$7.99	$6.99	$7.99
Medium	$8.99	$6.99	$6.99	$11.99	$8.99	$9.99	$8.99	$9.99
High	$12.99	$7.99	$10.99	$13.99	$11.99	$12.99	$11.99	$13.99

Table 3. Information treatment on Omega-3 fatty acids (Omega-3)

Fish that have more fat, such as salmon, are recommended for their Omega-3 fatty acids, which is "good fat" because it is unsaturated. Studies have found that Omega-3 fatty acids play a role in assisting in optimal brain, nerve, and eye development in children, and decreasing the risk of cardiovascular diseases. Lean finfish, such as flounder, grouper, mahi-mahi, and tilapia, and shellfish are excellent sources of low-fat protein.

Table 4. Information treatment on nutrition (nutrition)

Type	Calories	Total Fat (g)	Saturated Fat (g)	Omega-3 Fatty Acids (g)	Protein (g)	Iron (%DV)
Beef steak	148–213	5.3–12.5	1.9–4.9	0.00	24–25	9–17
Chicken breast	130	3.0	0.6	0.01	24	2
Pork	145–253	3.9–17.9	1.4–6.2	0.00	20–26	3–7
Salmon	160–237	6.3–15.3	0.8–3.5	0.76–2.24	22–26	2–5
Grouper	105	1.2	0.3	0.28	22	6
Mahi-Mahi	97	0.8	0.2	0.12	21	7
Shrimp	81	1.2	1.3	0.07	16	1
Oysters	58	1.9	0.5	0.36	7	29

*Nutrition information (approximate) for 4 ounces of raw, edible portions

Table 5. Demographics of online survey respondents (percentage).

		Pooled sample	Control	Omega 3	Nutrition	Nutrition and Omega 3
Gender	Female	82%	78%	82%	81%	80%
Age	19-29	5%	3%	4%	6%	4%
	30-39	33%	31%	33%	29%	38%
	40-49	42%	48%	44%	41%	37%
	50 and above	21%	18%	20%	25%	21%
Education	High school /some college	39%	37%	38%	40%	43%
	Four-year college	35%	34%	36%	30%	34%
	Post-graduate	20%	25%	20%	22%	16%
Income	Below $49,999	25%	25%	25%	27%	27%
	$50,000–$99,999	41%	41%	38%	38%	40%
	$100,000 or above	33%	34%	34%	35%	33%
Employment	Full-time	59%	56%	57%	59%	61%
	Part-time / other	41%	44%	42%	41%	39%

Note: we conducted Wilcoxon-Mann-Whitney tests between control group and each of the treatment groups to test if the two groups have the same distribution using Stata's ranksum test (StataCorp, 2013). Person's Chi-squared tests (tab, chi2) were also used to examine whether treatment and control status were independent of demographic characteristics (StataCorp, 2013). All test statistics were not significant at 5% indicating cannot reject the null hypotheses. We have collected more detailed information on income, education and employment status, to conserve space; we only reported the statistics at more aggregate levels.

Table 6. Consumption of shellfish and finfish for dinner at home and dining away-from-home/take-out

	Shellfish		Finfish	
	Dinner at home (%)	Dinning away-from-home (%)	Dinner at home (%)	Dinning away-from-home (%)
More than 3 times a week	0.2	0.7	0.7	0.8
2-3 times a week	1.5	2.1	6.7	2.7
Once a week	7.3	5.4	16.9	6.1
1-3 times a month	35.7	29.7	39.2	29.8
Less than once a month	24.9	23.9	19.3	24.9
Never	30.3	38.2	17.3	35.7
Total	100	100	100	100

Note: Percentages were summarized for the pooled sample including one control group and three treatment groups. There were no statistical differences in the reported consumption habits across groups using Chi-square tests and Wilcoxon-Mann-Whitney tests. Thus statistics for each group were omitted for brevity.

Table 7. Shellfish and finfish consumption with children in the last ten times (percent of participants)

Frequency	Control	Omega-3	Nutrition	Nutrition and Omega-3
Salmon				
0	61.24	51.79	56.82	52.21
1 to 3 times	23.26	37.50	27.27	37.17
4 to 6 times	12.40	10.71	12.88	9.73
7 to 10 times	3.10	0.00	3.03	0.88
Mahi-mahi				
0	88.46	82.14	87.12	82.30
1 to 3 times	11.54	16.96	12.12	17.70
4 to 6 times	0.00	0.89	0.76	0.00
7 to 10 times	0.00	0.00	0.00	0.00
Grouper				
0	88.46	82.14	90.15	87.61
1 to 3 times	10.77	16.96	9.09	10.62
4 to 6 times	0.77	0.89	0.76	0.88
7 to 10 times	0.00	0.00	0.00	0.88
Shrimp				
0	5.38	7.14	10.61	7.96
1 to 3 times	26.15	28.57	25.76	32.74
4 to 6 times	40.77	41.07	36.36	33.63
7 to 10 times	27.69	23.21	27.27	25.66
Oyster/Clams/Mussels				
0	83.08	81.25	81.82	81.42
1 to 3 times	16.15	17.86	15.15	17.70
4 to 6 times	0.77	0.89	3.03	0.88
7 to 10 times	0.00	0.00	0.00	0.00
Other Finfish				
0	57.69	57.59	58.71	58.41
1 to 3 times	33.46	31.70	29.55	26.99
4 to 6 times	8.08	9.38	9.47	12.83
7 to 10 times	0.77	1.34	2.27	1.77

We used Chi-square tests and Wilcoxon-Mann-Whitney tests and found there were not statistical differences in the reported percentage across groups. Other finfish included tuna, tilapia, snapper, cod, catfish, and others.

Table 8. Participant's perception about omega-3 fatty acids

Statements	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
Omega-3 fatty acids are beneficial to our health	1%	1%	12%	48%	38%
Omega-3 fatty acids can help reduce cholesterol levels	1%	1%	24%	49%	24%
Omega-3 fatty acids can help brain development of young children	1%	1%	23%	48%	27%
Red meat contains more Omega-3 fatty acids than other meats and seafood	15%	42%	35%	6%	2%
Poultry meat contains more Omega-3 fatty acids than other meats and seafood	12%	43%	39%	5%	1%
Seafood contains more Omega-3 fatty acids than other meats	1%	2%	21%	47%	29%

Note: Percentages were summarized for the pooled sample including one control group and three treatment groups. Statistics for each group were omitted for brevity since there were no statistical differences in the reported perceptions across groups using Chi-square tests and Wilcoxon-Mann-Whitney tests.

Table 9. Estimated results from random parameters logit models

Variables	Control	Omega-3	Nutrition	Nutrition and Omega-3
Price	-0.681***	-0.714***	-0.634***	-0.583***
	(0.023)	(0.023)	(0.021)	(0.021)
Salmon	-1.576***	-1.676***	-0.868***	-0.909***
	(0.398)	(0.421)	(0.244)	(0.289)
Mahi-Mahi	-1.334***	-1.484***	-1.220***	-0.911***
	(0.273)	(0.292)	(0.269)	(0.211)
Grouper	-0.024	0.09	0.38	-0.133
	(0.380)	(0.314)	(0.232)	(0.293)
Shrimp	-1.357***	-0.950***	-0.662***	-1.242***
	(0.198)	(0.186)	(0.161)	(0.236)
Oyster	-3.923***	-3.792***	-2.564***	-4.615***
	(0.761)	(0.732)	(0.427)	(0.931)
Pork	-1.691***	-1.410***	-1.564***	-1.673***
	(0.141)	(0.138)	(0.155)	(0.153)
Chicken	0.348**	0.199	0.345***	0.470***
	(0.151)	(0.122)	(0.105)	(0.119)
Observations	16800	17920	18270	17150
Log-likelihood	-2795	-2850	-3135	-2949

Standard errors in parentheses ***, **, and * indicate significance at the p = 0.01, 0.05, and 0.1 levels, respectively. For each model, all parameters are treated to be random, except for price. All models are estimated using the command mixlogit by Hole (2007).

Table 10. MWTP for meats and seafood in control group and changes in MWTP due to information treatment

	MWTP-control	ΔMWTP by Omega-3	ΔMWTP by Nutrition	ΔMWTP by Nutrition and Omega-3change
Salmon	-1.56***	-0.20	0.88*	0.42
	[-2.38, -0.77]	(0. 46)	(0. 43)	(0.53)
Mahi-Mahi	-1.34***	-0.13	0.56*	0.78***
	[-1.87, -0.81]	(0.29)	(0. 32)	(0. 32)
Grouper	-0.05	0.19	0.74***	0.25
	[-0.76, 0.74]	(0.20)	(0.19)	(0.22)
Shrimp	-1.34***	0.68***	0.75***	0.72***
	[-1.73,-0.95]	(0.22)	(0.23)	(0.29)
Oyster	-3.90***	-0.14	1.35***	0.70***
	[-5.35, -2.43]	(0.12)	(0.12)	(0.28)
Pork	-1.69***	0.48***	0.17	0.46**
	[-1.99, -1.40]	(0.18)	(0.25)	(0.24)
Chicken	0.35**	0.15	0.04	0.28
	[0.04, 0.64]	(0.25)	(0.23)	(0.27)

95% confidence intervals are in brackets, and based on the percentile interval procedure by Krinsky and Robb (Hole, 2007a). Standard errors are in parentheses. ***, **, and * indicate significance at the p = 0.01, 0.05, and 0.1 levels, respectively for the hypotheses that the mean WTP values of the treatment groups are larger than control group. We took 250 draws from a multivariate normal distribution with the coefficients and their covariance from estimates of the random parameter logit models. For brevity, we only reported the MWTP for the control group.

MWTP estimates for other groups are available upon request. We further did pair-wise comparisons in means of MWTP between the control group and each of the treatment group using t-tests. Additionally, we also tested for equality of median using Wilcoxon-Mann-Whitney tests. Our conclusions are robust to both tests. For brevity, we only report the results from the t-tests in column 2 to 4. Tests for equality of medians are available upon request.

and reported the differences in means and standard errors in column 2 to 4. We also tested the equality of the medians of the MWTP of the control group with each of the treatment group using.

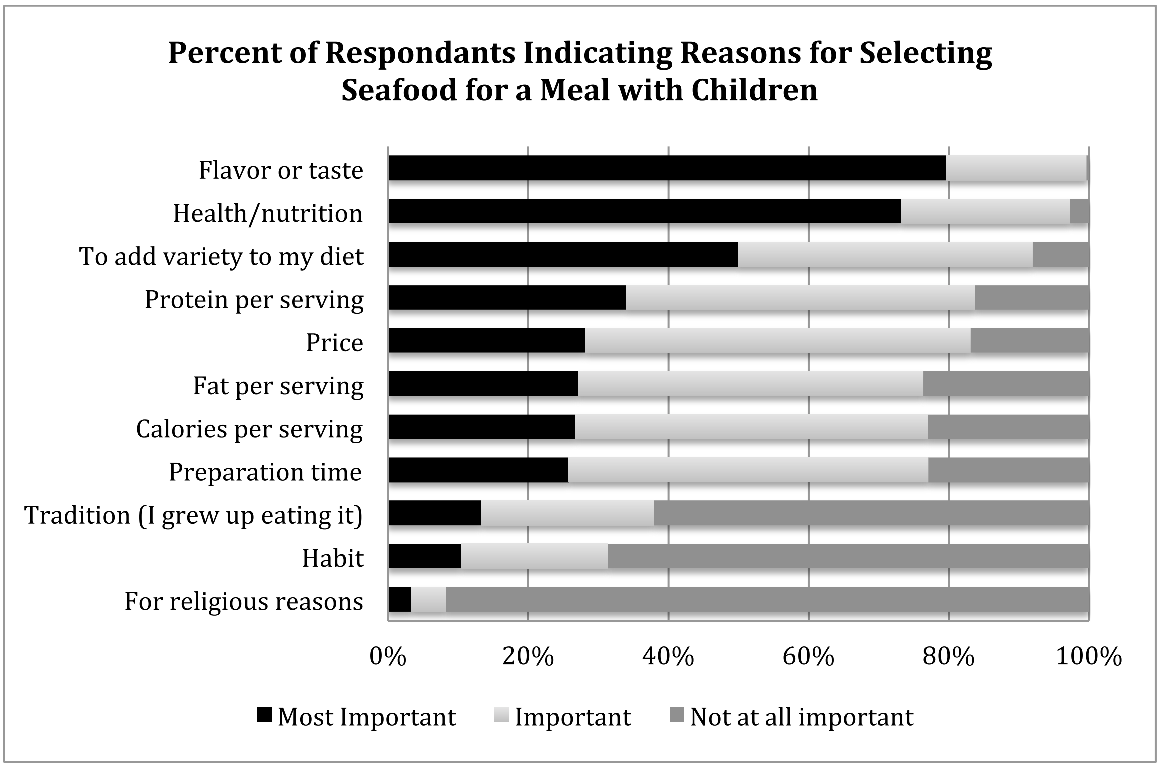
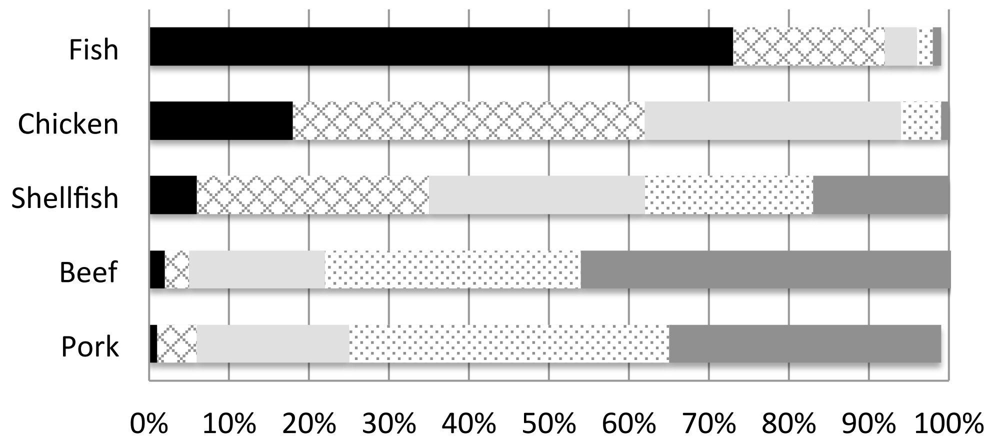


Figure 1. Reasons for selecting seafood for a meal with children

Note: Percentages were summarized for the pooled sample including one control group and three treatment groups. Statistics for each group were omitted for brevity. There were no statistical differences in the reported reasons between the control group and each of the treatment groups using Wilcoxon-Mann-Whitney tests.



	Pork	Beef	Shellfish	Chicken	Fish
1 Most Healthy	1%	2%	6%	18%	73%
2	5%	3%	29%	44%	19%
3	19%	17%	27%	32%	4%
4	40%	32%	21%	5%	2%
5 Least Healthy	34%	47%	17%	1%	1%

Figure 2. Participant perception of meat and seafood on health

Note: Percentages were summarized for the pooled sample including one control group and three treatment groups. Statistics for each group were omitted for brevity. There were no statistical differences between the reported rankings between control group and each of the treat groups using Wilcoxon-Mann-Whitney tests.