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Nutrition and origin of US chain restaurant seafood

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ABSTRACT

Background: Seafood has a nutritional profile that can be beneficial to human health, which gives it a role to play in healthy diets. In addition, because its production and harvesting can have fewer environmental impacts than some forms of animal protein, it can contribute to sustainable diets. However, the positive health and environmental outcomes are not guaranteed—they depend on how seafood is prepared and served and whether it is sourced from sustainable fisheries and aquaculture industries.

Objectives: We examined the availability and nutritional attributes of seafood meals at chain restaurants in the United States. We assessed nutritional attributes by store type and geography. We also assessed menu labeling for species, production methods, and origin.

Methods: The study population was 159 chain restaurants with 100,948 branch locations in the United States. Data were harvested from online restaurant menus, and the nutritional profile of seafood meals was calculated.

Results: The average seafood menu item provides up to 49–61% of the total daily limit of saturated fat, 65% of the total daily limit of sodium, and 58–71% of total daily protein requirement for adult men and women. Restaurant chains located in the Deep South and Ohio River Valley, and casual dining chains nationally, carry seafood meals with more total calories and saturated fat per 100 g than other regions or chain types. Most menu items did not list origin or production methods, which is information that would help consumers make informed decisions.

Conclusions: The added ingredients and cooking methods used at chain restaurants can attenuate the health benefits of seafood. We recommend reformulating menus to reduce portion sizes, total calories, added fat, and sodium content per meal and to improve consumer-facing information about origin and production methods. *Am J Clin Nutr* 2021;00:1–10.

Keywords: calories, chain, diet, fast food, fish, meal, nutrition, restaurant, seafood

Introduction

There is an urgent need to transition to healthy diets and more sustainable food systems. Many forms of seafood are associated with fewer environmental impacts compared with terrestrial animal protein production (1–3), and because of positive nutritional profiles, they are included in food-based dietary guidelines in many countries (4). Seafood has a favorable ratio of omega-3 (ω–3) to ω-6 fatty acids, and eating seafood 1–2 times per week can reduce morbidity and mortality from coronary heart disease and ischemic stroke (5). The consumption by women of 113–340 g (4–12 oz) of seafood per week during pregnancy can provide neurocognitive benefits for offspring (6). However, US consumers eat approximately half the amount of seafood recommended in the *Dietary Guidelines for Americans* (7), and they eat less seafood per capita than other categories of animal protein (8).

US consumers are eating more foods prepared outside the home (9). Since 1977, the proportion of calories consumed away from home has doubled, and calories consumed away from home represented approximately one-third of total calories consumed by Americans in 2012 (9). In the seafood category, 39% of seafood consumption by weight and 65% of seafood expenditures occur outside the home, primarily at restaurants (10). Although seafood as an ingredient is low in saturated fat and calories, the

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Supplemental Tables 1–5 and Supplemental Figures 1–4 are available from the “Supplementary data” link in the online posting of the article and from the same link in the online table of contents at https://academic.oup.com/ajcn/.

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way it is prepared and served as a meal ultimately determines its healthfulness. Food procured away from home contains more calories, sodium, and saturated fat and less calcium, iron, and fiber than food prepared at home (9). A third of US restaurants are chains (11), and eating at chain restaurants has nutrition and health implications (12), particularly for low-income consumers. Fast-food meals have been associated with higher calorie intake for children and adolescents, especially among low-income households (13), and chain restaurant advertising has a positive association with weight gain in low-income counties but not high-income counties (14).

Against the backdrop of increasing consumption of all foods at chain restaurants and recommendations to increase seafood intake, our research explores seafood meals sold at these outlets. We examined the nutritional attributes of seafood meals at chain restaurants and labeling for species, origin, and production methods (wild or farmed). The aim of this analysis was to better understand the nutritional profile of seafood meals by restaurant chain type and geography and also the production and sourcing information available to consumers.

Methods

In 2018, the FDA required chain restaurants with ≥20 locations with substantially the same menu items to disclose nutrition information for their standard menu items (15). This decision is intended to help consumers make more informed menu choices due to concerns about the role that chain restaurants have played in obesity (16).

We compiled and analyzed data on the nutritional content of seafood meals on chain restaurant menus. Our starting point was a list of 250 US chain restaurants ranked by 2017 sales (17). We visited chain restaurant websites from March to July 2019 and downloaded restaurant nutrition and food allergy guides to identify chains that sold seafood, and we used this information to create a database (Excel version 16.4; Microsoft). Data were collected from breakfast, lunch, and dinner menus, but we excluded children's menus and catering menus due to differences in portion sizes compared with those on standard menus. Nutrition information included total calories, calories from fat, total fat, saturated fat, *trans* fat, carbohydrates, cholesterol, sodium, fiber, sugar, and protein. Nutrition information reflects the whole dish, inclusive of the seafood and the other ingredients that make up the dish; for example, entrées could also include side dishes in the nutrition information. In order to determine the portion size (which was infrequently posted), we back-calculated the total weight of the dish by applying the Atwater coefficient assumptions for carbohydrates, fat, and protein (18). We then calculated the nutritional values on a per 100-g basis to normalize the data. We annotated each menu item with the type of chain (quick service, fast casual, casual dining, and fine dining), meal type (appetizer, entrée, salad, soup, sandwich, etc.), the common name of the seafood item (Pacific cod, Atlantic salmon, shrimp, fish, mixed seafood, etc.), source information (farmed or wild caught, origin), and items noted as regional specials. Based on the FDA inclusion criteria for requiring menu labeling, we assumed that standard menu items with calorie and nutrition information were widely available at all restaurants in the chain (15). The final menu database contained >2600 menu items containing seafood from 159 restaurants. In our data set, 89% (141/159) of restaurant chains posted nutrition information online, which provided a total of 2316 seafood menu items for the nutritional analysis. The fine dining segment was not included in the nutritional analysis because these restaurants' menus varied by branch and, therefore, they were exempt from reporting nutrient information.

Next, we purchased a database of chain restaurant locations from Chain Store Guide. The Chain Store Guide data set included 101 of the 159 chain restaurants in our menu database, and these 101 chains had 95,587 store locations. We manually added store location data for the remaining 58 smaller chain restaurants not in the Chain Store Guide data set, which added an additional 5361 store locations, for a total of 100,948 stores. These store locations were identified by visiting the chain website, which often lists chain locations, or using Google Maps. The Chain Store Guide store location data set was from 2016 and had 11,096 fewer stores than was reported by a separate data set of chain restaurant sales from 2017 ($n = 112{,}044$) (17). The difference could be due to stores opening and/or closing or different methods for tracking stores. Store locations and market share were reported by core-based statistical area (CBSA). CBSAs are defined as ≥1 counties around an urban center of ≥10,000 people. There are >900 CBSAs in the United States (19).

Analytical methods and statistics

The chain menu and Chain Store Guide databases were analyzed using R Studio version 1.2 and Excel. Figures were produced using Prism version 8 (GraphPad) and ArcGIS version 10.7. Statistical analysis of nutrient content by chain type used 1-factor ANOVA and Tukey's multiple comparison test and set the level of significance at $P = 0.05$.

Results

Seafood availability at chain restaurants

Overall, 64% of the top 250 US chain restaurants sold seafood, which includes 112,044 branch locations (**Table 1**). A total of 86% of casual dining and 78% of fine dining chain locations sold seafood, and approximately half of quick service and fast casual chain locations did so. However, quick service chains had the greatest number of locations nationwide selling seafood ($n = 77{,}023$ branch locations)).

Chain restaurants sold seafood in different meal formats (**Figure 1**A), which is a function of their price points and their target consumers (Table 1). Quick service and fast casual restaurants are lower price point restaurants and often served seafood in small dishes such as sandwiches and tacos, whereas casual dining restaurants have higher price points focused more on seafood in entrées. Fine dining chain restaurants primarily used seafood in appetizers.

Seafood was more prevalent and in greater variety at restaurants with higher price points (Table 1), and to the extent that price points affect the demographics of customers who frequent these chains, this could limit access to certain types of seafood for low-income consumers. Quick service and fast casual restaurants offered an average of 2.6 and 2.3 seafood species per restaurant, respectively, and an average of 8.0 and 9.1 menu items containing seafood, respectively (Table 1). Casual dining and fine dining

TABLE 1 Overview of US chain restaurants selling seafood

Chain type	Description	Example chains	Chains selling seafood[1] (% of total)	Total branch stores selling seafood[2] (% of total)	Average seafood species per chain	Average seafood menu items per chain
Quick service	Inexpensive, limited menu, counter service	Burger King, McDonald's, Subway	34 (40)	77,023 (48)	2.6	8
Fast casual	Hybrid of quick service and casual dining	Au Bon Pain, MOD Pizza, Panda Express	33 (59)	13,932 (53)	2.3	9.1
Casual dining	Table service, larger menus, more expensive	Applebee's, Olive Garden, Red Lobster	85 (86)	20,700 (87)	6.4	23.1
Fine dining	White tablecloth chain, most expensive	Fogo de Chao, Ruth's Chris Steak House	7 (78)	389 (86)	8.0	16.6
Total			159 (64)	112,044 (53)	4.8	16.6

[1] $n = 250$ restaurant chains were assessed, and 64% (159 of 250) sold seafood.
[2] In 2017 (17).

chain restaurants had more diverse seafood menus and offered an average of 6.4 and 8.0 species per restaurant, respectively, and an average of 23.1 and 16.6 menu items containing seafood, respectively. Higher price point chains tended to serve more expensive species on their menus such as lobster, crab, fresh tuna, and salmon (Figure 1B). Lower price point chains (quick service and fast casual) sold predominantly shrimp, "fish," and canned tuna. However, fast casual menus also included several more expensive species, such as salmon and fresh tuna, perhaps to help distinguish themselves from quick service chains. Shrimp was the most common seafood item served at chain restaurants (Figure 1B), and this result is consistent with other data indicating that shrimp is the most widely available seafood item in the United States (20).

Nutrition labeling

The nutritional content of seafood menu items was compared to the US dietary reference intakes for adult men and women and with Dietary Guideline and American Heart Association recommendations (7, 21). Although raw seafood is generally low in saturated fat and sodium (**Supplemental Table 1**), the average seafood meal at chain restaurants had high concentrations of both. For example, the average saturated fat content of seafood meals would provide 49–61% of the daily limit of saturated fat intake for adult women and 37–49% of the daily limit of saturated fat intake for adult men (**Table 2**). [The recommendations are to limit saturated fat intake to 17.8–22.2 g/d for adult women and 22.2–28.9 g/d for adult men (**Supplemental Table 2**).] Daily limits of saturated fat would be exceeded in 12–19% of seafood menu items for adult women and 7–12% of seafood menu items for adult men (Table 2). Average sodium concentrations in seafood meals account for 65% of the daily limit of sodium, and 19% of seafood menu items would exceed the daily sodium goal of 2300 mg (Supplemental Table 2). Women and older adults who have lower caloric requirements would be more likely to exceed daily caloric and nutritional limits compared with other groups when eating chain restaurant seafood meals.

Next, we explored whether restaurant price points affected the nutritional content of seafood meals. We found that higher price

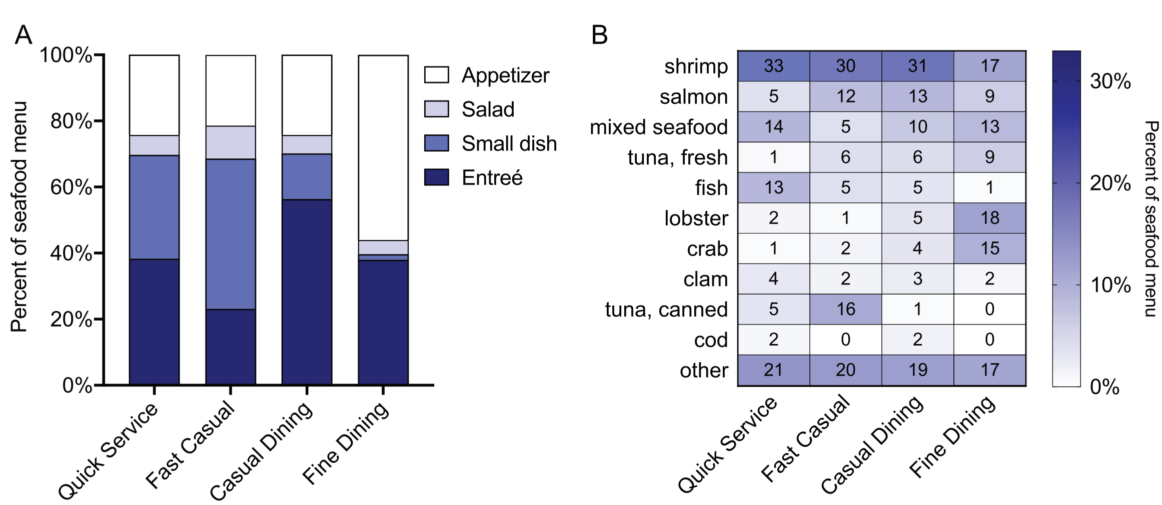

FIGURE 1 Seafood availability at US chain restaurants. (A) Seafood meal types at chain restaurants. Seafood menu items: quick service, $n = 264$; fast casual, $n = 299$; casual dining, $n = 1968$; and fine dining, $n = 116$. (B) Frequency of top seafood species on chain restaurant menus. Color gradient from dark blue (high) to light blue (low); white cells have no data; columns sum to 100%.

TABLE 2 Average nutrient concentrations in seafood menu items compared with daily nutritional goals or limits for adults[1]

	% of daily intake		% of menu items exceeding daily intake	
Calories and nutrients	Men	Women	Men	Women
Calories	25–33	33–41	0	0–3
Total fat (35% of calories), g	36–46	46–58	3–9	9–17
Saturated fat, g	37–49	49–61	7–12	12–19
Trans fat, g	19	19	4	4
Added sugar, g	22	33	3	6
Carbohydrates, g	37	37	5	5
Cholesterol, mg	51	51	11	11
Fiber, g	12–15	15–18	0	0–1
Protein, g	58	71	11	22
Sodium, mg	65	65	19	19

[1]Supplemental Table 2 provides nutritional goals and limits for age and sex groups based on dietary reference intakes and recommendations from the Dietary Guidelines and American Heart Association. Ranges are based on different caloric and nutrient needs among age groups based on $n = 2,316$ menu items with nutrition labeling.

point restaurants (casual dining chains) offered seafood meals that weighed more (i.e., larger portion sizes) than those offered by lower price point restaurants, and most of their meal formats (appetizer, small plate, entrée, and salad) were higher in total calories, total and saturated fat, protein, sugar, carbohydrates, and sodium compared with those of lower price point chains (**Figure 2**, **Supplemental Figure 1**). After normalizing the data to a 100-g basis, we found that seafood meals at casual dining restaurant chains remained higher in total calories, saturated fat, cholesterol, sugar, and protein compared with those at other chains (**Supplemental Table 3**). Consumers would be more likely to meet their daily nutritional requirements with a single meal at a casual dining chain compared with other chains (**Supplemental Tables 4** and **5**). Fast causal chains were generally somewhere in-between quick service and casual dining chains in terms of total and normalized nutritional levels for seafood meals, which makes sense given that fast casual chains are considered a hybrid of quick service and casual dining chains (9). Quick service chains had the lowest total and normalized calorie and nutritional levels, in agreement with previous work (22), with the exception of *trans* fats, which were higher in normalized quick service seafood meals than in those of other chain types (Supplemental Table 3).

Another factor that affected the nutritional content of seafood was the species being prepared. We found meals with salmon were higher in protein in comparison to meals with pollock (**Supplemental Figure 2**), which is consistent with the higher protein content inherent in salmon compared with pollock (Supplemental Table 1). Nutritional differences among fish are based on a variety of environmental and ecological factors, animal physiology, and the type of feed given to farmed fish (23, 24). ω-3 fatty acids were not reported on menus, but we note that species vary in ω-3 fatty acid concentrations; for example, shrimp is low and salmon is high in ω-3 fatty acids (Supplemental Table 1).

Geography of seafood at chain restaurants

We mapped the average calories and nutrients per 100 g of seafood dishes (**Figure 3**). Total calories per 100 g were highest in the Deep South (Mississippi, Alabama, and Georgia) and the Ohio River Valley (Ohio, Illinois, Tennessee, Kentucky, and West Virginia) and lowest in the West (California, Oregon, Nevada, and Washington) and Upper Midwest (Michigan and Minnesota) (Figure 3). Average saturated fat per 100 g was also elevated in the Deep South (Mississippi, Alabama, and Georgia) and upstate New York. Protein concentrations resembled total calories but did not have as clear of a regional focus, whereas sodium concentrations were variable. Chain restaurant density was a function of population density (**Supplemental Figure 3**), and cities had more chain restaurants selling seafood compared with rural areas (**Supplemental Figure 4**).

Next, we mapped the per capita seafood availability for top species (**Figure 4**). Pollock, canned tuna, and shrimp were widely available throughout the United States, which highlights the broad reach of food service distributors and the abundance of chain restaurants. Some species were more regionally focused, such as catfish, which are farmed in Mississippi and Alabama and widely available at chain restaurants in the Southeast. Flounder was more available in the Ohio River Valley than in other regions, which had more to do with species preference than regional supply (flounder is a saltwater species)). Seafood consumption is generally lower in the Midwest than in other regions, and there is a greater preference for meals called "fish" instead of the named species.

Labeling for origin and production methods

We found that 4% of all seafood menu items in our study included information about production method (i.e., wild caught or farmed) (**Table 3**). Overall, 18% of US chain restaurants reported the production method for $\geq$1 seafood menu items. The species most commonly reported as "wild caught" were wahoo, salmon, and pollock. The species reported as "farmed" were catfish and "fish." The most common species without production information were shrimp, salmon, and tuna, which are 3 of the most consumed species in the United States.

There was a lack of information on the geographic origin of seafood. Only 6% of all seafood menu items included information about the origin of the product (Table 3). One-third of US chain restaurants reported the geographic origin of $\geq$1 seafood menu items. The most frequently listed origins of seafood were

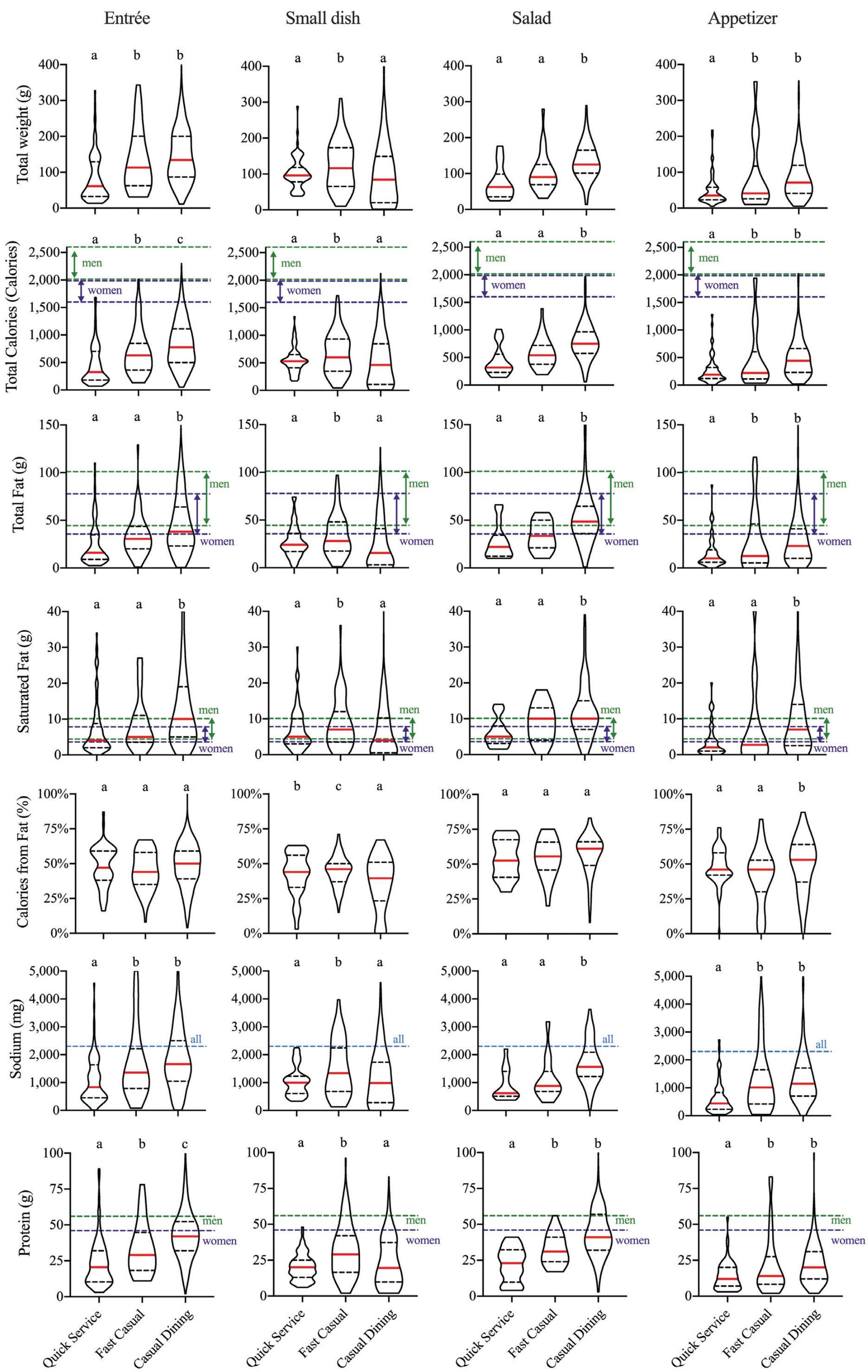

FIGURE 2 The nutritional content of seafood menu items served at US chain restaurants. Red lines: medians; dashed lines: 25th and 75th quartiles. Different letters indicate statistically significant differences by chain restaurant type for a particular meal type using Tukey's multiple comparison test. Horizontal lines represent daily nutritional goals or limits for adult women (purple), adult men (green), and both (blue) based on dietary reference intakes for age and sex groups listed in Supplemental Table 2. Sample sizes were as follows: quick service (entrée, n = 61–96; small dish, n = 50–83; salad, n = 12–16; appetizer, n = 59–63), fast casual (entrée, n = 55–64; small dish, n = 127–134; salad, n = 22–28; appetizer, n = 59–63), and casual dining: (entrée, n = 775–972; small dish, n = 188–256; salad, n = 95–101; appetizer, n = 339–437). Additional nutrients are graphed in Supplemental Figure 1.

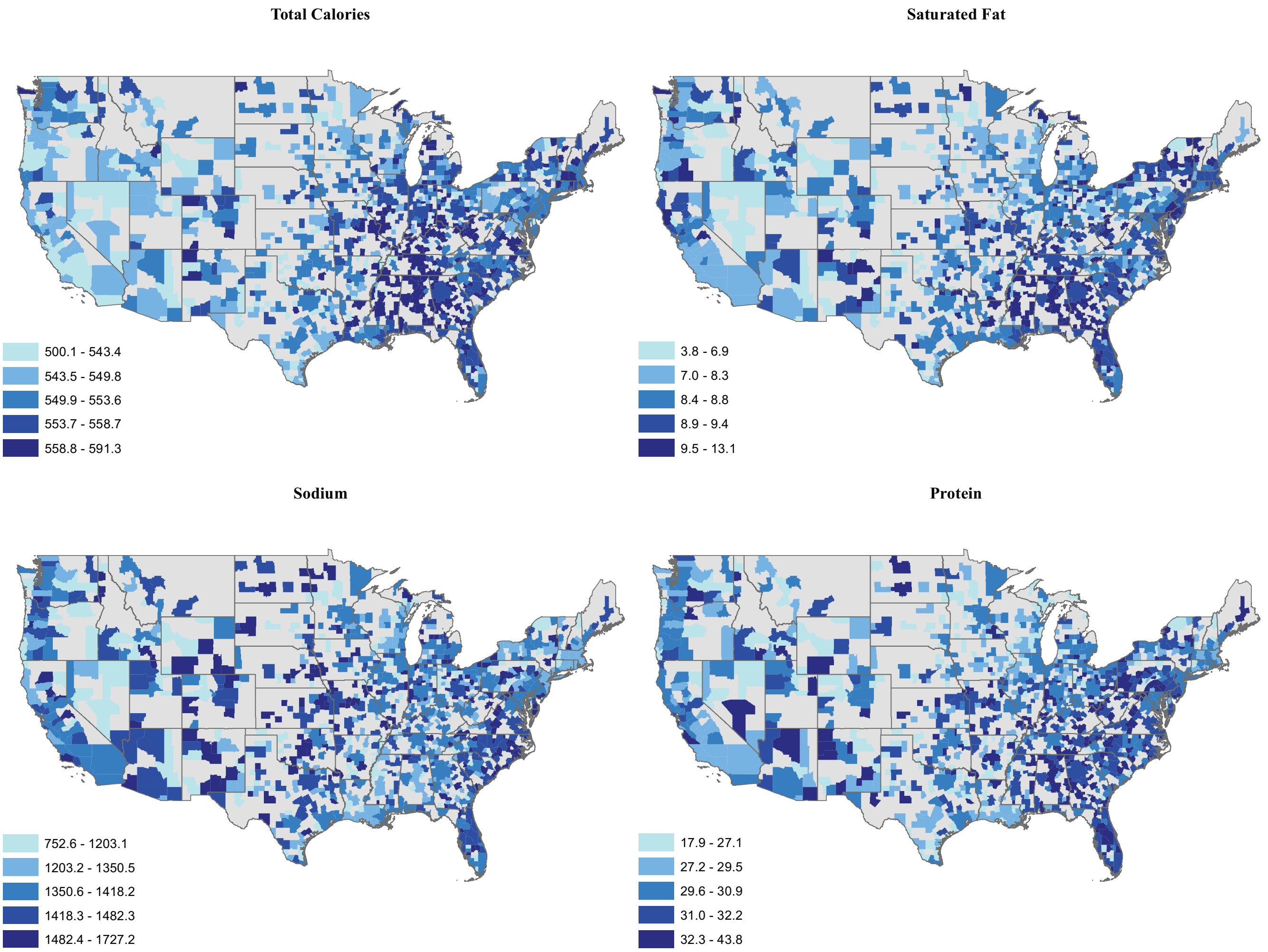

FIGURE 3 Average calories, saturated fat, sodium, and protein per 100 g of seafood meals by CBSA. Sample size: $n = 100{,}948$ chain restaurants located in >900 CBSAs. Color scale: light blue (low) to dark blue (high); gray regions have no store location data. CBSA, core-based statistical area.

Alaska, Maine, Pacific, North Atlantic, and Chile. The origin was provided on the menu most commonly for lobster, pollock, salmon, catfish, and cod. The most common species without origin information were shrimp, salmon, and "fish."

Discussion

Seafood can be both healthy and environmentally sustainable, but this depends on the details of how and from where products are sourced and how meals are prepared and served (25). Restaurant food is a major part of the diet for many Americans. Adult Americans consume 31% of their seafood (by weight) at restaurants (10) and 11% of their total calories from fast food (26); however, selecting nutritious seafood meals can be challenging. In this study of US chain restaurants, many seafood menu items were high in saturated fat and sodium, and some meals exceeded total daily nutritional limits. Higher price point chain restaurants served a more diverse array of seafood species, including species with higher ω-3 concentrations, but their meals were larger in size and higher in total calories and saturated fat per 100 g than seafood meals at lower price point restaurants. There were also regional differences; restaurant chains in the Deep South and Ohio River Valley served meals with more total calories and saturated fat per 100 g than other areas of the country. Ingredients were not reported in the nutrition labeling, but we can assume that high concentrations of saturated fats were not from seafood but, rather, from added ingredients and cooking methods, which affect the healthfulness of seafood meals.

Uncooked seafood is generally low in calories, saturated fat, sodium, and sugar; however, cooking and preparation can significantly modify the nutritional properties of a dish, in some cases negating its healthy properties. There is evidence that cooking under high heat can result in the loss of long-chain ω-3 fatty acids (27). Not only does breading and deep frying fish lead to more calories but also the vast majority (~90%) of the fat content comes from the cooking fat (27). Eating breaded or fried seafood increases risks for sudden cardiac death, congestive heart failure, and stroke compared with eating seafood that is not breaded or fried (28–31), which leads experts to recommend that nonfried seafood and seafood high in ω-3 fatty acids should be consumed to gain cardiovascular benefits (5).

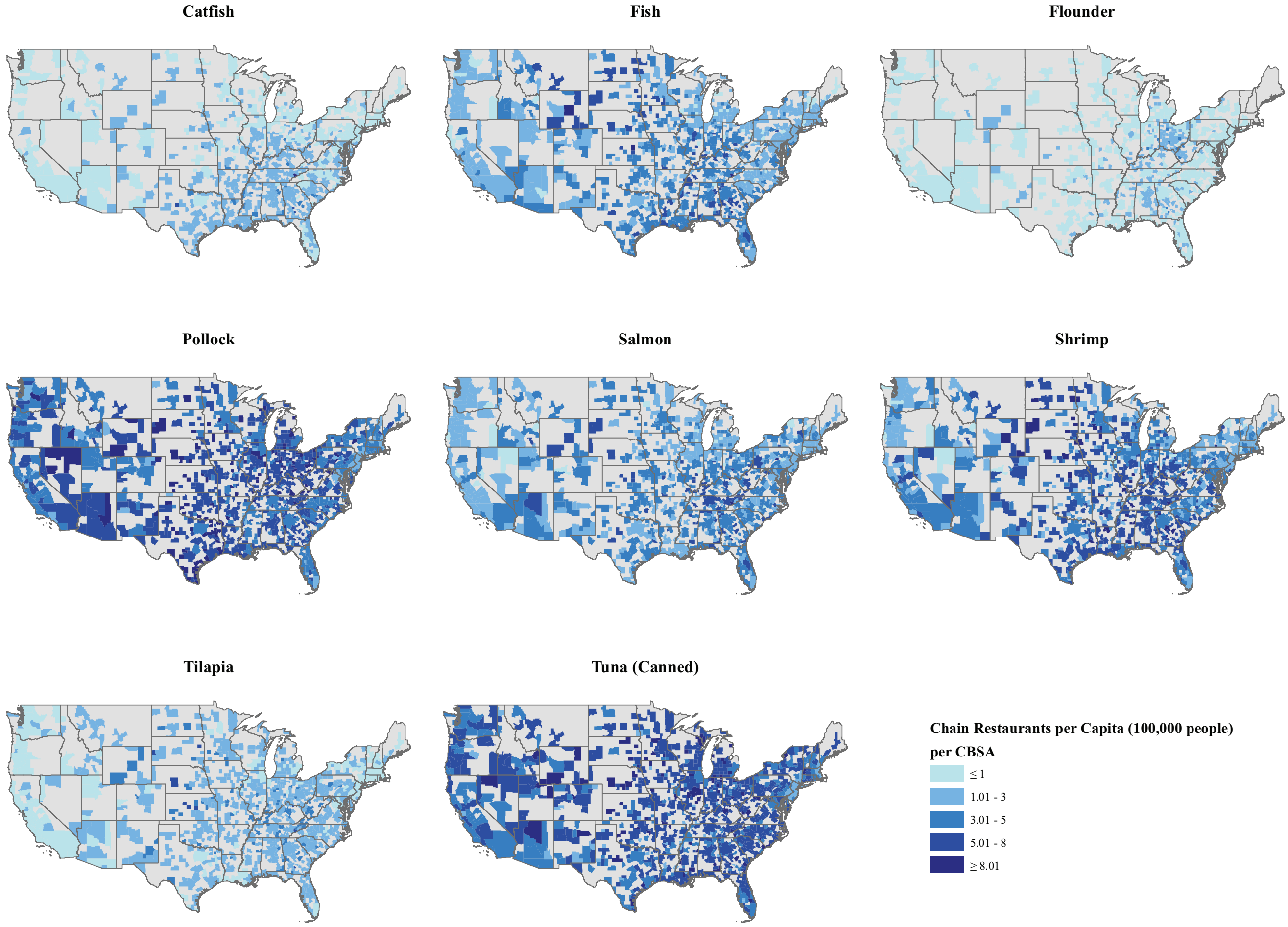

FIGURE 4 The number of chain restaurants per capita (per 100,000 people) selling seafood by CBSA. Sample size: $n = 100{,}948$ chain restaurants located in >900 CBSAs. Color scale: light blue (low) to dark blue (high); gray regions have no store location data. CBSA, core-based statistical area.

During the past three decades, chain restaurant entrées have increased in portion sizes, calories, and sodium, along with the number of items available (32). Large portion sizes and higher energy density and fat content of restaurant meals can contribute to weight gain and obesity (33, 34). Newer menu items in large US chain restaurants have decreased in calories since 2012, but there have been no significant trends toward healthier nutrient profiles of items on the overall menus, suggesting that much work remains to improve the nutritional content of items on chain restaurant menus (35). Given the health concerns regarding some chain restaurant food and the large share of meals eaten at these establishments, there is a clear opportunity to moderate portions and reformulate menu options across the board to facilitate healthier choices when eating away from home. We recommend that US chain restaurants reformulate their seafood menu recipes to reduce portion sizes, total calories, added fat, and sodium to preserve the health benefits otherwise inherent in seafood. Restaurant chains in the Deep South and Ohio River Valley and casual dining chains, specifically, could benefit the most from reformulating recipes.

Consumers are becoming more aware of their food choices, and there is an increasing focus on where and how their food was grown, raised, or caught (36); thus, menu labeling is an important means of communicating with customers. Although nutrition labeling has been almost universally accepted by US chain restaurants following federal government requirements in 2018 (37), labeling seafood for origin and production system is inconsistent and infrequent at US chain restaurants. This is in contrast to US supermarkets, where minimally processed seafood items are required to be labeled with country of origin and production method (38). Labeling seafood serves a number of purposes. Labeling helps businesses differentiate products and can help consumers better understand price signals, which may indicate overfishing or environmental damage in a particular fishery (39), and shifts in demand for more sustainable products can promote better management of fisheries (40). Labeling also allows third-party groups to assess the sustainability of restaurant menus (41); however, the lack of identification of species, origin, and production system would preclude this information from being conveyed to consumers. According to corporate websites,

TABLE 3 Seafood menu labeling at US chain restaurants

Description	n	% of Menu items	% of Restaurants	Most common species
Production method				
No method listed	2,553	96	82	shrimp, salmon, tuna (not canned), fish, lobster
Any method listed	94	4	18	—
Wild caught	83	3	16	wahoo, salmon, pollock, flounder, grouper, cod
Farmed	11	0.4	3	catfish, fish
Geographic origin				
No origin listed	2,485	94	66	shrimp, salmon, fish, crab, lobster
Any origin listed	170	6	34	lobster, pollock, salmon, catfish, cod
Alaska	64	2	18	pollock, salmon, crab, cod, halibut
Maine	23	1	5	lobster
Pacific	8	0.3	4	surimi, salmon, snapper, halibut, crab
North Atlantic	8	0.3	8	lobster, cod, haddock
Chile	7	0.3	4	sea bass, lobster
United States	7	0.3	7	catfish, wild-caught fish
Gulf of Mexico	6	0.2	2	oyster, grouper, shrimp, snapper
Caribbean	6	0.2	6	lobster, cobia
Norway	5	0.2	5	salmon, haddock
Mississippi	3	0.1	3	catfish
Other	21	0.8	—	—

some restaurant chains do source certified seafood products. For example, McDonald's sources Marine Stewardship Council certified products and Red Lobster purchases Best Aquaculture Practices certified products. Red Lobster was also the only chain in this study that partnered to the Seafood Watch Program, a member of the Conservation Alliance for Seafood Solutions, a group dedicated to increasing sustainable sourcing of seafood in developed world markets. Other chains in the study, such as Legal Sea Foods and Bonefish Grill, have a commitment to purchase domestic seafood. However, the overall transparency of chain restaurants participating in designated seafood sustainability programs is limited.

By their nature, chain restaurants purchase in bulk, which limits menu development to those species with a consistent and large supply, low price points, and year-round availability. The farmed salmon and shrimp industries are examples of large-scale production industries with efficient supply chains (42) that have emerged as reliable animal protein sources for chefs. Interchangeability—the replacing of like products from one country with those of another, or one species with others of similar characteristics (e.g., white flaky fish)—is also quite common. Shrimp can be sourced from several countries (e.g., India, Indonesia, Ecuador, Vietnam, China, and Thailand) without much difference in quality. Catfish and tilapia are both sold as generic whitefish at one restaurant chain (43). We also noted "pangasius" or "swai" sold as "catfish," which obscures their origin (typically from Southeast Asia), and products sold as "fish" instead of a named species—the latter was common among restaurant chains in the Midwest. Product interchangeability is important for chain restaurants because this allows for more flexible sourcing and avoidance of price increases tied to specific sources, but it makes it difficult to provide accurate and detailed sourcing information on menus. Renaming or mislabeling reportedly occur in slightly less than one-third of seafood (44), which can negatively impact fisheries if restaurants are replacing products for a less sustainable one, cause consumers to overpay for products, or lead to allergic reactions or exposure to higher concentrations of mercury (45). Technologies exist to enhance seafood traceability, which can increase sustainability of seafood offerings and providing accurate information to consumers (46, 47). Between 63% and 90% of seafood consumed in the United States is imported, increasingly focused on a limited number of species, with much of that being farmed (20, 48). The fact that restaurants rarely list origin and production information makes it difficult for consumers to act on their preferences for wild and domestic species (49–51). More research is warranted on low-income consumers and their seafood preferences and how these relate to the nutritional properties and sustainability.

Availability of seafood may have implications for meeting *Dietary Guidelines* recommendations, particularly for populations in the Midwest and Southeast and low-income consumers who consume less seafood (10, 52). We found regional differences in availability and preferences for certain species; however, more work is needed to understand regional markets for seafood and the role of seafood in regional food systems (53, 54). Although there is a role for these niche markets to support domestic fishers and fish farmers, in a US seafood market dominated by imported fish, the concentration of species also suggests that it is difficult for domestic fishers to secure chain restaurants as outlets for their catch.

There are several strengths and limitations of this study. The findings have high generalizability to the national situation because they capture the majority of the market for chain restaurants selling seafood in the United States, and 89% of these chains also reported nutrition information. Independent restaurants and fine dining chains were not included due to difficulty in collecting their menus and lack of nutrition reporting requirements, which makes our findings not generalizable to these segments. Nutrition labeling was reported per meal, not for each ingredient in a meal. Actual amount consumed may be different than we report—for example, if a consumer purchased and ate 2 fish sandwiches as 1 meal or ate less than a full meal. We also did not track nutrients for side dishes and drinks that could be purchased as part of a combination meal. In addition, we were not able to capture data on fish sold seasonally or as a "catch of the day" but note these often existed at higher price point chain restaurants.

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Data Availability

Data described in the manuscript, code book, and analytic code will be made available upon request.

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