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Handling Practices of Fresh Leafy Greens in Restaurants: Receiving and Training†

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Abstract

Multiple foodborne illness outbreaks have been associated with the consumption of fresh produce. Investigations have indicated that microbial contamination throughout the farm-to-fork continuum often contributed to these outbreaks. Researchers have hypothesized that handling practices for leafy greens in restaurants may support contamination by and proliferation and amplification of pathogens that cause foodborne illness outbreaks. However, limited data are available on how workers handle leafy greens in restaurants. The purpose of this study was to collect descriptive data on handling practices of leafy greens in restaurants, including restaurant characteristics, types of leafy greens used, produce receipt, and food safety training and certification. As a federal collaborative partner with the Environmental Health Specialists Network (EHS-Net) of the Centers for Disease Control and Prevention, the U.S. Food and Drug Administration (FDA) recommended that EHS-Net participants survey handling practices for leafy greens in restaurants. The recommendations in the FDA's *Guide to Minimize Microbial Food Safety Hazards of Leafy Greens* are significant to this study for comparison of the results. The survey revealed that appropriate handling procedures assist in the mitigation of other unsafe handling practices for leafy greens. These results are significant because the FDA guidance for the safe handling of leafy greens was not available until 2009, after the survey had been completed. The information provided from this study can be used to promote additional efforts that will assist in developing interventions to prevent future foodborne illness outbreaks associated with leafy greens.

In recent years, multiple foodborne illness outbreaks have been associated with the consumption of fresh produce (3). Data from the Electronic Foodborne Reporting System of

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the Centers for Disease Control and Prevention (CDC) indicated that 127 foodborne illness outbreaks were associated with leafy greens in the United States from 2004 to 2008. In 61% of these outbreaks, the implicated food item was eaten at a restaurant (2). Of the 127 leafy greens-associated outbreaks in which the pathogen(s) that caused the outbreak was identified, 64% were attributed to norovirus or other viral infections (sapovirus or hepatitis), 19 % were attributed to bacterial pathogens (*Salmonella*, Shiga toxin-producing *Escherichia coli*, or *Campylobacter*), and less than 1% were attributed to parasitic agents (*Cryptosporidium*, *Cyclospora*, or *Giardia*) (2). These data highlight the significant foodborne illness risk posed by leafy greens eaten in restaurants.

Microbial contamination of leafy greens can occur in the field or during harvest and processing (3, 4, 8). Contamination of leafy greens with either bacterial or viral pathogens also can occur at the retail food service level through cross-contamination with other food products or contamination by infected food workers (6, 7). Thus, leafy greens may arrive in restaurants contaminated. Inadequate temperature control of leafy greens during storage or preparation in restaurants may lead to bacterial proliferation, and improper handling by restaurant workers may result in direct contamination (5, 11).

Little is known about how restaurants currently handle leafy greens, and this information is vital to the development of effective prevention and intervention programs to reduce contamination of leafy greens. In 2008, the U.S. Food and Drug Administration (FDA) recommended that the Environmental Health Specialists Network (EHS-Net) of the CDC conduct a descriptive study to examine handling practices for leafy greens at the retail food service level. Thus, the purpose of this study was to collect descriptive data on handling practices for leafy greens in restaurants. This study specifically focused on receiving, storing, washing, preparing, and serving practices.

To prevent foodborne illness outbreaks associated with leafy greens, restaurants should handle leafy greens in ways that minimize the risk of pathogen contamination and proliferation. In 2009, after EHS-Net completed the descriptive study of handling practices for leafy greens, the FDA drafted and released the *Guide to Minimize Microbial Food Safety Hazards of Leafy Greens* (9). This guidance includes recommended practices for reducing microbial hazards associated with leafy greens throughout the farm-to-fork continuum. In 2009, the FDA also released a revised model Food Code (10) that defined cut leafy greens as a potentially hazardous food (PHF) requiring time and temperature control for safety (TCS). These provisions in the 2009 Food Code were developed specifically for cut leafy greens because the internal fluid and nutrients that are exposed after cutting provide a medium that supports the growth of pathogens when leafy greens are held without temperature control.

Recommendations taken from the FDA's *Guide* that are significant to this article for comparison of study results include the following.

- i. Consider not using leafy greens with visible signs of decay or damage because of the increased risk of the presence of human pathogens.
- ii. Store and display cut leafy greens under refrigeration throughout distribution to enhance the safety and quality of the product.

- iii. Maintain documentation related to operational information about the product and practices and product tracing information.
- iv. Develop training programs that will educate all potential handlers of leafy greens in restaurants regarding the importance of food safety and the FDA's recommendations.

These recommendations identified some but not all of the preventive measures that restaurants may take to minimize food safety hazards (9). In this study, data were collected on restaurant characteristics, types of leafy greens used, handling practices for leafy greens during receiving, food safety training (specific to handling of leafy greens), and food safety certification.

MATERIALS AND METHODS

Data source

This study was conducted August 2008 to May 2009 by EHS-Net, a network of environmental health specialists focused on the investigation of environmental factors contributing to foodborne illness outbreaks, including food preparation practices. EHS-Net is a collaborative project of the CDC, the FDA, the U.S. Department of Agriculture (USDA), and state and local health departments. At the time this study was conducted, the EHS-Net sites included parts of California, Connecticut, New York, Georgia, Iowa, Minnesota, Oregon, Rhode Island, and Tennessee.

Sample

The sample for this study consisted of approximately 50 randomly selected restaurants located in predefined geographical areas at each EHS-Net site, resulting in a sample of 439 restaurants. We used simple random sampling in the Statistical Package for the Social Sciences (SPSS 16.0.2, SPSS, Chicago, IL) to select the restaurant samples from restaurant lists provided by the EHS-Net participants. EHS-Net defined a restaurant as an establishment that prepares and serves food to customers. Restaurants in this context did not include institutions, food carts, mobile food units, temporary food stands, restaurants within supermarkets, or caterers. Restaurants that did not prepare and serve fresh leafy greens also were excluded from the study. Only one restaurant from any given regional or national chain was included for each EHS-Net site. For example, if chain A had three restaurants at an EHS-Net site, only one of those restaurants would be eligible to participate in the study. Because of resource constraints, data collectors collected data in only those restaurants with English-speaking kitchen managers.

Data collection

Data were collected from August 2008 to May 2009. The CDC Institutional Review Board and the appropriate review boards at the participating sites cleared the study protocol. Data collection was anonymous, and all data collectors (EHS-Net environmental health specialists) participated in trainings designed to increase data collection consistency. Data collectors solicited restaurant participation by contacting randomly selected restaurants via telephone using a standardized recruiting script.

The data collectors first determined whether the restaurants prepared and served fresh leafy greens. For the purposes of this study, the term “leafy greens” included iceberg lettuce, romaine lettuce, leaf lettuce, butter lettuce, baby leaf lettuce (i.e., immature lettuce), escarole, endive, spring mix, spinach, cabbage, kale, arugula, and chard. Such herbs as cilantro and parsley were not considered leafy greens.

If the restaurants prepared and served fresh leafy greens, the data collectors requested their participation in the study, arranged to visit the restaurant to conduct an on-site interview with a kitchen manager, and observed the kitchen and food workers handling leafy greens.

Once at the restaurant, data collectors interviewed kitchen managers about restaurant characteristics, types of leafy greens used, food safety training and certification, and handling practices for leafy greens, i.e., receiving, storage, washing, preparation, and serving.

Interview data were collected on the following receiving practices: source (e.g., the general distributor or grocery store), how the leafy greens were obtained (by delivery or pick-up), whether the leafy greens were delivered in a refrigerated truck, how often the leafy greens were delivered, how many pounds of leafy greens were included in each delivery, the packaging type, whether leafy greens purchase records were kept and if so what type of records and how long they were kept, and whether and why the restaurant had ever rejected a shipment of leafy greens. Data collectors also measured the temperature of any leafy green shipments found in receiving areas during the observation visit. For small loose leafy greens, a thermocouple was placed in the middle of the container; for prepackaged ready-to-eat leafy greens or leafy greens with large leaves, bags or leaves were wrapped around the thermocouple (fold-testing method).

Data analysis

Descriptive statistics (frequencies and medians) were obtained with the Stata/SE version 10 software package (StataCorp, College Station, TX) and PASW Statistics 18 (SPSS). Because of missing data and multiple responses for some questions, percentages were based on different totals across analyses. Requirements for temperature control of PHF/TCS foods differed by EHS-Net site from 41 to 45°F (5 to 7.2°C); therefore, 45°F was used as the upper limit for temperature requirements for PHF/TCS leafy greens.

RESULTS

Restaurant demographics

A total of 439 restaurant kitchen managers agreed to participate in the study. Sixty-six percent of eligible contacted restaurants agreed to participate. This percentage was based on data from eight of the nine EHS-Net sites; participation data were unavailable for one site. Sixty-one percent (269 of 439) of restaurants were categorized as prep serve (food items prepared and served without a kill or cook step), 30.3% (133) were cook serve (food items prepared for same-day service and involved a kill or cook step), and 8.4% (37) were complex (food items prepared required a kill or cook step and holding beyond same-day service or a kill or cook step and some combination of holding, cooling, reheating, and

freezing). More than half (68.1%, 299) of restaurants were independently owned, and 31.9% (140) were chains or franchises. Of the restaurants surveyed, 51.3% (225) reported serving 1 to 100 meals per day, 40.3% (177) served 101 to 500 meals per day, and 8.2% (36) served more than 500 meals per day. The menu types reported were American (70.8%, 311 restaurants), Asian (5.5%, 24), Italian (7.1%, 31), Mexican (11.2%, 49), a combination of menu types (0.9%, 4), and other (continental, Ecuadoran, French, German, Greek or Mediterranean, fusion, international, and Middle Eastern) (4.6%, 20).

Types of leafy greens served

Iceberg lettuce, romaine lettuce, and spring mix or other mix are primarily prepared for fresh consumption in restaurants (Table 1). Kitchen managers indicated that leafy greens were most commonly used in salads (88.8%, 390 restaurants) and on sandwiches or wraps (78.8%, 346). Kitchen managers indicated that leafy greens were used as a garnish on a dish (21.9%, 96), on self-serve salad buffets (5%, 22), in burritos or tacos (2.3%, 10), and for other items (e.g., uncooked spring roll) (2.1%, 9).

Leafy greens receiving

Restaurants received leafy greens from a variety of sources, including grocery stores, local farms, and corporate distributors (Table 2). Kitchen managers (483) indicated that leafy greens were delivered to the restaurant (73.1%, 353 restaurants) and/or picked up from a supplier (26.9%, 130). They also reported receiving 1 to 10 types of packaged leafy greens in their restaurants. Leafy greens were most commonly received in sealed plastic bags, unwaxed cardboard boxes, and waxed cardboard boxes (Table 3).

Two percent (7 of 439) of kitchen managers reported receiving leafy green deliveries less than once per week, 26.2% (115) reported receiving leafy green deliveries once per week, 36.2% (159) reported receiving leafy green deliveries twice per week, 21% (92) reported receiving leafy green deliveries three times per week, 6.2% (27) reported receiving leafy green deliveries four times per week, and 8.9% (39) reported receiving leafy green deliveries daily. Seventy-eight percent (330 of 422) of kitchen managers indicated that leafy greens were delivered on a refrigerated truck.

Table 4 shows weight of leafy greens received in each delivery. Thirty-one percent (136 of 433) of kitchen managers commonly reported receiving 21 to 50 lb (10 to 23 kg) of leafy greens per shipment. Only 6% (26) reported receiving 100 lb (45 kg) or more of leafy greens per shipment.

Sixty-five percent (266 of 411) of kitchen managers indicated that their restaurants had rejected a shipment of leafy greens upon receipt, and 7% (28) of kitchen managers were unsure whether their establishments had ever rejected shipments. Kitchen managers indicated a number of conditions why leafy greens were rejected: appearance (browning, wilting, tears, rot, mold, and/or dirt) (96.6%, 257 of 266), product moisture (soggy or dripping) (26.3%, 70), bad aroma or taste (10.9%, 29), required label missing (8.3%, 22), product out of temperature range (7.5%, 20), and other conditions such as insects, unapproved supplier, and damaged packaging (8.6%, 23).

Ninety-three percent (409 of 438) of kitchen managers indicated purchase records were kept for received shipments of leafy greens. Kitchen managers who kept purchase records indicated that several kinds of records were maintained, resulting in a total of 1,395 responses. Sixty-nine percent (283 of 409) of kitchen managers indicated that they kept invoices, 34.7% (142) kept purchase receipts, 20.3% (83) kept delivery receipts, and 3.2% (13) kept other kinds of records (e.g., lot numbers, labels, origin information, and computer files). Kitchen managers who kept records also indicated the length of time those records were kept, for 359 total responses. Fifty kitchen managers indicated that they were unsure about how long records were kept. Of the 359 kitchen managers who knew how long records were kept, 47% (170) kept them >2 years, 25.3% (91) kept them >1 to 2 years, 7% (25) kept them 7 to 12 months, 11.7% (42) kept them 2 to 6 months, 2.8% (10) kept them 1 month, and 5.8% (21) kept them <1 month.

Data collectors also observed and took actual product temperatures from 37 leafy green shipments in receiving areas. Ambient temperatures of the refrigerated trucks that transported the leafy green shipments were not taken. Forty-nine percent (18) of the shipments were received at 41°F (5°C), 24.3% (9) were received at 42 to 45°F (5.6 to 7.2°C), 18.9% (7) were received at 46 to 54°F (7.8 to 12.2°C), and 8.1% (3) were received at 55°F (12.8°C).

Training and food safety certification for leafy greens

Eighty-one percent (354 of 439) of kitchen managers indicated receiving instruction or training on how to handle leafy greens. Fifty-four percent (194 of 354) received instructions on the job, 54.8% (194) through food safety certification programs (registries such as Environmental Health Testing LLC, Orlando, FL; National Restaurant Association Solutions LLC, Chicago, IL; and Prometric Inc., Baltimore, MD), 14.7% (52) through a class or course, 9.3% (33) by posted instructions or materials, 6.8% (24) from videos, 5.4% (19) from computer-based or online training, 4.2% (15) through company materials or instruction, 1.7% (6) from health department materials or instructions, and 1.7% (6) from instructions from other sources (e.g., food worker card, supplier, military, and produce company).

Eighty-four percent (366 of 435) of kitchen managers indicated that food workers in their restaurants received instructions on handling leafy greens; 94% (345) of these 366 kitchen managers indicated that food workers received instructions on handling leafy greens on the job, 10.7% (39) through food safety certifications, 10.4% (38) from posted instructions or materials, 7.9% (29) from videos, 5.5% (20) from a class or a course, 2.7% (10) from computer-based or online training, 2.2% (8) from company materials, 0.8% (3) from previous work or training, and 0.2% (1) from another source (e.g., food worker card).

A total of 423 responses were received when kitchen managers were asked how many kitchen managers in their establishment were food safety certified; 31% (132) of the 423 restaurants had no kitchen managers that were certified in food safety, 33% (141) had one kitchen manager certified, 21.7% (92) had two kitchen managers certified, 7.6% (32) had three kitchen managers certified, 5% (21) had four kitchen managers certified, and 3.1% (13) had five or more kitchen managers certified.

DISCUSSION

This study provides valuable knowledge about restaurant characteristics, the types of leafy greens used, handling practices for leafy greens during receiving, and food safety training and certification of restaurant employees in the handling of leafy greens. The kitchen manager interview data indicated that at the time of data collection some restaurants were taking measures to minimize food safety hazards associated with handling of leafy greens. This finding was particularly encouraging because when this study was developed and conducted little guidance was available that specifically addressed the concerns associated with safe handling of leafy greens. However, after completion of this study the FDA released guidance with recommendations that can be tailored to food safety practices based on the assessment of potential food safety hazards along the farm-to-fork continuum (9).

More than 70% of kitchen managers described their restaurant's menu type as American. The primary uses of leafy greens in restaurants were in salads (90%) and on sandwiches or wraps (79%). Most restaurants received 1 to 50 lb (0.5 to 23 kg) of leafy greens twice per week, and kitchen managers identified more than 11 types of leafy greens used at their respective restaurants. The handling practices do not appear to differ significantly by leafy green type, although cut leafy greens provide a medium that readily supports the growth of pathogens and thus pose a greater risk than uncut leafy greens.

Most kitchen managers (65%) indicated that their restaurant had rejected a shipment of leafy greens because of their appearance at delivery. This indicates a positive trend in quality assurance among kitchen managers. However, it was unclear whether kitchen managers were rejecting shipments of leafy greens solely based on their appearance. The FDA has recommended that food services refrain from using leafy greens with visible signs of decay or damage because decomposition, damage, and/or lesions may act as harborage for pathogens (9).

The process of accepting or rejecting leafy greens differed among kitchen managers. Industry and food safety regulatory officials should consider collaboratively developing a written guideline that includes detailed illustrations that explicitly describe when shipments of leafy greens should be rejected. This protocol could be used as a standardized guide to ensure consistency for accepting leafy greens in restaurants. Such a guideline will help reduce the health risk incurred when kitchen managers accept substandard leafy greens, which may be more likely to be contaminated with pathogens that could have proliferated at some point between the farm and the restaurant.

The majority of kitchen managers (78%) indicated that leafy greens were delivered in a refrigerated truck. Temperature control through refrigeration is an important way to control pathogen proliferation. The FDA recommends that cut leafy greens be stored under refrigeration throughout the distribution chain. Although the present study design did allow distinguishing between cut and uncut leafy greens during distribution and receiving, the findings suggested that almost 50% of the leafy greens arrived at the restaurant at temperatures above 41°F (5°C) and almost 30% arrived above 45°F (7.2°C). Although many shipments of leafy greens were delivered to restaurants at or below 41 to 45°F, acceptance

of leafy greens at temperatures above 45°F was discouraging because such temperatures could support the amplification and proliferation of pathogens. Risk factors associated with amplification and proliferation could lead to foodborne illness outbreaks and thus adversely affect public health.

Restaurants received leafy greens from various sources. Most kitchen managers (93%) indicated that they kept source or purchase records for leafy greens. Thus, many restaurants were already following the FDA's recommendation of maintaining documentation and records that would facilitate traceback of leafy greens during an outbreak.

More than 80% of kitchen managers and food workers indicated they received training in the safe handling of leafy greens; however, no data were collected on what the training entailed and whether it met the FDA's current recommendations on handling of leafy greens. Studies such as "The Impact of Local Environmental Public Health Capacity on Foodborne Illness Morbidity in Maryland" (12) indicated that food safety programs with highly trained food worker regulations had a lower estimated risk of foodborne illness than did food safety programs that did not have regulations in place. The FDA recommends training programs targeting leafy greens for all potential handlers of leafy greens (9). Industry and food safety regulatory officials should consider developing a standardized protocol describing what information and practices should be covered in the training, especially on-the-job training, to improve basic knowledge related to safe handling of leafy greens.

This study had several limitations. First, the findings cannot be generalized beyond the restaurants included in the study. Second, this only restaurants with English-speaking kitchen managers were included. Future research in this area should include non-English-speaking kitchen managers to ensure accurate representation of the food service worker population. Third, the data collectors were unable to observe most of the deliveries of leafy greens and restaurant procedures during receiving because they did not know the delivery schedules for the restaurants surveyed. Delivery days and times differed among restaurants, and the opportunities for observing receiving practices were limited.

The study results allowed identification of leafy green handling practices that should be improved in the surveyed restaurants. First, the process of accepting or rejecting leafy greens differed among kitchen managers. The FDA's *Guide to Minimize Microbial Food Safety Hazards of Leafy Greens* lists the following recommends for retail kitchen managers.

- i. Consider not using leafy greens with visible signs of decay or damage because of the increased risk of the presence of human pathogens.
- ii. Understand that decayed or damaged leafy greens and lesions caused by plant pathogens may act as harborage for human pathogens.
- iii. When in doubt about the use of decayed or distressed product, either remove the unusable portions or do not use the leafy greens.

Kitchen managers and food workers were encouraged to use illustrations depicting the range of quality of leafy green products received at a restaurant upon delivery and indicating

which products should be accepted, which could be used if outer leaves were removed, and which products should be rejected. A visual learning tool such as this may help kitchen managers and food workers become more consistent in their decisions when reviewing a delivery. Where this learning tool is not readily accessible, possible improvements in its distribution to retail restaurants should be considered.

Interviews revealed that certified kitchen managers were not present in restaurants at all times. Many kitchen managers (33.3%) reported that their restaurant had only one certified kitchen manager on staff, and 31.2% (132 of 423) of kitchen managers reported that their restaurant did not have any certified kitchen managers on staff. For some restaurants, the lack of a certified kitchen manager on duty could be problematic. For example, restaurants that had only one certified kitchen manager on staff would have times when that person is not on site. A certified kitchen manager can provide oversight and knowledge that can reduce the risk of contamination and proliferation of pathogens during receiving, storing, and handling of leafy greens (12).

More than half (194 of 354) of kitchen managers interviewed reported receiving on-the-job training; however, the on-the-job training related to leafy greens could not be evaluated in this study. The on-the-job training related to leafy greens that was received by food workers from kitchen managers (the most common type of training cited in this study) also could not be assessed. A standardized educational protocol should be developed for kitchen manager and food worker training conducted on the job to improve basic knowledge related to handling of leafy greens.

In 2010, California state legislation was passed that required that nearly all of the more than 1 million food handlers in the state become certified in safe food handling practices (1). Prior to the state-implemented mandate, the San Diego County Department of Environmental Health was charged with monitoring the education of all food handlers in that county. In 2003, that department surveyed 1,200 food workers about major violations, food safety risk factors during inspections, and food handler training materials. Five years later, the survey was repeated, and the department found a more than 60% decrease in violations at restaurants and a 50% increase in food handler knowledge. The assistant director of the county department concluded that most restaurants improved their standard operating procedures and training, which were reinforced by the presence of a certified food safety manager.

Overall, this study provides valuable baseline data on how restaurants handled leafy greens before the issuance of the FDA guidance documents in July 2009. Additional research is needed for specific assessment of handling practices for cut leafy greens in restaurants because of the recent updates in guidance. Findings from the current study are reassuring: kitchen managers were already implementing many safe handling practices for leafy greens. Food safety education and training materials should be updated to ensure that kitchen managers and food workers understand and follow current guidance specific to the handling of leafy greens.

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TABLE 1

Types of leafy greens prepared in restaurants as reported by kitchen managers

Type of leafy greens	No. (%) of restaurants ^a
Iceberg lettuce	281 (64.0)
Romaine lettuce	260 (59.2)
Spring mix or other mix	163 (37.1)
Leaf lettuce	125 (28.5)
Spinach	104 (23.7)
Cabbage	87 (19.8)
Arugula	16 (3.6)
Butter or Boston lettuce	13 (3.0)
Endive	10 (2.3)
Baby leaf lettuce	10 (2.3)
Lettuce, carrot, and red cabbage	5 (1.1)
Other ^b	20 (4.6)

^aN = 439. Respondents could choose more than one leafy green type; thus, the total percentage adds to more than 100.

^bOther types included red oak lettuce, chard, frisée, watercress, escarole, kale, radicchio, micro greens, and alfalfa.

TABLE 2

Restaurants' source of leafy greens as reported by kitchen managers

Source	No. (%) of restaurants ^a
General distributor	241 (54.9)
Produce distributor	154 (35.1)
Wholesale store	61 (13.9)
Grocery store	51 (11.6)
Local or seasonal supplier, farm	18 (4.1)
Corporate distributor, commissary	14 (3.2)

^aN = 439. Respondents could choose more than one source; thus, the total percentage adds to more than 100.

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TABLE 3

Packaging of leafy greens shipments received at restaurants as reported by kitchen managers

Type of packaging	No. (%) of restaurants
Sealed plastic bag	653 (47.0)
Unwaxed cardboard box	318 (22.9)
Waxed cardboard box	203 (14.6)
Individual film wrap	112 (8.1)
Plastic bag (unsealed or with holes)	52 (3.7)
Plastic tub, cambro, clamshell	28 (2.0)
Wooden, paper, cardboard, or other	11 (0.8)
Paper	8 (0.6)
No packaging, loose	4 (0.3)
Total	1,389 (100.0)

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TABLE 4

Pounds of leafy greens received with each delivery to the restaurant as reported by kitchen managers

Pounds (kg^a)	No. (%) of restaurants
1–10 (0.5–5)	106 (24.5)
11–20 (5–9)	108 (24.9)
21–50 (10–23)	136 (31.4)
51–100 (23–45)	57 (13.2)
100+ (45+)	26 (6.0)
Total	433 (100.0)

^a Approximate weights.

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