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The Accuracy of Stated Energy Contents of Reduced-Energy, Commercially Prepared Foods

Lorien E. Urban, MS, Gerard E. Dallal, PhD, Lisa M. Robinson, RD, Lynne M. Ausman, DSc, RD, Edward Saltzman, MD, and Susan B. Roberts, PhD

L. E. Urban is a doctoral degree student, E. Saltzman is chair, Department of Nutritional Sciences, and L. M. Ausman is Saqr bin Mohammed Al Qasimi Professor in International Nutrition, Gerald J. and Dorothy R. Friedman School of Nutrition Science and Policy, Tufts University, Boston, MA. G. E. Dallal is director, Biostatistics Unit, L. M. Robinson is a research dietitian, and S. B. Roberts is director, Energy Metabolism Laboratory, Jean Mayer US Department of Agriculture Human Nutrition Research Center on Aging, Tufts University, Boston, MA

Abstract

The accuracy of stated energy contents of reduced-energy restaurant foods and frozen meals purchased from supermarkets was evaluated. Measured energy values of 29 quick-serve and sit-down restaurant foods averaged 18% more than stated values, and measured energy values of 10 frozen meals purchased from supermarkets averaged 8% more than originally stated. These differences substantially exceeded laboratory measurement error but did not achieve statistical significance due to considerable variability in the degree of underreporting. Some individual restaurant items contained up to 200% of stated values and, in addition, free side dishes increased provided energy to an average of 245% of stated values for the entrees they accompanied. These findings suggest that stated energy contents of reduced-energy meals obtained from restaurants and supermarkets are not consistently accurate, and in this study averaged more than measured values, especially when free side dishes were taken into account. If widespread, this phenomenon could hamper efforts to self-monitor energy intake to control weight, and could also reduce the potential benefit of recent policy initiatives to disseminate information on food energy content at the point of purchase.

The prevalence of obesity has risen markedly in the past 30 years (1), and energy intake has also risen substantially during this period (2,3). Reducing energy intake is therefore a cornerstone of weight management (4,5), and self-monitoring of food intake is widely recommended to facilitate success (6,7). However, achieving energy intake goals through self-monitoring depends on the accuracy of energy information available for consumed foods.

All foods, including those prepared at home, may potentially introduce error in self-monitoring of energy intake, but ready-prepared foods purchased from restaurants and supermarkets may be an area of particular concern. Consumption of these foods has increased in recent years (8,9), and meals purchased away from home are reported to contain more energy than home-prepared foods (10–14). Furthermore, information on the energy content of restaurant foods is provided without any required verification or oversight (15,16). Two recent media reports (17,18) suggested that the true energy contents of restaurant meals may be considerably more

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Address correspondence to Susan B. Roberts, PhD, Energy Metabolism Laboratory, Room 1312, Jean Mayer, US Department of Agriculture Human Nutrition Research, Center on Aging, Tufts University, 711 Washington, St, Boston, MA 02111. susan.roberts@tufts.edu.

STATEMENT OF POTENTIAL CONFLICT OF INTEREST:

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than the amounts of energy stated by the vendors, a suggestion that has important implications but is at odds with the results of a previous study (19). Inaccuracies in reported food energy content, if replicated, could contribute to inadvertent overeating, hamper efforts to use self-monitoring for weight control, and reduce the usefulness of recent government initiatives to make information on the energy content of restaurant foods available at the point of purchase (20–22).

A pilot study was therefore conducted to assess the accuracy of reported energy contents of restaurant and supermarket foods with reduced energy suitable for weight control.

METHODS

This study involved measurement of the energy content of 39 commercially prepared restaurant foods and supermarket frozen convenience meals obtained in the Boston, MA, area, and comparison of measured values with nutrition information stated by the vendor or manufacturer. The restaurant chains included in the study were selected as a convenience sample of quick-serve and sit-down restaurant chains with broad distribution throughout the United States who provided information on nutrient contents (or reliable information was available from other Web sites). Because the goal of the study was to examine the accuracy of stated energy contents of foods apparently favorable for weight control, specific restaurant menu items were chosen based on three criteria: having <500 kcal, being typical American foods, and having among the lowest stated energy contents on the menu. Supermarket purchases were focused on frozen complete meals that would be alternative choices to eating out. All items were purchased between December 2007 and June 2008. This study was deemed exempt under federal regulation 45 CFR §46.101(b).

Food Collection and Analysis

One unit of each food item was purchased and transported upright in the original container to the research center. Whole food items were weighed to determine portion size, homogenized, freeze dried (Virtis Benchmark 1000 Lyophilizer, Virtis Co, Gardiner, NY), ground to a fine powder, and then analyzed in duplicate for gross energy using an Isoperibol Bomb Calorimeter (Parr model 1261, Parr Instrument Co, Moline, IL). Weights obtained throughout the sample preparation were used to adjust for small food losses at different stages of processing. Benzoic acid standards (Benzoic Acid 1g pellets, Parr Instrument Co, Moline, IL) were analyzed and values were within 1% of the known heat of combustion for benzoic acid. The gross energy content of each food was calculated by multiplying the average kilocalories per gram of dry solids by the total weight of dry solids.

Food Standards

Two test “meals” were created out of basic food items with consistent composition (white wheat flour, granulated white sugar, corn oil, and nonfat dry instant milk) at three energy levels and with macronutrient balances spanning the range of test foods. The test meals were processed for energy content as described above and analyzed for energy content. Mean measured energy values were $-1.9\% \pm 0.3\%$ of values calculated from stated compositions of the individual ingredients, demonstrating the accuracy and precision of the methodology used for direct measurements of food energy content.

Calculations

Bomb calorimetry directly measures the heat of combustion of a food and thus gives values for gross energy (23), whereas stated food values are metabolizable energy estimations (ie, gross energy corrected for assumed obligatory energy losses before energy is available to the body). Therefore, it was first confirmed that stated metabolizable energy contents in study

foods could be reliably calculated from stated macronutrients, and then gross energy was calculated for each food item from stated macronutrients using the US Department of Agriculture multiplicative factors appropriate for mixed foods (24). This conversion introduced no error to the comparison and allowed measured values to be compared directly with values calculated from stated macronutrients (henceforth called stated values). One restaurant reported energy and all macronutrients except protein, which was calculated by subtraction. Two other restaurants reported only energy, fat, and fiber. For these two restaurants the carbohydrate content from www.calorieking.com was adopted and protein content was calculated by subtraction. This Web site employs registered dietitians who perform independent calculations, including using the US Department of Agriculture database (25), and thus the information was deemed acceptable. Gross energy values are henceforth called energy in the text for simplicity.

For foods that provided a portion weight on the restaurant Web sites or food package, stated values were compared to actual served portion weight as measured in the laboratory. For some analyses, measured energy values were adjusted for portion size discrepancies by multiplying the measured gross energy value by the percent difference in portion size.

Data Variables

Exploratory quantitative variables (eg, cost of food item, cost per kilocalorie, and restaurant size) and categorical variables (eg, whether the item was a free side dish or entrée, restaurant type was quick-serve or sit-down, or whether the meal would typically be eaten for breakfast or lunch/dinner) were assigned to food items. Cost of food was the menu price at the time and place of purchase, and restaurant size was the total number of locations as indicated in the annual report for each company. Free side dishes were defined as food items accompanying the entrée that were not specifically ordered. Menus typically listed these items as accompaniments with the entrée, but the Web site energy information for side dishes was listed separately from the entrée, or in one case, not at all. Sit-down restaurants were defined as those where table service from wait staff was available. Restaurants not meeting this criterion were considered quick-serve.

STATISTICAL METHODS

Although formal statistical methods do not apply to convenience samples, standard statistical tests were employed to summarize the data for exploratory purposes and to suggest directions for future study. Differences in energy content (measured vs stated) were therefore compared by using two-sided *t* tests of whether the observed mean was within sampling variability of zero. Multifactor analysis of variance was used to examine potential predictors of the percent difference between stated and measured energy for restaurant foods. Statistical significance was set at $P < 0.05$ (two sided). Statistical analyses were performed by using SAS version 9.1 (2002, SAS Institute Inc, Cary, NC).

RESULTS AND DISCUSSION

The energy contents of individual foods are given in the Table, and Figure 1 illustrates percent differences between measured and stated values. On average, restaurant foods contained 18% more energy than stated; however, there was substantial variability in the difference between measured and stated values, and some foods contained twice as much energy as stated. The measured energy content of supermarket-purchased meals was also greater than stated values, by 8%. There was no statistically significant difference between measured and stated values in either restaurant foods ($P = 0.12$) or supermarket meals ($P = 0.12$), and no significant difference between the mean accuracy of restaurant vs supermarket foods ($P = 0.64$). However, the difference between the standard deviation of the energy discrepancies in restaurant vs

supermarket foods approached significance ($P = 0.06$) and became significant once the energy discrepancies were adjusted for discrepancies of portion size ($P = 0.05$). Thus, there is more uncertainty regarding stated energy values in restaurant foods than in supermarket packaged foods. Five restaurants provided side dishes at no extra cost. The mean additional energy provided by these items was 471 ± 167 kcal, which was greater than the 443 kcal mean value for the entrées they accompanied. Portion size discrepancies (measured minus stated values) were a significant predictor of percent energy difference between measured and stated energy contents values when added to the model predicting provided food energy ($P < 0.0001$), indicating that greater portions than stated did contribute to the energy discrepancy.

There was no statistically significant association between differences in measured vs stated energy based on whether the item was a side dish or an entrée, type of restaurant (quick-serve or sit-down), meal at which the food is usually consumed (breakfast or lunch/dinner), restaurant size (number of franchises), cost per unit calculated energy content, or where the meal was purchased (restaurant or supermarket). It should also be noted that, since single samples of each food were obtained, the variability in results pertains to the general sample of foods studied, and individual results cannot be attributed to specific restaurants and brands of foods.

These results indicate that, in contrast to two recent reports in the media (17,18), restaurant meals and prepared meals purchased in US supermarkets do not typically contain substantially more energy than stated. However, measured energy values did average 18% higher in restaurant foods and 8% higher in supermarket meals than stated. The underreporting of energy by restaurants and food manufacturers notwithstanding, the majority of foods tested were not out of compliance with US Food and Drug Administration regulations because most fell within the 20% overage the Administration allows for packaged food (no ceiling of overage is specified for restaurant foods). In relation to this observation, it should be noted that, as outlined in Figure 2, the US Food and Drug Administration considers noncompliance in packaged foods to include food energy (average of 12 samples) in excess of 120% of stated energy or <99% of stated weight (average of 48 samples) (26,27), which because of greater leniency in standards on the side of overprovision compared to underprovision, may contribute to provided energy values being greater than measured. It should also be noted that three individual supermarket-purchased meals and seven restaurant foods did contain up to twice the stated energy, so some individual discrepancies were substantial.

The extra mean measured energy in this study compared to stated information may cause substantial weight gain over time. For example, positive energy balance of only 5% per day for an individual requiring 2,000 kcal/day could lead to a 10-lb weight gain in a single year. It is also notable that free side dishes on average contained more energy than the entrées alone. It is unclear whether consumers are aware of how much energy free side dishes contain, and providing more accessible information on meal energy contents both with and without side dishes could help increase attention to the potential of these casual food items to more than double meal energy intake.

CONCLUSIONS

Mean measured energy contents of reduced-energy restaurant and supermarket meals in this pilot study exceeded vendor-stated amounts by substantially more than could be accounted for by laboratory measurement error. Although the discrepancies were within acceptable limits based on federal regulations for most packaged and restaurant foods (which are not subject to these federal regulations) some restaurant foods did have measured energy contents that were double those stated by the restaurant, and free side dishes contained more energy on average than the entrées they accompanied. On an individual level, discrepancies of this magnitude, if widespread, are likely to substantially hamper efforts to control weight by individuals self-

monitoring their energy intake. On a public scale, the emerging policy initiatives on requiring energy information at the point of purchase may not translate into improved dietary intake if foods typically contain more energy than stated. Based on these findings, registered dietitians can advise consumers about the wide variability in accuracy of stated energy contents for prepared reduced-energy foods. Approaches to improving the accuracy of stated energy information may include increased attention to quality control in food preparation. Additional measures may also be needed such as improved federal and state regulations and a monitoring system to ensure compliance.

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References

1. Ogden CL, Carroll MD, Curtin LR, McDowell MA, Tabak CJ, Flegal KM. Prevalence of overweight and obesity in the United States, 1999–2004. *JAMA* 2006;295:1549–1555. [PubMed: 16595758]
2. Economic Research Service. Average daily per capita calories from the US food availability, adjusted for spoilage and other waste. US Department of Agriculture, Economic Research Service. [Accessed July 28, 2008]. Web site. <http://www.ers.usda.gov/Data/FoodConsumption/FoodGuideIndex.htm#calories>.
3. Health, United States 2007. National Center for Health Statistics: Hyattsville, MD; 2007.
4. Jakicic JM, Clark K, Coleman E, Donnelly JE, Foreyt J, Melanson E, Volek J, Volpe SL. American College of Sports Medicine position stand. Appropriate intervention strategies for weight loss and prevention of weight regain for adults. *Med Sci Sports Exerc* 2001;33:2145–2156. [PubMed: 11740312]
5. Wadden TA, Osei, S. The treatment of obesity: An overview. In: Wadden, TA., Stunkard, AJ., editors. *Handbook of Obesity Treatment*. New York, NY: The Guilford Press; 2002. p. 229–248.
6. Wadden TA, Butryn ML. Behavioral treatment of obesity. *Endocrinol Metab Clin North Am* 2003;32:981–1003. [PubMed: 14711071]
7. Wing RR, Hill JO. Successful weight loss maintenance. *Annu Rev Nutr* 2001;21:323–341. [PubMed: 11375440]
8. Lin, B.; Frazao, E.; Guthrie, J. Away-from-home foods increasingly important to quality of American diet. Washington, DC: Economic Research Service; 1999. *Agricultural Information Bulletin* No. 749
9. Kant AK, Graubard BI. Eating out in America, 1987–2000: Trends and nutritional correlates. *Prev Med* 2004;38:243–249. [PubMed: 14715218]
10. Paeratakul S, Ferdinand DP, Champagne CM, Ryan DH, Bray GA. Fast-food consumption among US adults and children: Dietary and nutrient intake profile. *J Am Diet Assoc* 2003;103:1332–1338. [PubMed: 14520253]
11. Eck Clemens LH, Slawson DL, Klesges RC. The effect of eating out on quality of diet in premenopausal women. *J Am Diet Assoc* 1999;99:442–444. [PubMed: 10207396]
12. Bowman SA, Vinyard BT. Fast food consumption of US adults: Impact on energy and nutrient intakes and overweight status. *J Am Coll Nutr* 2004;23:163–168. [PubMed: 15047683]
13. Lin BH, Frazao E. Nutritional quality of foods at and away from home. *Food Rev* 1997;20:33–40.
14. Guthrie JF, Lin BH, Frazao E. Role of food prepared away from home in the American diet, 1977–78 versus 1994–96: Changes and consequences. *J Nutr Educ Behav* 2002;34:140–150. [PubMed: 12047838]
15. Vol. 21. 1996. Nutrition Labeling of Restaurant Foods. CFR §101.10

16. US Center for Food Science and Applied Nutrition. Guidance for industry: A labeling guide for restaurants and other retail establishments selling away-from-home foods. US Center for Food Science and Applied Nutrition. [Accessed June 9, 2008]. Web site. <http://www.cfsan.fda.gov/~dms/labrguid.html>. Published April 2008.
17. Wolf I. Restaurant menu promises buried in fat. Scripps Howard News Service. 2008 May 21;
18. Hurley J, Liebman B. Restaurant confidential Italian restaurant food: Belly-ssimo! Nutrition Action Healthletter 2007;11–15.
19. Root AD, Toma RB, Frank GC, Reiboldt W. Meals identified as healthy choices on restaurant menus: An evaluation of accuracy. *Int J Food Sci Nutr* 2004;55:449–454. [PubMed: 15762309]
20. Woo S. Push for calories on menus gains. *The Wall Street Journal* 2008 June 11;:A2.
21. Menu Education and Labeling Act (MEAL act), HR 3895, 110th Congress, 2nd Session. 2007
22. Pomeranz JL, Brownell KD. Legal and public health considerations affecting the success, reach, and impact of menu-labeling laws. *Am J Public Health* 2008;98:1578–1583. [PubMed: 18633081]
23. Elia M, Cummings JH. Physiological aspects of energy metabolism and gastrointestinal effects of carbohydrates. *Eur J Clin Nutr* 2007;61:40. [PubMed: 16885929]
24. Merrill, AL.; Watt, BK. Energy Value of Foods: Basis and Derivation. Washington, DC: Agricultural Research Service; 1973. US Department of Agriculture Handbook No. 74
25. CalorieKing—About the food database. [Accessed June 5, 2009]. <http://www.calorieking.com/aboutus/food-database>
26. Nutrition Labeling of Foods. Vol. 21. 2005. CFR §101.9(g)(5)
27. US Food and Drug Administration. Foods—Net Weight. Silver Spring, MD: US Food and Drug Administration; 2005. Compliance Policy Guide 7120.19 §562.300
28. Nutrition Labeling of Foods. Vol. 21. 2005. CFR §101.9(a)
29. Nutrition Labeling of Foods. Vol. 21. 2005. CFR §101.9(c)
30. Nutrition Labeling of Foods. Vol. 21. 2005. CFR §101.9(g)(2)
31. Nutrition Labeling of Foods. Vol. 21. 2005. CFR §101.9(g)(8)
32. Nutrition Labeling of Foods. Vol. 21. 2005. CFR §101.9(c)(1)(i)(A) - (E)
33. Food Additives Permitted for Direct Addition to Food for Human Consumption. Vol. 21. 2005. CFR §172
34. Direct Food Substances Affirmed as Generally Recognized as Safe. Vol. 21. 2005. CFR §184
35. Guidance for industry: FDA nutrition labeling manual—A guide for developing and using data bases. US Center for Food Science and Applied Nutrition. [Accessed June 10, 2008]. Web site. <http://www.cfsan.fda.gov/~dms/nutrguid.html>. Published March 17, 1998.
36. Guidance for industry: A food labeling guide. Appendix H: Rounding the values according to FDA rounding rules. US Center for Food Science and Applied Nutrition. [Accessed June 9, 2008]. Web site. <http://www.cfsan.fda.gov/~tcjm/21g-xh.html>. Published April 2008.
37. Compliance Program Guidance Manual Fiscal Year 2007–2008. Washington, DC: Food and Drug Administration; 2006. Domestic and import NLEA, nutrient sample analysis, and general food labeling requirements program. 7321.005
38. Investigations Operations Manual. Washington, DC: US Food and Drug Administration; 2009. p. 4.1–4.6.
39. FDA analysis finds bread grossly mislabeled. Enforcement Story 2003: Center for Food Safety and Applied Nutrition. US Food and Drug Administration. [Accessed April 2, 2009]. Web site. http://www.fda.gov/ora/about/enf_story/archive/2003/ch4/cfsan1.htm. Published 2003.
40. Compliance Program Guidance Manual Fiscal Year 2007–2008. Washington, DC: Food and Drug Administration; 2007. Domestic food safety program. 7303.803
41. Regulatory Procedures Manual. Washington, DC: US Food and Drug Administration; 2008.
42. Nutrition Labeling of Restaurant Foods. Vol. 21. 1996. CFR §101.10
43. New York City Health Code. 2008. §81.50

Figure 1.

Measured energy amounts in selected reduced-energy restaurant foods (panel A) and supermarket convenience meals (panel B). GE = gross energy. Numbers correspond to restaurant or supermarket food items shown in the Table.

PACKAGED FOODS**Labeling**

Food macronutrients and portion size Manufacturers of packaged food must provide a Nutrition Facts label, including information on macronutrients and dietary fiber (per serving and number of servings) for each commercial food they sell (28). The macronutrient determinations may be conducted chemically by the manufacturer according to the most recent Official Methods of Analysis of the AOAC International (29,30), or can involve calculation from recipe ingredients using US Food and Drug Administration (FDA)-approved nutrient composition databases (31).

Energy content Nutrition Facts labels on packaged foods must also report energy (ie, predicted metabolizable energy [ME] available to the body) using one of five methods prescribed in the Code of Federal Regulations (CFR) (32). Manufacturers may choose any one of the five methods and are not required to justify their choice of one method over another.

- Using specific Atwater factors (24, Table 13) to calculate ME from macronutrient weights. The specific Atwater factors give estimated metabolizability of energy in different classes of foods. The values were determined in human digestibility studies by Atwater and others in which subjects consumed specific foods and food groups or specific foods within a mixed diet, then fecal and urinary energy losses were determined (24).
- Using general Atwater factors (9, 4, and 4 kcal/g for fat, protein, and carbohydrate, respectively) to calculate ME from macronutrient weights. The general Atwater factors predict ME contents of all macronutrients irrespective of food type they are contained in, and were determined by compositing the specific Atwater factors (24).
- Using general Atwater factors adjusted for insoluble fiber (by subtracting the amount of insoluble dietary fiber from total carbohydrate content) to calculate ME from macronutrient weights. These adjusted Atwater factors allow manufacturers to take into account the lower estimated ME content of insoluble fiber compared to other types of carbohydrate, including soluble fiber, and result in a lower estimated ME content of the food when insoluble fiber content is higher.
- Using specific factors for macronutrient energy content as approved by FDA to calculate ME. This option is designed for food additives such as preservatives, gums, anticaking agents, and coatings (see 21 CFR §172 for complete list) (33), and substances added to food that are generally recognized as safe, such as tannic acid and selected algae (see 21 CFR §184 for complete list) (34).
- Using bomb calorimetry values for gross energy corrected to estimated ME by subtracting 1.25 kcal/g protein (to take into account the low ME of protein). This method assumes 100% metabolizability of carbohydrate and fat and allows manufacturers to develop their own data based on bombed food samples.

In addition, manufacturers may develop databases of nutrient content information from their own laboratory testing or from software used to calculate nutrient content from recipe ingredients (31). FDA provides guidance on developing these databases, and encourages manufacturers to submit the databases for FDA approval. Submission is voluntary; however, it is the manufacturer's responsibility to ensure that any nutrition information attained by use of database is compliant if subsequently chemically tested by FDA (35).

Rounding The FDA promotes rounding of nutrient values to encourage realistic expectations of accuracy in stated nutrition information. Total carbohydrates and protein are rounded to 1 g and fat is rounded to 0.5 g, and foods containing less than 1 g or 0.5 g, respectively, are labeled as 0 g. Energy values are rounded to the nearest 5 kcal for foods ≤50 kcal and to the nearest 10 kcal for foods >50 kcal. Foods containing <5 kcal are labeled as 0 kcal (36).

Compliance Assessment and Enforcement

There is no required oversight of Nutrition Fact information for packaged food before distribution for sale; however, FDA performs inspections of Nutrition Fact labels on packaged food at least every 2 years as an add-on program to inspections mandated under other programs (eg, food safety) (37). Within this add-on program, emphasis is placed on specific labeling issues to be inspected, which recently have included absence of a Nutrition Facts label, unauthorized health or nutrient claims, allergen declaration, approved health or nutrient content claims where the nutrient content fails to meet the level of the claim, missing components of the Nutrition Facts label, and other deficiencies such as missing percent juice (37).

FDA may collect food samples to verify questionable composition information uncovered during inspections (called compliance samples) by obtaining samples either overtly at the point of manufacture (37) or covertly through commercial outlets (38). In one documented case, an inspection of a bread manufacturer prompted officials to purchase bread at a supermarket and send it for analysis. Nutrient content was analyzed, the product was found to be misbranded, and a warning letter was issued to the manufacturer (39). In addition to samples collected on the basis of suspicion, random surveillance samples of food types specified quarterly may be collected. Analysis of these samples focuses first on those nutrients about which a nutrient content claim is made (eg, "low calorie"). If no claim is made, random nutrients listed on the label with a content greater than a certain percentage of the daily value may be analyzed (37). Widespread testing of nutrients may not be common due to the risk-based prioritization of the FDA described above and consideration of available resources at the district level. District offices are required to collect a certain number of samples annually; however, information on the number of times samples are randomly collected for nutrient analysis is not publically available.

Compliance is assessed in chemical analysis of 12 random samples, and in the case of energy must average no more than 120% of the value stated on the label (no specifications are given on lower acceptable limits for energy content) (26). In addition, there are strict requirements that packaged food meet defined weight limits relative to stated; specifically, that the average weight of 48 units cannot be <99% of the weight stated on the package after shrinkage and other losses due to shipping and storage are considered (27). Thus, current regulations may predispose toward larger portions than reported because compliance limits for low portion weight are stricter than compliance limits for high energy content.

Manufacturers found to be noncompliant in the previous year may be inspected more frequently than every 2 years. Also, manufacturers of items such as infant formula and products containing peanuts may be inspected more frequently because of greater potential risks associated with noncompliance (40).

Punitive measures for mislabeled packaged food typically begin with a Notice of Observations letter that details significant observations and deficiencies. If reinspection reveals continuing problems, a Warning Letter will be issued. More severe actions (seizures and injunctions) are reserved for violations that have a major influence on public health (41). Violations meeting this criterion are not likely to include energy content mislabeling.

RESTAURANT FOOD**Labeling**

The regulations described above for packaged food are not generally applied to food served in restaurants. Currently, restaurants are required to follow 21 CFR §101.9 only if a nutrient or health claim is being made about the food (eg, “low calorie”). In these cases, only the constituent about which the claim is made must be reported in accordance with 21 CFR §101.9, and the method of determining energy and macronutrient information to be reported includes not only the methods described above for packaged food but also use of databases, recipes, or other “reasonable bases that provide assurance that the food or meal meets the nutrient requirements for the claim” (42) as set forth in 21 CFR §101.10. Restaurants voluntarily posting nutrition information are also not required to follow 21 CFR §101.9 precisely, but instead may state nutrients and energy according to the reasonable basis method described in 21 CFR §101.10. The same rounding criteria for reporting macronutrients and energy for packaged foods described above are applied to restaurant foods.

Compliance Assessment and Enforcement

Responsibility for restaurant nutrition labeling falls under state jurisdiction, rather than federal as for packaged food, and is subject to much less scrutiny currently than packaged foods. States’ prerogative governs whether accuracy of reported nutrition information provided by restaurants is assessed and there is no federal oversight. If a state decides to assess accuracy for any individual item at a restaurant it is not assessed by chemical analyses (as for packaged food) but rather by whether the food reasonably fits the claim (16). Furthermore, the states are responsible for interpretation of what a “reasonable fit” may be.

Some local governments such as New York City have adopted labeling regulations for restaurant food, and now require energy contents to be posted prominently at the point of purchase in restaurants with at least 15 locations (43). This affects approximately 10% of the 21,000 restaurants in New York City. Whereas the variable nature of food preparation in restaurants naturally leads to a likelihood of some uncertainty regarding stated energy values, the true magnitude of the uncertainty is not well characterized and, even in New York City, reviewing accuracy has only recently been considered.

Figure 2.

Summary of US Food and Drug Administration regulations on nutrition labeling in relation to energy.

Table
Nutrients and energy in reduced-energy meals ordered from restaurants and convenience meals purchased in supermarkets

Food item description	Vendor-Statement Values ^a						Measured Values			
	Serving (g)	Fat (g)	Net CHO ^d (g)	Dietary Fiber (g)	Protein (g)	ME ^b (kcal)	GE ^c (kcal)	Serving (g)	GE ^c (kcal)	GE ^c (% difference from stated)
Restaurants (meals and side dishes)^d										
1. Denny's ^e veggie-cheese omelette (with egg beaters)	340	22	8	3	25	346	394	270	419	6
2. Denny's hashed browns	113	12	18	2	2	197	207	121	213	3
3. Denny's dry english muffin	57	2	25	2	5	150	159	49	149	-6
4. Denny's center cut sirloin and eggs	284	15	1	0	54	370	450	201	486	8
5. Denny's dry toast (white)	28	1	16	1	3	92	97	72	283	192
6. Denny's grits (served with butter)	113	0	18	0	2	80	86	262	258	200
7. Ruby Tuesday's ^f petite sirloin steak	118 ^g	5	2	0	38	206	271	118	244	-10
8. Ruby Tuesday's ^f baked potato (with butter and sour cream)	357 ^g	19	51	11	10	459	492	357	490	0
9. Ruby Tuesday's ^f broccoli	133 ^g	8	5	3	6	129	144	133	177	23
10. Ruby Tuesday's ^f Asian glazed salmon	183 ^g	27	7	0	38	424	499	183	461	-8
11. Ruby Tuesday's ^f toast	27 ^g	9	16	1	3	160	171	27	110	-36
12. Ruby Tuesday's ^f brown rice pilaf	189 ^g	6	33	2	7	221	240	189	322	34
13. Ruby Tuesday's ^f broccoli	83 ^g	8	5	3	6	129	144	83	110	-23
14. Taco Bell's ^h express taco salad (chicken)	376	11	13	12	21	280	326	415	607	86
15. Taco Bell's ^h nachos	99	21	29	2	4	330	349	55	243	-30
Restaurants (individual items)										
16. Ruby Tuesday's ^f fries	146 ^g	13	52	5	4	359	379	146	465	23
17. P.F. Chang's ⁱ Cantonese shrimp	338 ^g	12	17	4	33	330	386	338	268	-31
18. P.F. Chang's ⁱ Sichuan-style asparagus (large)	348 ^g	6	28	6	11	200	260	348	558	115
19. Olive Garden's ^j shrimp primavera	539 ^g	11	59	6	31	483	548	539	624	14

Food item description	Vendor-Styled Values ^q						Measured Values			
	Serving (g)	Fat (g)	Net CHO ^a (g)	Dietary Fiber (g)	Protein (g)	ME ^b (kcal)	GE ^c (kcal)	Serving (g)	GE ^c (kcal)	GE ^c (% difference from stated)
20. Applebee's ^k Steak and portobellos	378 ^g	10	16	8	36	330	397	378	331	-17
21. Taco Bell crunchy beef taco	78	10	10	3	8	170	193	81	191	-1
22. McDonald's ^l Caesar salad with grilled chicken	311	6	9	3	30	220	276	289	228	-17
23. McDonald's McChicken sandwich	143	16	38	2	14	360	396	130	406	3
24. Domino's ^m thin crust veggie feast pizza (large)	155	18	23	3	14	300	352	95	257	-27
25. Domino's thin crust cheese pizza (large)	76	10	18	2	7	180	212	56	141	-33
26. Dunkin' Donuts ⁿ plain bagel	127 ^g	3	60	2	12	320	349	127	371	6
27. Dunkin' Donuts egg cheese english muffin sandwich	145 ^g	13	34	1	14	310	347	145	376	9
28. Wendy's ^o ultimate chicken grill	211	7	34	2	28	320	373	195	408	9
29. Wendy's grilled chicken go wrap	122	11	22	1	17	260	295	135	344	17
Means±standard deviation	194±129	11±6	23±17	3±3	17±14	266±108	303±123	191±128	329±145	18±59
Supermarket convenience meals										
30. Lean Cuisine ^p roasted garlic chicken	251	7	8	1	21	180	222	253	212	-4
31. Lean Cuisine shrimp and angel hair pasta	283	4	30	2	14	220	250	345	319	28
32. Weight Watchers ^q Smart Ones Roast Beef Bistro Selections	255	8	8	3	19	190	228	274	231	1
33. Weight Watchers lemon herb chicken piccata	255	2	39	2	12	230	252	318	306	21
34. Healthy Choice ^r slow roasted turkey breast with gravy	241	4	19	5	15	200	222	242	211	-5
35. Healthy Choice chicken parmigiana	373	9	50	6	16	370	407	373	431	6
36. South Beach Living ^s kung pao chicken	235	9	10	4	25	250	284	247	288	1
37. South Beach Living roasted turkey	269	9	23	4	17	240	293	298	265	-10
38. Bell & Evans ^t grilled chicken breast	78	1	1	0	18	80	111	88	145	31
39. Bell & Evans chicken breast tenders	113	6	11	1	19	180	214	111	228	7
Means±standard deviation	235±84	6±3	20±16	3±2	18±4	214±73	248±75	255±93	264±78	8±14

^aCHO = carbohydrate. Net CHO is total carbohydrate content minus fiber content.

^bME = metabolizable energy (stated by vendor).

^cGE = gross energy. GE calculated from macronutrients stated by vendor using general heats of combustion

^dFree side dishes are listed in italics directly under the entree they accompanied.

^eDenny's Corp, Spartanburg, SC.

^fRuby Tuesday, Maryville, TN.

^gThese restaurants reported serving size as entire served portion.

^hTaco Bell Corp, Irvine, CA.

ⁱP.F. Chang's China Bistro, Inc, Scottsdale, AZ.

^jDarden Restaurants, Inc, Orlando, FL.

^kApplebees Services, Inc, Lenexa, KS.

^lMcDonald's Corp, Oak Brook, IL.

^mDomino's Pizza, Ann Arbor, MI.

ⁿDunkin' Brands, Canton, MA.

^oWendy's Old Fashioned Hamburgers, Dublin, OH.

^pNestle SA, Salon, OH.

^qWeight Watchers Foods, LLC, New York, NY.

^rConAgra Foods, Omaha, NE.

^sKraft Foods, Northfield, IL.

^tBell & Evans, Fredricksburg, PA.