Nutrition Environment Measures Study in Restaurants (NEMS-R)

Development and Evaluation

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Background: Americans are increasingly eating out, but nutrition environments in restaurants are poorly understood. An observational measure was developed to assess factors believed to contribute to food choices in restaurants, including availability of more healthy foods, facilitators and barriers to healthful eating, pricing, and signage/promotion of healthy and unhealthy foods.

Methods: Inter-rater and test–retest reliability were assessed in 217 sit-down and fast-food restaurants in four neighborhoods in 2004 and 2005.

Results: Inter-rater reliability was generally high, with most kappa values greater than 0.80 (range 0.27–0.97) and all percent-agreement values greater than 75% (77.6–99.5). Test–retest reliability was high, with most kappa values greater than 0.80 (0.46–1.0) and all percent-agreement values greater than 80% (80.4–100). There were several differences ($p<0.05$) between nutrition environment variables in sit-down versus fast-food restaurants, although neither restaurant type was consistently more healthful. Fast-food restaurants had greater healthy entrée and main-dish salad availability, but sit-down restaurants had a higher proportion of healthy main-dish salads and more healthy food and beverage items. Fast-food restaurants more often encouraged large portions, unhealthful eating, and overeating, and offered relative cost savings for combination meals, but were also more likely to provide nutrition information and highlight healthy options.

Conclusions: Testing hypotheses about food environment influences on obesity and eating patterns requires psychometrically sound measurement of nutrition environments. This Nutrition Environment Measures Study restaurant assessment (NEMS-R) has evidence of reliability, and can discriminate restaurant types. The NEMS-R can be used in research and practice to characterize restaurant environments.

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Introduction

The proportion of meals eaten outside the home has increased in the United States[1,2] among children and adults.[3–5] Greater reliance on restaurants has potential negative nutritional and health consequences because individuals eating at restaurants more frequently have higher average caloric and fat intake, and lower fruit, vegetable, and fiber consumption.[1,6–10] Frequency of eating in restaurants is positively related to weight and increases in weight,[8,11,12] perhaps due to many unhealthy choices available in restaurants and resultant higher energy consumption.[1,13,14]

Fast-food restaurants have been identified as a potential contributor to higher obesity prevalence.[15] Higher concentrations of fast-food restaurants in poorer neighborhoods[16–19] and less healthful options within fast-food restaurants[20] may partially explain higher obesity prevalence among economically disadvantaged populations. The density of fast-food restaurants accounted for 6% of the variance in obesity prevalence across United States.[21] However, the evidence to date about the relationship between individuals' weight status to their surrounding neighborhoods' restaurant density is weak. Sturm and Datar[22] found that young children's increases in body mass index were related more to metropolitan-level estimates of fruit and vegetable prices than overall restaurant or restaurant type (e.g., fast food versus sit down) density. Restaurant density

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has been found to be unrelated to adults' obesity prevalence,[23] and proximity to the nearest fast-food restaurant was unrelated to overweight prevalence in lower income children.[24]

There is a considerable limitation of using restaurant proximity as a proxy for individuals' food environment. This assumes that all restaurants, or at best all restaurants of the same type, have the same dietary quality, food promotion environment, and pricing. It is likely the consumer nutrition environment, that is, the environment consumers' experience within restaurants, differs appreciably among restaurants, and could be influencing patrons' eating patterns.[25] Consumer nutrition environments within restaurants may differ in the availability of healthier menu options, nutrition information, and signage/promotion regarding specific foods or eating in general. However, research on the environment **within** restaurants is limited. Two studies[26,27] found low rates of low-fat menu items in restaurants. Extending findings of racial and socioeconomic disparities in the distribution of restaurants, a recent study[28] found less health promotion and fewer healthy food choices in restaurants in predominantly African-American ZIP codes in Los Angeles.

There have been advancements in the measurement of food environments within restaurants, including good interobserver reliability for availability of fruits and vegetables.[29] Cassady and colleagues[30] developed a restaurant menu checklist for use by community members that assesses food preparation, number of healthful choices, and fruit/vegetable availability. However, this checklist did not assess the whole restaurant environment, and was tested in only 14 family-style restaurants. Further, the checklist did not evaluate price comparisons between unhealthy and healthy alternatives despite the central role of price in food selection.[31,32]

To understand the relationship of food environments to eating and weight patterns, measures of neighborhood food access need to integrate restaurant accessibility with attributes of the food environment within restaurants. Measures are needed that evaluate the wide range of environmental stimuli faced by consumers within restaurants that may affect food choices. The present paper describes the development and evaluation of an observational measure of the "consumer nutrition environment" within restaurants. The instrument's test–retest reliability, inter-rater reliability, and the ability to discriminate based on restaurant type were assessed.

Methods

Selection of Neighborhoods and Identification and Classification of Restaurants

The Nutrition Environment Measures Study (NEMS) developed and evaluated nutrition environment measures for restaurants (NEMS-R, described here) and retail stores (described in a separate paper[33]). For this part of NEMS, four neighborhoods, defined as one census tract each, were selected to provide diversity in community design (walkable versus nonwalkable) and socioeconomic status (higher and lower income). Briefly, neighborhoods designated as high or low in walkability (based on measures of residential density, street connectivity, and land use mix[34]) and high or low in median income (derived from the Year-2000 Census) were selected in the Atlanta GA metropolitan area. Restaurants in the four neighborhoods were enumerated through county food licenses, the Yellow Pages, online business directories, and field work. Restaurants had to be open to the public to be included, so, for example, cafeterias within worksites were excluded. Restaurants were classified as either fast food or sit down. Fast-food restaurants were defined as having limited service wherein patrons order and pay before eating (see North American Industry Classification System definition of Limited-Service Restaurants; www.census.gov/epcd/www/naics.html), with the additional characteristics of having food served quickly after ordering, and food kept cold or often cooked in advance and/or reheated (see http://en.wikipedia.org/wiki/Fast_food). In contrast, sit-down restaurants were characterized by table ordering and service (see NAICS definition of Full-Service Restaurant; www.census.gov/epcd/www/naics.html) or establishments with limited service, but more cook/prepare to order (sometimes referred to as "fast-casual" restaurants). A total of 217 restaurants were evaluated, including all restaurants in three of the four neighborhoods, all fast-food restaurants, and a random sample of sit-down restaurants in the remaining neighborhood (due to the large sample of such restaurants). Evaluations were conducted in 102 fast-food and 115 sit-down restaurants, with retest evaluations conducted in 101 (99.0%) fast-food, and 115 (100%) sit-down restaurants (see Table 1).

Instrument and Protocol Development

Based on a conceptual model of nutrition environments,[25] literature on the factors related to food choice (i.e., price, availability, cues),[35,36] and input from nutrition and public health researchers, the restaurant observation instrument was designed to assess the relative healthfulness of foods and beverages available on the main menu and child's menus, with a focus on availability, facilitators, and supports for healthful eating, barriers to healthful eating, pricing, and signage/promotion (see Table 2). The measure focuses on dietary factors related to risk of major chronic diseases, including obesity, diabetes, cancers, and cardiovascular diseases.[37] The measure was pretested in restaurants in other regions of the United States to enhance generalizability.

The NEMS restaurant assessment (NEMS-R). The instrument evaluates availability of items in multiple menu categories, including entrees and main-dish salads, side dishes, and beverages. In the absence of nutritional information for a menu item (e.g., for some main-dish salads, vegetable side dishes), conservative criteria regarding the inclusion of high-fat and high-calorie ingredients were established. Because of the often large portion sizes and lack of recipes that specified preparation methods, menu items were not classified as "healthy" based on a general description alone. The guiding principle was that items

Table 1. Restaurants by type identified and evaluated in four study neighborhoods

	Number of restaurants enumerated		Percent evaluated	
Neighborhoods	**Sit down**	**Fast food**	**Sit down**	**Fast food**
High walkability, high income (HH)	121	22	33.1[a]	100
High walkability, low income (HL)	15	22	100	100
Low walkability, high income (LH)	44	28	97.7[b]	100
Low walkability, low income (LL)	17	32	100	93.8[b,c]

[a]Given the larger number of sit-down restaurants in this neighborhood, a random sample of restaurants was selected.
[b]$n=1$ neither evaluation conducted due to owner refusal nor unsuitable conditions.
[c]$n=1$ retest evaluation not conducted due to owner refusal.

were assumed to be unhealthy unless specific information to the contrary was provided or if the nature of the item was healthful (e.g., raw fruit). For example, broiled fish or roasted chicken entrees would seem to be "healthy," but examples of nutritional information for these items were found that revealed large portions and added fats in preparation, resulting in high-fat, high-calorie dishes. Criteria for designating healthy food and beverage options were derived from government recommendations for a healthful diet (U.S. Food and Drug Administration [FDA; www.cfsan.fda.gov/~dms/flg-7a.html] U.S. Department of Health and Human Services, and the U.S. Department of Agriculture [USDA][37]).

The tool first assessed the availability of healthy entrées and main-dish salads. "Healthy" entrées were defined as ≤800

Table 2. Restaurant nutrition-environment measure content and reliability

		Inter-rater reliability		Test–retest reliability	
Item category	**Item content**	**% agree**	**Kappa**	**% agree**	**Kappa**
Main dishes/entrees	Availability of healthful options	99.5	[a]	99.5	[a]
	Healthy options identified on menu	91.1	0.77	96.2	0.91
Main-dish salads	Availability	97.7	0.95	99.5	0.99
	Healthy options available	86.5	0.50	94.9	0.82
Specific foods availability	Fruit	96.7	0.84	96.2	0.78
	Nonfried vegetables	86.8	0.73	89.6	0.79
	Baked chips	99.5	0.97	100.0	1.0
	Whole grain bread	96.3	0.88	91.6	0.72
Beverages	Diet soda	98.6	0.86	99.5	0.95
	100% fruit juice	95.2	0.90	94.3	0.89
	1% or nonfat milk	97.2	0.82	97.2	0.81
Kid's menu	Availability	96.3	0.93	98.1	0.91
	Healthy options available	79.4	0.59	84.8	0.70
	100% fruit juice	96.3	0.92	96.2	0.92
	1% or nonfat milk	97.2	0.94	90.5	0.81
Facilitators of healthy eating	Nutrition information on menu	93.5	0.53	94.4	0.57
	Healthy entrees identified on menu	94.4	0.80	98.1	0.93
	Reduced-size portions	77.6	0.60	80.4	0.64
	Special requests encouraged	83.2	0.37	93.9	0.77
	Salad bar	99.1	0.75	100.0	0.89
Barriers to healthy eating	Menu: large portion encouraged	91.6	0.69	94.0	0.79
	Menu: overeating encouraged	87.4	0.36	95.4	0.78
	Menu: special requests discouraged	87.4	0.38	95.3	0.77
	"All-you-can eat" or "unlimited" available	97.7	0.77	98.1	0.82
	Low-carbohydrate promotion	93.5	0.80	93.9	0.82
Pricing	Individual versus combination food	80.6	0.67[b]	89.6	0.79
	Healthy versus regular	100.0	1.00	100.0	1.00
	Charge for shared entrée	99.1	0.80	99.5	0.91
	Smaller versus regular portion	88.8	0.27	91.1	0.46
Signage	Nutrition information near point-of-purchase	98.6	0.82	99.1	0.84
	Highlight healthy options	88.3	0.33	95.3	0.64
	Encourage healthy eating	90.7	0.33	95.3	0.62
	Encourage unhealthy eating	79.9	0.36	86.5	0.58
	Encourage overeating	88.3	0.48	89.7	0.55

[a]Statistics could not be computed because crosstabulation had two or fewer levels.
[b]Cramer's V was calculated instead of kappa because number of observed levels for the two variables are not equal.

calories (two fifths of the FDA food label standard of 800 calories); ≤30% calories from fat; ≤10% calories from saturated fat for nonburger/sandwich entrees (the fat and saturated fat criteria were based on USDA dietary guidelines); or a regulated healthy designation (e.g., light, low-fat) was provided for the entrée. Main dishes not designated in any way were not considered healthy. A main-dish salad was defined as a salad listed among and priced similarly to entrées, with overall availability and healthy main-dish salad availability evaluated. A main-dish salad was defined as healthy if nutritional information on the menu indicated it met the above-detailed healthy entrée designation for calories, fat, and saturated fat. If nutrition information was not provided for the main-dish salads, they were considered healthy only if low-fat or fat-free dressing was available and no more than two of the salad's ingredients contained items that were ≥50% fat. The availability of the following individual items was also assessed: fruit without added sugar, nonfried vegetables without sauce or toppings, baked chips, whole grain bread, diet soda, 100% fruit juice, and 1% fat or nonfat milk. The tool also included evaluation of children's menus including child's menu availability, and availability of nonfried entrées (e.g., grilled chicken or seafood; turkey), 100% fruit juice, and 1% fat or nonfat milk.

Five items assessed facilitators of healthy eating including whether (1) any nutrition information was provided on the menu; (2) any entrées were labeled as being more healthy (low fat, low calories, or a general classification of healthy such as American Heart Association "heart-check"); (3) reduced-size portions were offered on the menu (e.g., ½ portion available); (4) special requests for modifying entrées encouraged on menu (e.g., can substitute vegetables for french fries); and (5) a salad bar was available. Five items assessed barriers to healthy eating including (1) a larger portion was encouraged on the menu (e.g., get 50% more for only 25 cents); (2) overeating was encouraged on the menu (e.g., we keep bringing the food until you say stop); (3) special requests were either prohibited or charged for (e.g., no substitutions); (4) there was a low-carbohydrate promotion; (5) "all-you-can-eat" or "unlimited" portions of any food item (not beverage) was specified.

Comparative pricing between healthy or unhealthy and more or less food was assessed by four items, including if (1) the summed price of individual items was higher than an offered combination of those items, (2) price differed between the regular and healthy versions of main entrées or main-dish salads, (3) there was a charge for sharing an entrée, and (4) there was a price difference between a smaller versus regular portion of an entrée or main-dish salad.

Five items assessed healthy and unhealthy food nonmenu marketing within the restaurant including whether (1) nutrition information was provided near point of purchase, (2) signs/table tents/other displays highlighted healthy menu options, (3) signs/table tents/other displays encouraged healthy eating in general (e.g., eating fruits and vegetables is smart), (4) signs/table tents/other displays encouraged unhealthy eating (e.g., dessert=good), and (5) signs/table tents/other displays encouraged overeating (e.g., king-size it and eat up!). Information about hours of operation, drive-through window and parking availability, and size of restaurant was also collected because they affect food accessibility.

Procedures

Standard protocols for completing evaluations were developed and used by trained raters, who were college educated, but not nutrition specialists. Training included classroom sessions that provided background information, review of the NEMS-R tool, practice sessions including menu reviews, and field work at restaurants in neighborhoods that were not part of the main measurement study, with feedback on results. Training required between 10 and 20 hours.

The procedures for completing ratings of restaurants are summarized in Figure 1. Raters visited each restaurant to confirm the restaurant type designation, collect the take-away menu, and conduct the site visit. Preliminary assessment of 100 take-away menus, compared to in-restaurant menus, confirmed that >95% of the take-away menus were very complete. The most-often missing items were beverages and daily specials, if offered. If no paper menu was used, raters completed observations onsite based on posted menu boards. Internet information was obtained for restaurants having websites.

Assessment of inter-rater and test–retest reliability was achieved by conducting a total of three complete assessments of each restaurant. To assess inter-rater reliability, two raters visited each restaurant independently and completed menu reviews on the same day. To evaluate test–retest reliability, restaurants were assessed again by one of the same raters

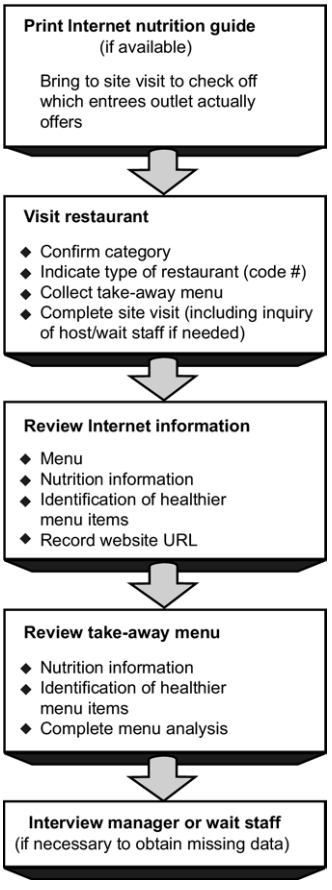

Figure 1. The NEMS measure of restaurant environments (NEMS-R): process of data collection for restaurants (printed with permission).

within 1 month of the initial evaluation. The average total time for a restaurant site visit and menu evaluation was 28.1 minutes (SD=15.8).

Data Analysis

Inter-rater and test–retest reliability were assessed by percent agreement and kappa coefficients. Kappa values >0.80 were considered high.[38] Restaurant size was categorized as counter service only, small (≤67 seats), medium (68 to 219 seats), or large (>219 seats), based on tertiles found in the current sample. Comparisons between restaurant types were made using chi-square analyses for dichotomous (yes/no) variables and *t*-tests for continuous variables. Statistical significance was set at $p<0.10$ given the exploratory nature of the restaurant type comparisons. Data were collected and analyzed in 2004 and 2005.

Results

Reliability

Inter-rater and test–retest reliability values for each NEMS-R item are provided in Table 2. Inter-rater percent agreement was consistently high (all above 75%). Kappa values were generally high for inter-rater reliability (most greater than 0.80), although values were lower (less than 0.60) for main-dish salad and child's menu healthy option availability, nutrition information availability on the menu, indication of special request and overeating encouragement, smaller versus regular portion pricing, and many of the signage items. Some of these latter items also had low test–retest kappa values, although the majority of test–retest kappa values were greater than 0.80 (see Table 2), and test–retest agreement was high (greater than 80%) for all items.

Comparisons by Restaurant Type

Sit-down restaurants were more likely to have take-away menus than fast-food restaurants (82.6% vs 30.4%, $p<0.0001$), although nutrition information availability and the identification of healthy items on such menus was rare (4.7% and 16.3%, respectively) and did not differ by restaurant type. More fast-food restaurants had a website than sit-down restaurants (68.6% vs 53.9%, $p<0.03$). For restaurants with a website, the fast-food (vs sit-down) restaurants more often provided a menu (95.7% vs 87.0%, $p=0.07$), nutrition information (75.7% vs 13.0%, $p<0.0001$), and the identification of healthier menu items on the website (41.2% vs 16.8%, $p<0.002$). Fast-food restaurants more often had drive-through facilities (36.3% vs 3.5%, $p<0.0001$) and on-site parking (96.1% vs 85.2%, $p<0.007$) than sit-down restaurants, but sit-down restaurants were larger on average ($p<0.0001$).

Nutrition environment comparisons by restaurant type are provided in Table 3. Sit-down and fast-food restaurants differed across many of the nutrition environment variables, although there were some unexpected differences and inconsistency in which restaurant type was more healthful. For instance, fast-food restaurants were more likely to offer a healthy main dish/entrée and have a higher proportion of healthy to total main dish/entrées. Similarly, fast-food restaurants were more likely to offer at least one healthy main-dish salad, but the proportion of healthy to total main-dish salads was higher in sit-down restaurants. With the exception of baked chips, sit-down restaurants were more likely to have healthier versions of individual foods and beverages that were evaluated (e.g., nonfried vegetables, 100% fruit juice). Neither sit-down nor fast-food restaurants were observed to have many facilitators of healthy eating, but reduced portion size availability was higher at sit-down restaurants. Larger portions were more often encouraged at fast-food than sit-down restaurants, although the converse was true for "all-you-can-eat" availability, which occurred more often at sit-down restaurants. Combination meals that offered price savings relative to the cost of individual food items were more common in fast-food restaurants. Although a low percentage overall, healthy entrées were sometimes cheaper than regular entrées at sit-down, but not fast-food restaurants. Fast-food restaurants never charged for a shared entrée as a small percentage of sit-down restaurants did, although sit-down restaurants more often designated a less expensive smaller portion size. Fast-food restaurants consistently had more signage providing nutrition information and highlighting the availability of healthy options. However, fast-food restaurants were also more likely to have signage promoting unhealthy eating and overeating in comparison to sit-down restaurants.

Discussion

The NEMS-R items were found to have acceptable, and generally very good, inter-rater and test–retest reliabilities. The utility of the tool was demonstrated by numerous significant differences in food environment variables across restaurant types, which can be interpreted as support for construct validity of the variables. Observers had high levels of agreement on most of the items, and the few items with low kappa values had low occurrence rates, such as main-dish salads labeled as healthy and nutrition-related signage. The high test–retest reliabilities indicated the observed variables generally were stable across a 1-month period. The ability of 22 of the 33 items to discriminate fast-food from sit-down restaurants supports the health relevance of the measure. It is notable that fast-food restaurants had healthier scores on several items than sit-down restaurants, including availability of any healthy entrees or main-dish salads. Sit-down restaurants were somewhat more likely to have healthier individual item options (e.g., nonfried vegetables, 100% fruit juice).

Table 3. Nutrition environment comparisons by type of restaurant

Variable	Restaurant type		*p* value
	Sit down % (*n*=115)	Fast food % (*n*=102)	
Main dishes/entrees			
Healthy entrée available	20.9	36.3%	<0.012
Proportion of entrées that are healthy	3.2	8.8%	<0.002
Main-dish salads			
Healthy main-dish salads available	9.6	24.5%	<0.004
Proportion of main-dish salads that are healthy	11.1	3.2%	<0.008
Specific foods availability			
Fruit availability	11.3	11.9	ns
Nonfried vegetable availability	53.0	26.5	<0.0001
Baked chip availability	2.6	15.7	<0.0008
Whole grain bread availability	21.7	16.7	ns
Beverages			
Diet soda availability	95.7	94.1	ns
100% fruit juice availability	59.7	36.3	<0.0007
1% or nonfat milk availability	8.0	8.8	ns
Kid's menu			
Availability	41.7	62.8	<0.003
Healthy choice availability	50.0	43.8	ns
100% fruit juice availability	68.5	46.9	<0.03
1% or nonfat milk availability	60.4	39.1	<0.03
Facilitators of healthy eating			
Nutrition information on menu	5.2	6.9	ns
Healthy entrées identified on menu	17.4	16.7	ns
Reduced sized portions available[a]	15.7	2.0	<0.0001
Special requests encouraged	18.3	12.8	ns
Salad bar	3.5	0	<0.06
Barriers to healthful eating			
Large portions encouraged	4.4	29.4	<0.0001
Menu discourages special requests	14.8	10.8	ns
"All-you-can-eat" or "unlimited" available	8.7	0	<0.003
Low-carbohydrate promotion	20.0	27.5	ns
Pricing			
Combination meal cheaper than sum price of individual items	21.9	78.4	<0.0001
Healthy entrées less expensive than regular entrées	3.1	0	<0.04
No charge for shared entrée	95.7	100	<0.04
Designated smaller portion less expensive than regular portion	13.9	2.0	<0.002
Signage			
Nutrition information posted	3.5	34.3	<0.0001
Highlighting healthy options	2.6	9.8	<0.03
Healthy eating encouraged	4.4	6.9	ns
Unhealthy eating encouraged	13.0	34.3	<0.0003
Overeating encouraged	5.2	25.5	<0.0001

[a]"Reduced sizes" do not include offerings at restaurants where varying size food items are considered "standard," such as pizza, burger sandwiches, or beverages.
ns, not significantly different.

In addition to demonstrating the good psychometric performance of the NEMS-R measure, this study of 217 restaurants in four diverse neighborhoods clearly documents the difficulty that restaurant patrons face in selecting healthy foods. From information available on the menu or website, only 21% of sit-down restaurants and 36% of fast-food restaurants had what we defined as healthy main dishes. Thus, in the majority of restaurants it was not possible to choose a healthy main dish without asking for further information or requesting modifications to standard menu items. If a restaurant has healthy main dishes, there are usually few options, as less than 9% of main dishes were considered healthy in the present study. Fewer than 12% of main-dish salads were rated as "healthy." Both of the healthy main-dish variables, availability, and proportion of healthy to total were more favorable in fast-food restaurants, possibly reflecting the nutrition information provided on websites for such restaurants, but this information was far removed from the point of decision making. The low rates of nutrition information specifically on the menu in the present study and a recent

study examining a single fast-food restaurant chain document the difficulty patrons have in obtaining point-of-purchase nutrition information.[39] Adding to this problem of lack of nutrient information is recent evidence that consumers underestimate such factors as calories and fat in restaurant entrées, with greater underestimation for less healthy options.[40]

There were other indicators that most restaurants made it difficult or impossible to select foods that met the Dietary Guidelines for Americans.[37] For example, less than 12% of restaurants listed any fruit at all available, and nonfried vegetables were available in only 53% of sit-down restaurants and 27% of fast-food restaurants. Whole grain bread was available in less than a quarter of restaurants, and low-fat or nonfat milk was available at less than 10% of restaurants, although such milk was more likely indicated on children's menus, particularly in sit-down restaurants. However, half of children's menus appeared to have no healthful entrée choices. A limitation of the observation method and definitions used was that more healthful food choices may be available than were apparent on the menu or websites. However, raters routinely asked a server or host(ess) about items that were not usually listed on menus—such as skim milk, baked chips, whole wheat bread (see Figure 1). Importantly, a patron attempting to choose a healthy diet of known nutritional value was unable to do so at the point of choice in the vast majority of restaurants surveyed in these Atlanta neighborhoods.

In addition to food availability, current data illustrate multiple ways in which restaurants encourage poor diets and create barriers to healthful eating. Less than 7% of menus provided nutrition information, and few restaurants highlighted healthy menu items. Restaurants were three to four times more likely to have signs encouraging unhealthy than healthy eating. Unhealthy main-dish options were virtually always the same price or cheaper than healthy options, and few restaurants offered smaller portions at reduced prices. Given the lack of variability observed by raters, the inter-rater and test–retest reliability is unknown for the comparative pricing items assessing individual versus combination food pricing and whether regular versus healthy alternatives were priced similarly. Overall though, fast-food restaurants did little with pricing to encourage selection of healthier options or consuming less food. In the present sample, fast-food restaurants more often provided combination meal discounts and less often had a reduced cost for a smaller portion of an entrée or main-dish salad compared to sit-down restaurants. Fast-food restaurants never offered healthy entrées at a lower cost than the analogous regular version; health-promoting pricing strategies were very rare in sit-down restaurants as well. In contrast, a few sit-down restaurants charged a fee for sharing an entrée, but no fast-food restaurants did. Based on this sample of restaurants, it apparently is very difficult or perhaps even irrational to choose a more healthy meal in most restaurants based on cost structures and information provided. Moreover, nutrition information was most often unavailable onsite, pricing policies encouraged unhealthy choices and overeating, and unhealthy eating was encouraged by signage.

The observational NEMS-R tool did not evaluate the actual healthfulness of foods, which would require laboratory or recipe (e.g., through a food database such as the Nutrition Data System for Research) analyses. The NEMS-R protocol counted items marked as "heart healthy" or "light" as healthful, based in part on a published analysis of such designated foods being more healthful[41] and federal regulation of certain designations, but few restaurants used these indicators. In completing assessments, more specific nutrition information for menu items would have been preferable, but such detailed information was generally lacking, even among chain restaurants.[42] Pending legislation may require this information at chain restaurants in the future.[43] Given restaurant- or entrée-specific differences in serving sizes and preparation method, it is unlikely such nutrition information would ever be available for nonchain restaurants unless legally mandated. The NEMS-R was designed to assess the "consumer food environment," or the stimuli encountered by restaurant patrons as they use available information to make their selections. In addition, NEMS-R tool items seek to evaluate whether "healthier" options are available, without making assumptions about what is the most healthful choice possible. For instance, the NEMS-R assesses whether "baked chips" are available, based on the premise that "regular chips" would be the likely alternative and that "baked chips" are lower in fat than "regular chips." The healthiest option could be to not have any type of snack chip, but this would fail to capture a common food type offered in restaurants, particularly for children. Large portion sizes may be contributing to obesity, but the NEMS-R was not designed to directly evaluate portion sizes, making it unable to distinguish between restaurants that offer "standard" portions of varying sizes.

Limitations of the present study included restriction to a small number of neighborhoods within one metropolitan region, so present data should not be considered representative of the region or the nation. Further studies in other areas are needed to assess the generalizability of the measure and findings. There are likely to be other restaurant environment factors of interest to investigators that were not part of the NEMS, because the instrument was designed to assess selected attributes that could be readily observed and are relevant to obesity and chronic disease risk. However, the present version of the NEMS-R could serve as the core of observational systems that could be adapted to specific populations, geographic areas, cultures, or

study questions. Adapted versions should be psychometrically evaluated prior to implementation. This will be especially important for the small number of items that evidenced little within-rater variability and/or had lower actual base rates, resulting in unknown reliability (e.g., comparative pricing on healthy vs regular options). Such items required continued testing.

As Americans increase the frequency of eating in restaurants,[1,2] they increase their exposure to food environments likely to encourage them to choose unhealthy foods and essentially prevent them from choosing healthy meals. It is noteworthy that in a recent study consumers provided with nutrition information about common entrées shifted purchase intentions away from less healthful options.[40] It remains to be determined whether the variables assessed by the NEMS-R are related to individuals' food choices and risks of obesity and chronic diseases.

These results illustrate why leading health experts and organizations, such as the Centers for Disease Control and Prevention, Institute of Medicine, World Health Organization, and the International Obesity Task Force emphasize the only way to improve diets and prevent chronic diseases and obesity is to change the food environment.[44,45] The NEMS-R is among the first comprehensive evaluation instruments that allow measures of the multiple information environment attributes and pricing policies that create barriers to healthful eating in restaurants. Although the effort required to apply the NEMS-R assessment is substantial, the extent, specificity, and credibility of the data create a favorable ratio of measurement cost to value. Similar information cannot be obtained by surveying restaurant employees, who provide inaccurate information[26] or by merely assessing information on the Internet.

The NEMS-R assessment can be used to examine how the consumer environment within restaurants is related to dietary and health outcomes as well as health disparities. The measure is feasible, in that it is not disruptive to businesses and requires little interaction with restaurant staff. However, at 30 minutes per average restaurant, not including travel time, the costs of implementation could be substantial. In some studies it may be necessary to observe a sample of restaurants. The NEMS-R can be used by researchers, and it may also be useful for community groups who can use local results in health advocacy work (online appendix at www.ajpm-online.net). Information about training in the use of the NEMS-R is available at www.sph.emory.edu/NEMS.

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Supplementary data

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.amepre.2006.12.022.

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