The Ubiquity of Energy-Dense Snack Foods: A National Multicity Study

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Objectives. We assessed the availability and accessibility of energy-dense snacks in retail stores whose primary merchandise was not food and whether these varied by store type, region, or socioeconomic factors.

Methods. We conducted systematic observations of 1082 retail stores in 19 US cities and determined the availability and accessibility of 6 categories of energy-dense snack foods.

Results. Snack food was available in 41% of the stores; the most common forms were candy (33%), sweetened beverages (20%), and salty snacks (17%). These foods were often within arm's reach of the cash register queue. We observed snack foods in 96% of pharmacies, 94% of gasoline stations, 22% of furniture stores, 16% of apparel stores, and 29% to 65% of other types of stores. Availability varied somewhat by region but not by the racial or socioeconomic characteristics of nearby census tracts.

Conclusions. Energy-dense snack foods and beverages, implicated as contributors to the obesity epidemic, are widely available in retail stores whose primary business is not food. The ubiquity of these products may contribute to excess energy consumption in the United States. (*Am J Public Health.* 2010;100: 306–311. doi:10.2105/AJPH.2009.178681)

Obesity rates continue to rise in the United States.[1] Coincident with this rise have been increases in the amount of energy consumed and shifts in the locations and patterns of food consumption by Americans.[2–4] Practices that have become increasingly common are eating away from home, snacking, and consuming sweetened beverages and energy-dense foods such as salty snacks.[4] One study suggested that nearly all of the increase in calorie consumption in the United States between the late 1970s and the mid-1990s was in the form of snacks.[4] The individual food items contributing the most to increases in energy consumed were sweetened beverages and salty snacks.[4] Sweetened beverages have been associated with obesity and weight gain in both observational and intervention studies.[5]

Sweetened beverages and energy-dense snack foods are sold at nearly all grocery stores as well as most restaurants, and are available from snack counters and vending machines in many workplaces and schools. They are also available in retail stores that primarily sell other types of items and services. The widespread availability of energy-dense snack foods may contribute to the obesity epidemic in 2 ways: (1) by providing more opportunities to acquire these foods and (2) by providing cues to people suggesting that they snack.

To understand the potential magnitude of this problem, we conducted observations in stores in 19 cities across the United States. Our objectives were to determine the proportion of retail establishments whose primary merchandise was not food that sold energy-dense snack foods and to assess whether and how that proportion varied by store type, region of the country, and socioeconomic status of the surrounding area.

METHODS

Our study was conducted from 2007 to 2008 as a cooperative project by volunteers at the Centers for Disease Control and Prevention–funded Prevention Research Centers in schools of public health and other academic health centers in 19 cities. The cities were a convenience sample selected according to the location of the Prevention Research Centers and other academic health centers and the availability of volunteers, but efforts were made to obtain a national geographic distribution.

Sampling of Intersections and Stores

In each selected city we identified commercial streets and intersections, where we then observed nearby stores. Commercial streets were defined as major streets that contained at least 2 retail outlets of the types commonly found in retail areas (e.g., clothing stores, drug stores, coffee shops, liquor stores) and were identified with Google maps. Commercial intersections were defined as intersections of 2 or more commercial streets. All commercial intersections within a 5-by-7-mile area around each city center were eligible for sampling.

An initial sample of 8 commercial intersections (6 primary, 2 alternate) was randomly selected in each city from those eligible and was provided to each observer team. Observers then used these intersections as starting points and traveled along 1 or more of the commercial streets, following detailed protocols and assessing each consecutive location to determine if it met eligibility criteria for a retail store to be observed. The teams were instructed to conduct observations in eligible stores until they had completed 10 observations.

If they passed 10 consecutive locations on the designated street that were not retail stores or did not meet inclusion criteria, observers returned to the assigned intersection and traveled along a different commercial street. If all 4 directions at an intersection were systematically exhausted, observers discarded that intersection and moved to a replacement commercial intersection. If observers exhausted the list of 8 commercial intersections provided to them, they were given additional randomly selected eligible commercial intersections. In each city, the observer team's objective was to complete 10 observations near each of 6 intersections.

Locations assessed by observers were eligible for observation if (1) they were retail

commercial stores that did not sell food as a primary business, that is, they were not grocery stores, convenience stores (independent of gasoline stations), liquor or wine stores, restaurants, or snack bars, and (2) they were open for business at the time the observers arrived. All observations took place between 9:00 AM and 6:00 PM, Monday through Saturday.

Observations

For each store included in the study, observers noted the primary business and whether the business had another food business nested within it (e.g., a coffee shop within a bookstore). Within each store, observers conducted observations only in street-level areas accessible to customers and did not ask employees about items that were not visible.

Observers noted and recorded the availability of carbonated soft drinks and other sweetened beverages, coffee, salty snacks (e.g., chips, popcorn), candy, baked sweets (e.g., snack cakes, cookies), and frozen sweets (e.g., ice cream, popsicles). They also noted whether the foods were available for free, whether they were within arm's reach of the cash register queue, whether they were sold in vending machines, and, for beverages, whether they were available cold (in a cooler or on ice).

Analysis

The intersections that served as starting points for the observations were geocoded, and measures of socioeconomic status from the 2000 US census[6] were assigned to the cluster of stores observed near them. We obtained and analyzed these measures for 2 geographic levels: the census tract and the entire city (i.e., the census-defined "place"). At each level, the measures assigned to the cluster of stores were median household income and percentage of the population that was Black or Hispanic; we categorized both measures in tertiles (low, medium, high) for analysis.

After the observations were completed, we sorted the stores into 17 categories derived from Standard Industrial Classification codes,[7] with some grouping or reclassification for store types for which food availability markedly differed from others within the codes. We calculated frequencies of food availability by city, region of the United States, store type, and measures of socioeconomic status of the census tract. We then constructed random-effects logistic regression models of food availability that included as predictors region, store type, and socioeconomic status; these models took into account the clustering of the observed stores within intersections and cities.

RESULTS

The 19 cities in the sample ranged in size from Morgantown, West Virginia (population=29 000), to Manhattan, New York (population=1 621 000); the median was 377 000 persons.

Observers attempted to conduct observations near 206 commercial intersections, of which 94 did not have sufficient numbers of eligible retail locations for inclusion, leaving 112 in the study. Observations were ultimately conducted near 6 intersections in 17 of the 19 cities and 5 intersections in 2

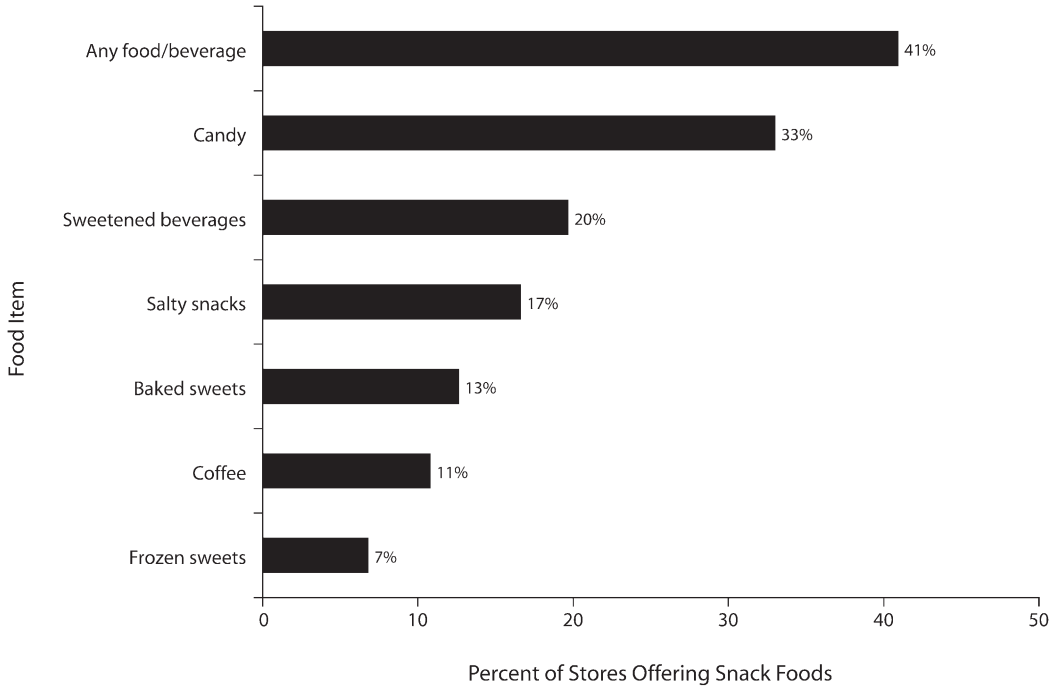

FIGURE 1—Percent of nonfood stores with snack foods available: 19 US cities, 2007–2008.

TABLE 1—Accessibility of Snack Foods in Stores Carrying These Items: 19 US Cities, 2007–2008

Type of Food	Located Within Arm's Reach of Cash Register Queue, No./Total Available (%)	Accessible for Free, No./Total Available (%)	Located in Vending Machine, No./Total Available (%)
Candy	231/354 (65)	80/356 (22)	112/356 (31)
Sweetened beverages	70/212 (33)	4/212 (2)	79/212 (37)
Salty snacks	93/178 (52)	7/178 (4)	43/178 (24)
Baked sweets	61/135 (45)	12/135 (9)	16/135 (12)
Frozen sweets	23/71 (32)	. . .	1/72 (1)
Coffee	. . .	63/116 (54)	107/125 (86)

Note. Ellipses indicate not observed.

cities (Albany and Philadelphia). Of the 2545 locations encountered by observers, 1463 were excluded because they were not retail establishments, they were food establishments, or they were not accessible, leaving 1082 retail nonfood establishments in the final data set.

Among stores observed, 25 (2.3%) had a food establishment nested within them. Some form of snack food was available in 41% of the stores; the most common forms were candy (33%), sweetened beverages (20%), and salty snacks (17%; Figure 1). When foods were available, they were within arm's reach of the cash register queue in 32% to 65% of stores, depending on the item type (Table 1). In 22% of stores that had candy, it was offered without charge.

We observed a range in the availability of snack foods across different store types, but these foods were widely available among all types. Snack foods were available in 96% of pharmacies, 94% of gasoline stations, 22% of furniture stores, 16% of apparel stores, and 29% to 65% of other types of stores (Figure 2). Candy was the item most consistently available, found in more than 90% of pharmacies and gasoline stations and 14% to 57% of all other store types. Sweetened beverages were found in 89% of pharmacies and 92% of gasoline stations; only 1% of apparel stores, 6% of furniture and electronics stores, and 6% of banks and check-cashing outlets had sweetened beverages, but 9% to 46% of all other store types provided them.

Table 2 shows the availability of snack foods by region, city, and socioeconomic status of the census tract and city in which the starting intersection was located. Food availability varied somewhat by region, with the lowest availability in the West (38%) and Southwest (37%) and the highest in the Midwest (53%; $P<.05$ after controlling for store type). Differences in snack food availability by household income and percentage minority in the census tract or city were not statistically significant.

We entered the socioeconomic characteristics of the intersection census tract, the region, and store type variables into 2 multivariable models as predictors of food availability; 1

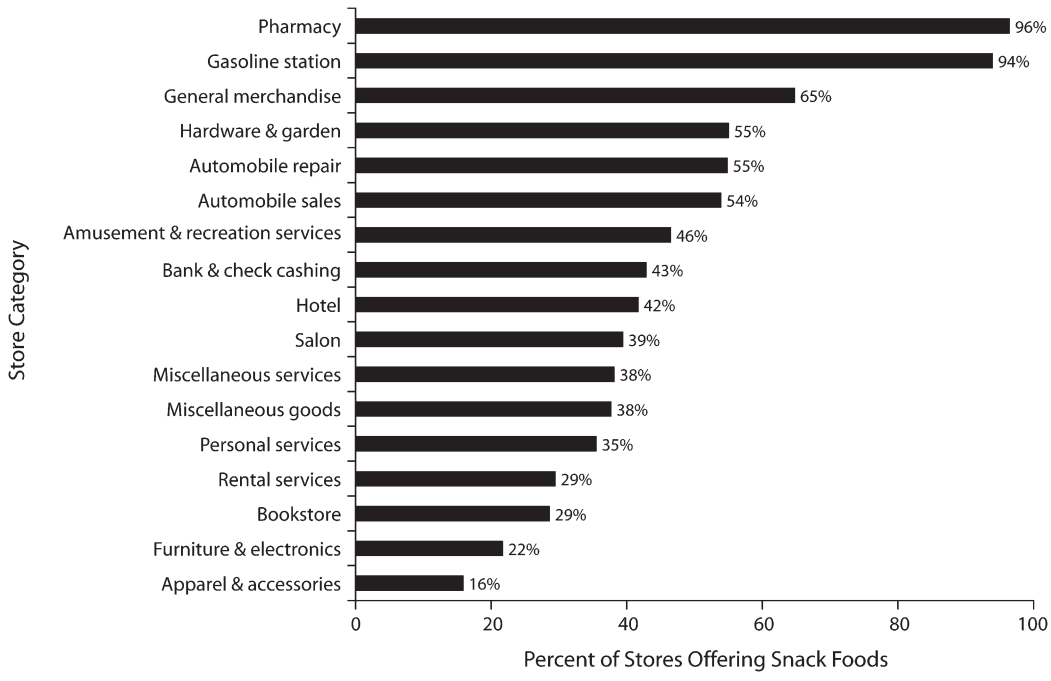

FIGURE 2—Availability of snack foods by store category: 19 US cities, 2007–2008.

TABLE 2—Availability of Snack Foods in Retail Stores, by Geography and Demographic Characteristics of City and Census Tract: 19 US Cities, 2007–2008

Location/Demography	Stores With Any Food Present/Stores Observed (%)
Northeast	109/272 (40)
Albany, NY	23/50 (46)
Boston, MA	23/60 (38)
Manhattan, NY	19/59 (32)
Rochester, NY	25/54 (46)
Philadelphia, PA	15/49 (31)
Southeast	115/279 (41)
Columbia, SC	14/60 (23)
Lexington, KY	29/51 (57)
Birmingham, AL	29/58 (50)
Morgantown, WV	22/55 (40)
New Orleans, LA	21/55 (38)
Midwest	63/118 (53)
St Louis, MO	29/50 (48)
Minneapolis, MN	34/58 (59)
Southwest	64/171 (37)
College Station, TX	27/60 (45)
Tucson, AZ	19/58 (33)
Oklahoma City, OK	18/53 (34)
West	82/218 (38)
San Francisco, CA	14/58 (24)
Portland, OR	26/60 (43)
Seattle, WA	20/59 (34)
Denver, CO	22/41 (54)
Median household income in city	
Low	142/334 (43)
Medium	100/278 (36)
High	191/446 (43)
Percentage minority in city	
Low	124/285 (44)
Medium	172/437 (39)
High	137/336 (41)
Median household income in census tract	
Low	145/340 (43)
Medium	120/327 (37)
High	168/391 (43)
Percentage minority in census tract	
Low	131/325 (40)
Medium	165/410 (40)
High	137/323 (42)

Note. $P < .05$ for differences by region after control for store type.

included stores of all types and 1 excluded pharmacies and gasoline stations (Table 3). The only statistically significant predictor of food availability in these models was region, with the Midwest having higher availability than the West (odds ratio=2.20 in the full sample). Food availability was more common in census tracts in the lowest and highest tertiles than in the middle tertile, but these differences were not statistically significant.

DISCUSSION

We found that energy-dense snack foods and beverages, which have been implicated as contributing to the obesity epidemic, are widely available in retail stores whose primary merchandise is not food. This ubiquity of energy-dense snack foods may contribute to eating patterns and obesity in the United States.

Several lines of research support the idea that food availability and accessibility exert a strong influence on food consumption and energy intake. Studies have shown that diet quality and body mass index (BMI; defined as weight in kilograms divided by height in meters squared) are associated with the types of food stores near a person's residence.[8] Marketing research studies conducted in retail stores show that sales of food items change markedly in response to changes in the amount of shelf space allotted to them, implying that food is particularly likely to be purchased on impulse.[9–11] Food laboratory studies have shown consistently that volunteers given larger portions of food simply consume more and that when those foods are energy dense, energy intake is higher.[12] Experimental trials have shown that snack food consumption increases when the foods are put within arm's reach or are merely visible.[13] Together, these findings suggest that the mere presence of ready-to-eat snack food near cash registers increases the likelihood that people will purchase those foods and consume more energy.

Experimental studies have found that people given snacks between meals do not compensate for this consumption by reducing their consumption at subsequent meals,[14] and national dietary surveys show that total calorie consumption increases with the number of eating occasions per day.[15] For example, people consuming 1 snack in addition to 3 meals in a day consume approximately 200 calories more than do people consuming 3 meals but no snacks in a day.[16] This suggests that calories consumed through impulse purchases of snack foods will increase total daily energy intake and thus contribute to weight gain.

We were unable to find other studies of the availability of foods in nonfood stores in the United States. Our study was limited in that we could not be certain that the stores included in our sample were representative of stores throughout the country. Our sample of intersections was taken from the central areas of cities (5-by-7-mile areas), which could have influenced the likelihood of finding snack foods in stores. However, we observed outlets across a wide range of regions, city sizes, and socioeconomic areas, and the variation in snack food availability that we observed was small, suggesting that it is unlikely that snack food availability differed greatly in other areas.

Our finding that 41% of stores sold energy-dense snack food implies that people are frequently exposed to opportunities to obtain and consume these foods on impulse. How often this opportunity occurs depends on the frequency of visiting retail stores and the types of stores visited, but it is likely that many people are exposed to this opportunity often. A person who is exposed twice per week and during 10% of exposures purchases a snack item containing 250 calories (the approximate energy value of a 20-ounce serving of a sweetened beverage, a candy bar, or a 2-ounce bag of potato chips) will consume 2600 calories from snack items in a year's time. Assuming no change in physical activity and no compensation by reduced energy consumption in subsequent meals, this would

TABLE 3—Multivariate Models Predicting Snack Food Availability in Retail Stores: 19 US Cities, 2007–2008

Predictor	Full Sample, OR (95% CI)	Reduced Sample,[a] OR (95% CI)
Region		
West	. . .	. . .
Northeast	0.94 (0.56, 1.58)	0.95 (0.55, 1.61)
Southeast	1.01 (0.57, 1.78)	1.03 (0.57, 1.84)
Midwest	2.20 (1.16, 4.15)	2.19 (1.13, 4.22)
Southwest	0.74 (0.40, 1.37)	0.76 (0.40, 1.44)
Median household income[b]		
Low	1.47 (0.93, 2.33)	1.41 (0.88, 2.27)
Medium	. . .	. . .
High	1.37 (0.82, 2.29)	1.36 (0.80, 2.31)
Percentage minority[b]		
Low	. . .	. . .
Medium	0.95 (0.60, 1.52)	0.94 (0.58, 1.53)
High	0.85 (0.51, 1.41)	0.86 (0.51, 1.46)

Note. CI = confidence interval; OR = odds ratio. Ellipses indicate not observed.
[a]Excluding pharmacies and gasoline stations.
[b]For census tract of nearby sampled intersection.

lead theoretically to a weight gain of 0.34 kg per year. To put this in context, during a period of rapidly rising obesity rates in the United States, a longitudinal study followed more than 10 000 middle-aged adults for 6 years and recorded an average weight gain of 0.35 kg per year.[16] More research is needed to characterize the actual frequency of exposure to snack items, the proportion of those exposures that lead to purchases (both planned and on impulse), and the contribution of snack items obtained from nonfood stores to overall energy intake. Nonetheless, our estimate of the potential for weight gain in individuals suggests that the ubiquity of energy-dense snack foods may contribute meaningfully to the current obesity epidemic.

According to regulations of the Food and Drug Administration, all food establishments in the United States must have a permit to operate issued by a local or state regulatory agency, such as a health department.[17] However, the definition of "food establishment" in the federal regulations and most state regulations excludes stores that sell only "prepackaged foods that are not potentially hazardous," with "potentially hazardous" defined as supporting the rapid growth of pathogenic microorganisms.[17(sec1-201)] These rules allow nonfood stores to sell packaged snack foods such as candy, salty snacks, and sweetened beverages (but not fruits or vegetables) without a permit.

The obesity epidemic in the United States is estimated to be responsible for more than 100 000 deaths per year, 20 times the estimated 5000 deaths from food-borne infectious pathogens, so it may be justified to revisit the definition of potentially hazardous and to include energy-dense snack foods.[18,19] This epidemic should prompt public health experts to evaluate the contribution of the widespread availability of energy-dense snack foods and beverages to weight gain and to consider ways to address this availability. ■

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Contributors

T.A. Farley, E.T. Baker, and J.C. Rice originated the study. T.A. Farley, E.T. Baker, and L. Futrell supervised the data collection. T.A. Farley led the writing and all authors reviewed and commented on the drafts of the article. J.C. Rice analyzed the data.

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Human Participant Protection

The study protocol was reviewed by the Tulane University institutional review board and classified as exempt because it did not involve human participants.

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