Supplementary Online Content

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This supplementary material has been provided by the authors to give readers additional information about their work.

eMethods.

Movie Sample

The 250 movies with the highest US box-office gross revenues between 1994 – 2018 (top 10-grossing movies from each year) were included.[1] Official theater versions of movies were purchased from YouTube in the highest definition available and were viewed on a MacBook Pro (2015 model with retina display or newer). A handful of movies were not available for purchase on YouTube and were instead viewed via alternative streaming services. Movie metadata (eTable 1) regarding Motion Picture Association of America (MPAA) rating (G, PG, PG-13, R), production studio (e.g., Warner Bros., Walt Disney Studios), production budget, genre (e.g., romance, adventure), domestic box office ticket sales, and run time were obtained from the Internet Movie Database in February 2020.[1]

Identification of Foods and Beverages

Trained researchers entered and content-coded all foods and beverages depicted in every scene from each of the 250 films. A scene was defined as a continuous time span occurring in the same setting (i.e., a change in setting or time of day marked the beginning of a new scene). Scenes that involved a flashback or memory, rapid changes in setting set to music, car chases, or extended fight scenes were coded as one continuous scene. The researchers had the ability to pause, re-watch, and slow down (as low as 0.1× normal speed) any scene as many times as necessary for clarification. All foods and beverages were coded as precisely as possible, whether in use by a character or not, regardless of positioning on the screen, and including empty food and beverage containers. See eTable 2 for coding decisions regarding specific situations. Foods and beverages appearing multiple times in the same scene were only coded once. When scenes depicted multiple types of a food or beverage (e.g., multiple brands of soda), each visible type was recorded as a separate observation in that scene (e.g., Pepsi, Diet Pepsi, Coca-Cola). However, if no brands were visible, then a single observation of soda (general) was recorded for that scene. Foods and beverages were counted as branded if the food or beverage contained a visible brand or logo. Total time that an observation appeared on screen was not coded.

As is standard practice,[2-6] a sample of 25 movies (10 of the sample) were content-coded by both researchers to monitor reliability. Inter-rater reliabilities for 5-minute blocks (the approximate time of a typical scene) within each movie in this subsample (n = 586 5-minute blocks) were 0.91 for identifying the presence of a beverage, and 0.93 for identifying the presence of a food, indicating "almost perfect" agreement.[7] Confirming that coders agreed on the specific food and beverage types present (out of n = 406 beverages and n = 900 foods), average inter-rater reliability ranged from K = .73 – 1.00 across food categories and K = .86 – 1.00 across beverage categories. Pearson correlation coefficients for the number of beverage and food scenes per film was r = 0.97 and r = 0.96 (p's < .001), respectively, demonstrating that coders applied consistent definitions of scene length. Disagreements were settled by the first author.

Food and Beverage Categories

To quantify the frequency of food and beverage categories and subcategories depicted in the entire sample, we used the USDA's What We Eat In America (WWEIA) 2015-2016 food categories and subcategories (Tables S3-S4).[8] WWEIA categorizes discrete food items (e.g., pizza) rather than disaggregating into ingredients (e.g., grain, cheese, tomatoes). Two researchers sorted all unique beverages that appeared in the full data set into one of 8 categories (alcoholic beverages, water, dairy beverages, coffee and tea, sweetened beverages, 100% juices, diet beverages, and infant formula/human milk), consulting the USDA's Food Data Central website (https://fdc.nal.usda.gov/index.html) as a searchable resource that populates WWEIA categorizations for many foods and beverages. Inter-rater reliability was very high across categories (K = .85 – 1.00), indicating "almost perfect" agreement.[7] Two researchers also sorted all unique foods in the full data set into one of 11 categories (dairy, grains, proteins, fruits, vegetables, snacks and sweets, mixed dishes, fats/oils, condiments/sauces, sugars, and protein/nutritional powders, each with multiple subcategories) with "almost perfect" average inter-rater reliability across categories (K = .91 – 1.00).

Calculating Nutritional Content

To determine the nutritional content of each food and beverage in each scene, we consulted the USDA's Food and Nutrient Database for Dietary Studies (FNDDS) 2015-2016.[9] This database provides standard nutritional content information per 100g of a food or beverage for over 8,600 unique foods and beverages. For each food and beverage in each scene, we recorded the following nutrition information for a 100 g sample, which was necessary for later

nutrition score calculations: total fat (g), saturated fat (g), sugar (g), sodium (mg), protein (g), fiber (g), and energy (kJ). The FNDDS does not provide data on added sugars, therefore only total sugars is reported.

For foods that had a single relevant code in the FNDDS, (e.g., Snickers candy bar), nutrient values for that code were used. For foods that had multiple relevant FNDDS codes (e.g., cookies), we used the most specific FNDDS code that was applicable for each observation (e.g., "cookie, chocolate chip" for chocolate chip cookies). Otherwise, the "not specified" or "not further specified" FNDDS code was used, which provides nutrition information for an average or general form of that food (e.g., "cookie, not further specified" for cookies of unknown type). See eTable 2 for examples of how specific cases were handled. We used an FNDDS entry for the cooked form of the food, unless it is commonly eaten in raw form (e.g., fruits). To be conservative (i.e., err towards healthier scores), most fruit juices were assumed to be 100% fruit juice, unless the label or context specified that it was not. Foods and beverages that obviously belonged to a particular category, but the specific type of food was not discernable (e.g., an orange-colored fruit in the background that could have been an orange, nectarine, peach, or grapefruit; fictional fruits in movies such as "Star Wars") were counted using the FNDDS entry for a general form of that food category (e.g., "Fruit, not specified as to type"). In five cases where takeout containers of food were visible but the specific contents were not, we recorded nutrition information for two popular items from that restaurant (Panda Express: fried rice, orange chicken; McDonald's: McDonald's cheeseburger, fast food French fries; Burger King: Burger King cheeseburger, fast food French fries; generic Chinese takeout: vegetable chow mein, General Tso's chicken; Taco Bell: beef soft taco, nachos with meat and sour cream).

To monitor reliability of selecting which of the ~8,600 FNDDS codes corresponded to each unique observation, two researchers each identified the closest matching FNDDS code for a random set of 20% of all unique foods and 20% of all unique beverages. Agreement was very high (91.6% agreement on foods, 98.0% agreement on beverages), and coders independently applied nutritional information codes to the remainder of the data.

Classifying Nutritional Content

To evaluate the healthiness of nutrient content, we used two well-established nutrient content rating systems that represent enacted law in the United Kingdom.[10-13] First to generate a summary nutrition score for each food/beverage that provides an overall classification of a food or beverage as "healthier" or "less healthy", we used the Nutrient Profile Index (NPI), which is a 0-100 scoring system adapted from the Nutrient Profile Model, the standard nutrition scoring system used in UK advertising law.[10-12] The NPI has been used in prior research on food advertisements[12,14-16] and is ideal for providing ratings for individual foods and beverages, as opposed to other rating systems, such as the Alternate Healthy Eating Index – 2010[17] or American Heart Association diet score,[18,19] that are designed for evaluating a person's consumption (including serving sizes) across 24 hours. The NPI assigns points for the nutrient content of 7 components per 100 g of food/beverage, penalizing foods for four nutrients that should be limited (sugar, sodium, energy, and saturated fat), and rewarding foods for three nutrients that are encouraged (fiber, protein, and fruit/vegetable content). The overall nutrition score ranges from 0 (least healthy) to 100 (healthiest). Under UK legal advertising guidelines, foods with NPI scores < 64 and beverages < 70 are considered "less healthy" and are unlawful in media advertisements in which youth ≤ age 16 comprise ≥ 25 of viewership.[10] **e**Figures 1 and 2 present example NPI scores of approximately 150 foods and 75 beverages, respectively.

Second, to classify total fat, saturated fat, sugar, and sodium content as low, medium, or high for each food and beverage depicted, we used the UK's Front-of-package "traffic light" labeling guidelines[13] for packaged foods (green = low, amber = medium, red = high). These "traffic light" labels are currently voluntary in the UK, but if used, must comply to standardized use of color formatting, appearance, and thresholds for low, medium, and high content of total fat, saturated fat, sugar, and sodium content per 100 g of a food or beverage. eFigure 3 presents example foods that fall within low, medium, and high ranges for sugar, saturated fat, total fat, and sodium content, according to "traffic light" labeling guidelines.

Comparison to Federal Recommended Daily Values

For comparison to national dietary recommendations, we consulted the most recent recommended levels of nutrient content from the U.S. Food and Drug Administration (FDA), which, in 2016, updated the recommended percent daily values from various nutrient categories to be used on the revised Nutrition Facts Label. These values per 2,000 kcal diet[20] are 78 g total fat, 20 g saturated fat, 2300 mg sodium, 28 g fiber, and maximum of 1 alcoholic drink (14 g alcohol). For sugars, recommendations are only instituted for added sugars (50 g), not total sugars. However, data for both movie-depicted foods/beverages and US individuals' consumption were only available for total sugars

because the FNDDS does not provide data for added sugars. To calculate the movie-depicted amounts of those nutrients, we first used a linear mixed effects model (with random intercept effect of scene nested within movie, see Statistical Analysis section) to estimate the kcal per 100 g among all foods and beverage observations in the data (N = 14,946), which was 151.80 kcal (95% CI: [146.15, 157.42]). We then used the same model to predict quantities of each nutrient (e.g., sodium, saturated fat) per 100 g among all observations and normalized these values to 2,000 kcal by multiplying by (2,000 kcal / 151.80 kcal) to obtain the estimate, multiplying by (2,000 kcal / 146.15 kcal) to obtain the lower bound of the 95% confidence interval, and multiplying by (2,000 kcal / 157.42 kcal) to obtain the upper bound of the 95% confidence interval.

Comparison to US Individuals' Actual Dietary Intake

To compare nutritional content and food and beverage categories depicted in movies to US individuals' actual dietary intake, we consulted data from NHANES 2015-2016.[8,21] NHANES 2015-2016 is a nationally representative survey of US individuals' 24-hour food and beverage intake, and, mirroring our approach in the present research, uses WWEIA categories for food and beverage classification into categories and subcategories. US consumption data (Day 1 reports, n = 8,506 individuals, all ages) for amounts of total fat, saturated fat, sugars, sodium, alcohol, and fiber per 2,048 kcal of food and beverage intake were provided by the USDA based on analyses of NHANES 2015-2016 data[21] and we normalized values to 2,000 kcal. We additionally compared proportions of WWEIA food and beverage categories and subcategories that comprised the movie-depicted diet and US individuals' consumption.[8]

Statistical Analysis

To calculate nutrient content for each movie, we used a random-intercept model from the lmerTest package[22] in R.[23] The model estimated, separately for each movie, the NPI nutrition score with a random intercept effect of scene ID nested within movie ID. This allowed us to quantify the proportion of movies that depicted healthier (score ≥ 64 for foods, ≥ 70 for beverages) and less healthy (score < 64 for foods, < 70 for beverages) nutrition scores, according to the NPI nutrition rating system. Similarly, for sugar, saturated fat, total fat, and sodium content, we used the same mixed effects model that estimated a given nutrient content per 100 g of food or beverage for each movie with a random-intercept effect of scene ID nested within movie ID. This allowed us to quantify the proportion of movies that depicted low, medium, and high levels of sugar, saturated fat, total fat, and sodium, according to "traffic light" labeling guidelines. We opted for these mixed effects models to account for the non-independence of foods that co-occurred in the same scene because they better represent the nested structure of the data than calculating simple averages across all observations.

Secondary outcomes tested for differences in nutrition scores and nutrient content over time, by MPAA rating, and by branding. We used separate mixed effects models that predicted NPI nutrition score or a given nutrient content as a function of release year (coded as a continuous variable with 1994 = 0, 1995 = 1, …, 2018 = 24), MPAA rating (factor coded as G, PG, PG-13, or R), or branding (factor coded) with a random-intercept effect of scene nested within movie. Models were run separately for foods and for beverages, except where otherwise specified. P values < .05 or 95% confidence intervals that did not include zero were considered statistically significant.

eResults.

Comparing branded observations in the present research with other studies of branded products
To verify the accuracy of our finding that only 11.5% of depicted foods and beverages were branded, here we compare results of the present research to results obtained independently by Sutherland and colleagues[3] and Bergamini and colleagues.[6] Sutherland and colleagues identified all branded foods and nonalcoholic beverages, including food retail establishment (FRE) brand appearances with an identifiable logo, product name, or both from the top 20-grossing movies in U.S. sales from each year between 1996-2005 (N = 200 movies). Sutherland et al.'s results identified a total of 1,180 brand placements (427 foods, 425 nonalcoholic beverages, and 328 FRE brands), but this did not include branded alcoholic beverages, which the present research reports to be 41.5% of branded beverages. Assuming this same proportion of alcoholic beverages was present in the movies observed by Sutherland and colleagues, Sutherland and colleagues would have observed 726 beverages (425 * (100/58.5)) in 200 movies, for a total of 1,481 branded observations (427 foods + 726 total beverages + 328 FREs) per 200 movies, or 7.4 branded observations per movie.

In the present research, we observed 1,721 branded foods and beverages (783 foods + 938 beverages) in 250 movies, plus an additional 109 branded restaurant storefronts that would have counted as FRE's in Sutherland and colleagues' investigation, yielding 1,830 branded observations per 250 movies, or 7.3 branded observations/movie. Thus, the frequencies of branded food and beverage items per movie were very similar in Sutherland and colleagues' investigation of only branded products and the present research investigating both branded and non-branded foods and beverages (7.4 vs. 7.3 branded items/movie, respectively).

As an additional check, we also compared the frequency of branded alcoholic beverages in the present research (389 branded alcoholic beverages / 250 movies = 1.6 branded alcoholic beverages/movie) to that identified by Bergamini and colleagues' independent investigation[6] of only branded alcoholic beverages (1400 movies released between 1996-2009), which was 1.7 branded alcoholic beverages/movie (2433 observations/1400 movies). Thus, the present research identified a very similar rate of branded alcoholic beverage observations per movie as Bergamini and colleagues (1.6 vs. 1.7 per film), despite the fact that R-rated movies depict alcoholic beverages at higher rates and the sample used by Bergamini and colleagues had a nearly 3-times greater proportion of R-rated movies (35%) than the sample used in the present research (12%). Together, these sensitivity analyses comparing observations from multiple independent investigations indicate that the finding that only 11.5% of all depicted food and beverages observations were branded is reliable.

Trends by MPAA Rating
NPI nutrition scores and food and beverage category proportions by MPAA rating are presented in Figure 2, eFigure 5, and eTable 12. Nutrient content differences by MPAA rating are presented in eTable 12. Among foods, NPI nutrition score did not significantly differ between any two MPAA rating categories (all p's > .05). Here we report further exploratory analyses by nutrient type. Foods in PG-rated movies contained higher sugar than foods in PG-13 rated movies (b = 2.46 g per 100 g food, 95% CI: [0.31, 4.62], p = .03). Movies did not significantly differ in saturated fat content from foods by MPAA rating. Total fat from foods was significantly higher in R-rated movies than in G-rated movies (b = 2.79 g per 100 g food, 95% CI: [0.13, 5.45], p = .04) and PG-rated movies (b = 1.64 g per 100 g food, 95% CI: [0.08, 3.21], p = .04). Sodium content from foods was also higher in R-rated movies than in PG-rated movies (b = 88.4 mg per 100 g food, 95% CI: [39.8, 136.9], p < .001) and PG-13-rated movies (b = 50.8 mg per 100 g food, 95% CI: [6.4, 95.3], p = .03).

Among beverages, NPI nutrition score did not significantly differ between any two MPAA rating categories (all p's > .09). However, beverages in G-rated movies contained significantly higher sugar content than PG (b = 1.21 g per 100 g beverage, 95% CI: [0.21, 2.22], p = .02), PG-13 (b = 2.24 g per 100 g food, 95% CI: [1.30, 3.19], p < .001), and R-rated (b = 2.03 g per 100 g food, 95% CI: [0.99, 3.07], p < .001) movies. PG-rated movies, in turn, had higher sugar content than PG-13 (b = 1.03 g per 100 g food, 95% CI: [0.56, 1.50], p < .001) and R-rated (b = 0.82 g per 100 g food, 95% CI: [0.18, 1.45], p = .01) movies.

eTable 1. Movie Characteristics

Characteristic	No.	%
MPAA Rating		
G	16	6.4
PG	60	24.0
PG-13	143	57.2
R	31	12.4
Genre		
Adventure	165	66.0
Action	130	52.0
Comedy	90	36.0
Fantasy	87	34.8
Sci-Fi	77	30.8
Family	73	29.2
Thriller	59	23.6
Drama	51	20.4
Animation	47	18.8
Romance	34	13.6
Mystery	22	8.8
Crime	19	7.6
Musical	10	4.0
Biography	5	2.0
Sports	5	2.0
Music	4	1.6
War	4	1.6
Horror	3	1.2
History	2	0.8
Production Studio		
Walt Disney Studios	59	23.6
Warner Bros	46	18.4
Twentieth Century Fox	30	12.0
Universal Pictures	30	12.0
Sony Pictures	22	8.8
Paramount Pictures	17	6.8
DreamWorks	15	6.0
New Line Cinema	12	4.8
Lionsgate	5	2.0
Miramax	4	1.6
Summit Entertainment	4	1.6
MGM	3	1.2
Artisan Entertainment	1	0.4
IFC Films	1	0.4
Newmarket Films	1	0.4
Production Budget (USD, millions)		
0-50	32	12.8
51-100	68	27.2
101-150	54	21.6
151-200	41	16.4
201-250	17	6.8
251+	5	2.0
N/A	33	13.2

Data for 250 movies retrieved from the Internet Movie Database.[1] Genre percentages do not add up to 100 because each movie represented between 1 and 7 genres.

eTable 2. Detailed Coding Decisions

Situation Description	Coding Decision
Beverages for non-drinking purposes (e.g., alcohol to light a flame, water for soaking dentures, rinsing mouth at dentist)	Excluded
Animals drinking milk from utter	Excluded
Things that characters ate but humans in Western cultures do not eat (e.g., guano, acorns, squirrels, rats, rocks, bugs)	Excluded
Medicines, cough drops, vitamins	Excluded
Salt, pepper, herbs, spices	Excluded because FNDDS does not categorize these foods
Generic words on storefronts (e.g., “pizza”, “coffee”)	Excluded
Foods within beverages (e.g., olives, lemons, limes, cherries) that character does not eat	Excluded
Dialogue about foods or beverages that are not present	Excluded
Chain/branded storefronts depicted but no foods or beverages (e.g., McDonald’s arches, Burger King sign)	Excluded
Extra toppings such as on cakes, pizza, desserts, sandwiches	Excluded, toppings did not count as separate items but were sometimes included in relevant FNDDS code
Dialogue about foods or beverages that are present in scene but not quite visible in frame	Included
Empty boxes, wrappers, cans, bottles	Included
Foods and beverages depicted in movie credits	Included
Branded names or brand logos on foods and beverages	Included, counted as branded item if either coder noted an identifiable logo or product name
Foods and beverages on signs, posters, t-shirts, paintings (including brands like Oreo)	Included
Items shaped like a food (carrot-shaped pen, onion-shaped carriage, statue of grapes)	Included
Foods growing on farms or in fields	Included if character picked or ate food (otherwise excluded)
Water from wild drinking sources (e.g., a watering hole, river)	Included if drank water
Opaque bag of food from branded restaurant but specific type of food is not visible	Included, counted as 2 popular items from that restaurant (see Supplemental Methods)
Opaque coffee mugs containing a hot beverage	Included, counted as coffee
Unlabeled white liquid add-in for coffee	Included, counted as half and half (which FNDDS codes as food)
Salad with unknown salad dressing	Included, used FNDDS code for general salad dressing
Beverages known to be alcoholic from movie context but type of alcohol not discernable (e.g., solo cups, opaque bottle)	Included, counted as beer (general) to be conservative
Unlabeled cups of soda that could be regular soda or diet	Included, counted as regular soda unless verbal or visible indication that it was diet
Characters that are themselves foods or beverages	Included on case-by-case basis (e.g., tea kettle in Beauty and the Beast counted only when contained tea)

eTable 3. Food Categories Depicted in Movies

Food Category	No.	%
Snacks and Sweets	**2,173**	**23.6**
Sweet bakery products (cookies, pies, pastries, cakes, donuts, brownies)	851	9.3
Candy (candy, chocolate, caramels)	702	7.6
Savory snacks (cheese balls, pretzels, potato chips, popcorn, tortilla chips)	378	4.1
Other desserts (ice cream and frozen dairy desserts, puddings, gelatins)	156	1.7
Crackers	62	0.7
Snack / Meal bars (breakfast bar, energy bar, granola bar)	24	0.3
Fruits	**2,053**	**22.3**
Vegetables	**1,324**	**14.4**
Vegetables (dark green, starchy, red/orange, leafy salads, veg mix dishes)	1,124	12.2
White potatoes (mashed, baked, fried, boiled, French fries)	200	2.2
Protein	**900**	**9.8**
Plant-based proteins (nuts, seeds, soy products, beans, legumes)	190	2.1
Meats (pork, lamb, beef, goat, game)	169	1.8
Eggs (including omelets)	153	1.7
Seafood (fish, shellfish)	140	1.5
Cured Meats/Poultry (cold cuts, bacon, sausages, hot dogs)	125	1.4
Poultry (chicken, turkey, duck)	123	1.3
Grains	**833**	**9.1**
Breads, rolls, tortillas (bread loaves, buns, dinner rolls, tortillas, bagels)	451	4.9
Cereals (ready-to-eat)	150	1.6
Quick breads / bread products (biscuits, muffins, pancakes, waffles)	116	1.3
Cooked grains (dry or plan pasta, noodles, rice)	96	1.0
Cooked cereals (oatmeal, breakfast grits)	20	0.2
Mixed Dishes	**682**	**7.4**
Mixed Dishes – Sandwiches (cheeseburger, deli subs, hot dogs, PBJ)	254	2.8
Mixed Dishes – Asian (chow mein, stir-fry, egg rolls, dumplings, sushi)	121	1.3
Mixed Dishes – Pizza	91	1.0
Mixed Dishes – Soups	83	0.9
Mixed Dishes – Grain-based (lasagna, mac and cheese, pasta, rice dishes)	66	0.7
Mixed Dishes – Meat, Poultry, Seafood	43	0.5
Mixed Dishes – Mexican (burritos, tacos, nachos)	24	0.3
Condiments and Sauces (ketchup, mustard, soy sauce, dips, gravy, sauces)	**539**	**5.9**
Fats and Oils (butter, cream cheese, whipped cream, mayo, vegetable oils)	**325**	**3.5**
Sugars (sugar, honey, sugar substitutes, jams, syrups, toppings)	**251**	**2.7**
Dairy	**116**	**1.3**
Cheese	102	1.1
Yoghurt	14	0.2
Other (protein and nutritional powders)	**2**	**0.0**

All food categories are defined by WWEIA Categories 2015-2016. Bolded entries represent categories and non-bolded entries represent subcategories. Percentages obtained by dividing observed frequencies by 9,198 total foods.

eTable 4. Beverage Categories Depicted in Movies

Beverage Category	No.	%
Alcoholic Beverages	**2,303**	**40.1**
Liquor and Cocktails	841	14.6
Wine	777	13.5
Beer	685	11.9
Coffee and Tea	**1,323**	**23.0**
Coffee (coffee, cappuccino, blended coffee drinks, mocha)	1,102	19.2
Tea (tea, sweet tea)	221	3.8
Water	**881**	**15.3**
Plain Water	849	14.8
Flavored or Enhanced Water	32	0.6
Sweetened Beverages	**790**	**13.7**
Soft drinks	579	10.1
Fruit drinks	128	2.2
Sport and Energy drinks	61	1.1
Smoothies and grain drinks	15	0.3
Nutritional beverages	7	0.1
Dairy Beverages	**223**	**3.9**
Milk	179	3.1
Milkshakes and Other Dairy Drinks	20	0.3
Flavored Milk	19	0.3
Milk Substitutes (almond, soy)	5	0.1
100% Juices	**169**	**2.9**
Citrus juice	114	2.0
Other fruit juice	28	0.5
Apple juice	19	0.3
Vegetable juice	8	0.1
Diet beverages	**48**	**0.8**
Diet soft drinks	48	0.8
Diet sport and energy drinks	0	0
Other diet drinks	0	0
Infant formula / Human milk	**11**	**0.2**

All beverage categories are based on WWEIA Categories 2015-2016. Bolded entries represent categories and non-bolded entries represent subcategories. Percentages obtained by dividing observed frequencies by 5,748 total beverages.

eTable 5. Movie-level and Item-level Nutrition Ratings for Foods and Beverages in Movies

	Foods								Beverages[b]							
	Movie Scores[a]		All Food		Branded Food		Non-branded Food		Movie Scores[a]		All Bevs		Branded Bevs		Non-branded Bevs	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
NPI ratings																
Healthier	67	27.3	4,564	49.6	105	13.4	4,459	53.0	24	9.8	3,260	56.7	483	51.5	2,777	57.7
Less Healthy	178	72.7	4,634	50.4	678	86.6	3,956	47.0	222	90.2	2,488	43.3	455	48.5	2,033	42.3
Traffic light ratings																
Sugar																
low	16	6.5	4,557	49.5	296	37.8	4,261	50.6								
medium	192	78.4	2,861	31.1	118	16.0	2,743	32.6								
high	37	15.1	1,780	19.4	369	47.1	1,411	16.8								
Saturated fat																
low	37	15.1	5,727	62.3	282	36.0	5,445	64.7								
medium	185	75.5	1,432	15.6	208	26.6	1,224	14.5								
high	23	9.4	2,039	22.2	293	37.4	1,746	20.7								
Total fat																
low	17	6.9	4,804	52.2	214	27.3	4,590	54.5								
medium	221	90.2	2,404	26.1	232	29.6	2,172	25.8								
high	7	2.9	1,990	21.6	337	43.0	1,653	19.6								
Sodium																
low	122	49.8	4,926	53.6	280	35.8	4,646	55.2								
medium	123	50.2	4,180	45.4	483	61.7	3,697	43.9								
high	0	0.0	92	1.0	20	2.6	72	0.9								

[a]Percentages in "Movie Scores" columns represent the percent of movies that depicted foods (*n* = 245) or beverages (*n* = 246), rather than percent of total movies (*N* = 250).
[b]Because few beverages contain fat or sodium, traffic light ratings for the proportions of observations with values in low, medium, and high nutrient ranges were not calculated for beverages.
NPI = Nutrient Profile Index

eTable 6. Branded Food Categories Depicted in Movies

Food Category	No.	%
Snacks and Sweets	**478**	**61.0**
Candy (candy, chocolate, caramels)	195	24.9
Savory snacks (cheese balls, pretzels, potato chips, popcorn, tortilla chips)	137	17.5
Sweet bakery products (cookies, pies, pastries, cakes, donuts, brownies)	96	12.3
Crackers	31	4.0
Other desserts (ice cream and frozen dairy desserts, puddings, gelatins, sorbet)	10	1.3
Snack / Meal bars (breakfast bar, energy bar, granola bar)	9	1.1
Grains	**109**	**13.9**
Cereals (ready-to-eat)	90	11.5
Cooked cereals (oatmeal, breakfast grits)	9	1.1
Breads, rolls, tortillas (bread loaves, buns, dinner rolls, tortillas, bagels)	5	0.6
Quick breads / bread products (biscuits, muffins, pancakes, waffles, french toast)	4	0.5
Cooked grains (dry or plan pasta, noodles, rice)	1	0.1
Mixed Dishes	**64**	**8.2**
Mixed Dishes – Sandwiches (cheeseburger, deli subs, hot dogs, peanut butter and jelly)	20	2.6
Mixed Dishes – Soups	17	2.2
Mixed Dishes – Grain-based (lasagna, mac and cheese, pasta dishes, rice dishes)	10	1.3
Mixed Dishes – Mexican (burritos, tacos, nachos)	9	1.1
Mixed Dishes – Pizza	4	0.5
Mixed Dishes – Meat, Poultry, Seafood	2	0.3
Mixed Dishes – Asian (fried rice, chow mein, stir-fry, egg rolls, dumplings, sushi)	2	0.3
Condiments and Sauces (ketchup, mustard, soy sauce, dips, gravies, sauces, olives)	**56**	**7.2**
Protein	**35**	**4.5**
Plant-based proteins (nuts, seeds, processed soy products, beans, legumes)	18	2.3
Cured Meats/Poultry (cold cuts, bacon, sausages, hot dogs)	10	1.3
Seafood (fish, shellfish)	5	0.6
Poultry (chicken, turkey, duck)	1	0.1
Meats (pork, lamb, beef, goat, game)	1	0.1
Eggs (including omelets)	0	0
Sugars (sugar, honey, sugar substitutes, jams, syrups, toppings)	**12**	**1.5**
Vegetables	**11**	**1.4**
White potatoes (mashed, baked, fried, boiled, French fries)	10	1.3
Vegetables (dark green, starchy, red/orange, leafy salads, vegetable mixed dishes)	1	0.1
Fats and Oils (butter, cream cheese, whipped cream, mayo, vegetable oils, creamer)	**10**	**1.3**
Fruits	**6**	**0.8**
Dairy	**1**	**0.1**
Cheese	1	0.1
Yoghurt	0	0
Other (protein and nutritional powders)	**1**	**0.1**

Food categories are defined by What We Eat in America Food Categories 2015-2016. Percentages obtained by dividing observed frequencies by 783 total branded foods.

eTable 7. Branded Food Items Depicted in Movies

Branded Foods	No.
Tabasco hot sauce	24
Lay's chips	21
Hostess packaged pastries	20
Doritos	18
Oreos	18
Pepperidge Farm cookies	17
Campbell's soups	15
Hershey's chocolate bars/kisses	15
Pringles	14
Ruffles chips	14
Burger King products	13
Cheerios	13
Fritos	13
Wonka candies	13
Cheetos	12
M&Ms candies	11
Pepperidge Farm Gold Fish	11
A1 steak sauce	10
Cap'n Crunch cereals	10
McDonald's products	10
Taco Bell products	10
Nestle chocolate bars	9
Lifesavers candy	9
Pop Tarts	9
Quaker Oats	9
Snickers	9
Little Debbie packaged pastries	8
Utz brand savory snacks	8
Lucky Charms cereal	7
Nicorette gum	7
Planter's nuts	7
Cocoa Pebbles cereal	6
Froot Loops cereal	6
Golden Crisp cereal	6
Red Vines licorice	6
Ritz crackers	6
Spaghettios	6
Spam	6
Wrigley's gum	6
Skippy peanut butter	5
Skittles candy	5
Twix	5

Branded food items depicted 4 times or fewer are not presented in this Table. Total number of branded food items identified = 783.

eTable 8. Branded Beverage Categories Depicted in Movies

Beverage Category	No.	%
Alcoholic Beverages	**389**	**41.5**
Beer	322	34.3
Liquor and Cocktails	64	6.8
Wine	3	0.3
Sweetened Beverages	**383**	**40.8**
Soft drinks	296	31.6
Sport and Energy drinks	50	5.3
Fruit drinks	28	3.0
Nutritional beverages	6	0.6
Smoothies and grain drinks	3	0.3
Diet beverages	**48**	**5.1**
Diet soft drinks	48	5.1
Diet sport and energy drinks	0	0
Other diet drinks	0	0
Coffee and Tea	**44**	**4.7**
Coffee (coffee, cappuccino, blended coffee drinks, mocha)	33	3.5
Tea (tea, sweet tea)	11	1.2
Water	**42**	**4.5**
Plain Water	28	3.0
Flavored or Enhanced Water	14	1.5
100% Juices	**22**	**2.3**
Citrus juice	12	1.3
Vegetable juice	5	0.5
Apple juice	3	0.3
Other fruit juice	2	0.2
Dairy Beverages	**10**	**1.1**
Milk	3	0.3
Milkshakes and Other Dairy Drinks	3	0.3
Flavored Milk	2	0.2
Milk Substitutes (almond, soy)	2	0.2
Infant formula and human milk	**0**	**0**

Beverage categories are defined by What We Eat in America Food Categories 2015-2016. Percentages obtained by dividing observed frequencies by 938 total branded beverages.

eTable 9. Branded Beverage Items Depicted in Movies

Branded Beverage	No.
Budweiser / Bud Light	146
Coca–Cola / Diet Coke	139
Pepsi / Diet Pepsi	108
Dr. Pepper/ Diet Dr Pepper	32
Coors / Coors Light	27
Heinecken beer	27
Miller / Miller Lite	25
Mountain Dew	21
Gatorade	21
Starbucks coffees and teas	13
Tropicana juices	12
Guinness beers	12
Minute Maid beverages	11
Jack Daniels whiskey	11
Sprite	11
Corona Extra / Light	10
Dunkin' Donuts coffee	10
Dasani water	10
Rainier beer	9
Perrier sparkling water	9
Slice soda	9
Monster energy drink	9
7Up	8
Michelob / Ultra	7
Lipton teas	7
Aquafina water	7
Red Bull energy drink	7
Foster's beer	6
Pabst Blue Ribbon beer	6
Glenlivet whiskey	6
V8 juice	5
Singha / Light	5
Maker's Mark whiskey	5
Smirnoff vodka	5
Snapple	5
Nos energy drink	4
Achaia Clauss Ouzo	4
Busch / Light	4
Dos Equis beer	4
Mike's Hard Lemonade	4
Evian	4
Fanta	4

Branded beverages depicted 3 times or fewer are not presented in this Table. Total number of branded beverages identified = 938.

eTable 10. Branded Restaurant Storefronts Depicted in Movies

Restaurant Storefront	No.
McDonald's	20
Starbucks	15
Bubba Gump	9
Burger King	9
Pizza Hut	5
7-11	5
Dunkin' Donuts	4
Subway	4
Baskin Robbins	3
IHOP	3
Ben & Jerry's	2
Boudin Sourdough	2
Dave & Buster's	2
Denny's	2
Jimmy Buffett's Margaritaville	2
KFC	2
Krispy Kreme	2
TGI Fridays	2
Wendy's	2
Applebee's	1
Boston Market	1
Carl's Jr.	1
Chipotle	1
Dairy Queen	1
Del Taco	1
Hard Rock Café	1
Hooter's	1
Jimmy John's	1
Maggiano's	1
Quizno's	1
Sbarro	1
Taco Bell	1
The Coffee Bean & Tea Leaf	1

Frequencies include obvious imitation spoofs such as "Farbucks" coffee for Starbucks coffee and "Burger Prince" for Burger King. Frequencies do not include individual branded food or beverage items.

eTable 11. Trends in Nutrition Ratings and Key Nutrients Over Time

Outcome	Intercept	Effect of year released (*b*)	95% CI	*P* value (linear)
Food scenes per film	10.77	-0.05	[-0.15, 0.05]	.34
Beverage scenes per film	14.05	-0.13	[-0.26, 0.01]	.07
NPI score per food item	58.20	0.07	[-0.05, 0.19]	.23
NPI score per beverage item	68.74	0.00	[-0.01, 0.02]	.53
Sugar (g) per 100 g food item	15.74	-0.05	[-0.18, 0.08]	.43
Sugar (g) per 100 g beverage item	2.39	-0.01	[-0.04, 0.02]	.44
Saturated fat (g) per 100 g food item	3.23	-0.01	[-0.03, 0.01]	.43
Total fat (g) per 100 g food item	10.16	-0.04	[-0.10, 0.03]	.29
Sodium (mg) per 100 g food item	313.8	-0.3	[-2.3, 1.8]	.80

Model outputs for the number of food scenes and number of beverage scenes per film are from a linear regression model predicting the outcome as a function of release year. All other model outputs are from a linear mixed effects regression model predicting the outcome as a function of year released plus a random intercept effect of scene nested within movie. Year released was coded as 1994 = 0, 1995 = 1, 1996 = 2, … 2018 = 24. NPI = Nutrient Profile Index

eTable 12. Trends in Nutrition Ratings and Key Nutrients by MPAA Rating

	G		PG		PG-13		R	
	Est.	95% CI	Est.	95% CI	Est.	95% CI	Est.	95% CI
Foods								
Scenes per movie	7.1[b,d]	[4.2, 10.0]	12.7[a,c]	[11.2, 14.2]	9.2[b]	[8.3, 10.2]	11.3[a]	[9.2, 13.3]
NPI score	59.5	[55.6, 63.4]	58.7	[57.0, 60.4]	59.7	[58.5, 60.9]	57.0	[54.6, 59.4]
Sugar (g per 100g)	16.4	[12.3, 20.5]	16.8[c]	[15.0, 18.6]	14.3[b]	[13.1, 15.6]	14.8	[12.3, 17.3]
Saturated fat (g per 100g)	3.0	[2.2, 3.9]	3.2	[2.9, 3.5]	3.0	[2.8, 3.3]	3.3	[2.9, 3.8]
Total fat (g per 100g)	8.0[d]	[5.7, 10.4]	9.2[d]	[8.3, 10.1]	9.9	[9.3, 10.5]	10.8[a,b]	[9.5, 12.1]
Sodium (mg per 100g)	307	[238, 375]	277[c,d]	[250, 305]	315[b,d]	[295, 334]	366[b,c]	[326, 406]
Beverages								
Scenes per movie	6.2[c,d]	[2.5, 9.9]	10.2[c,d]	[8.3, 12.1]	13.4[a,b]	[12.1, 14.6]	16.2[a,b]	[13.6, 18.9]
NPI score	68.4	[67.9, 68.9]	68.9	[68.7, 69.1]	68.8	[68.7, 68.9]	68.7	[68.5, 69.0]
Sugar (g per 100g)	4.2[b,c,d]	[3.3, 5.1]	3.0[a,c,d]	[2.6, 3.4]	1.9[a,b]	[1.7, 2.2]	2.2[a,b]	[1.7, 2.6]

Model outputs for the number of food scenes and number of beverage scenes per movie are from a linear regression model predicting the outcome as a function of MPAA rating. All other model outputs are from a linear mixed effects model predicting the outcome as a function of MPAA rating plus a random intercept effect of scene nested within movie.
[a] indicates column proportions that differ significantly from G-rated movies column ($p < .05$)
[b] indicates column proportions that differ significantly from PG-rated movies column ($p < .05$)
[c] indicates column proportions that differ significantly from PG-13-rated movies column ($p < .05$)
[d] indicates column proportions that differ significantly from R-rated movies column ($p < .05$)

eTable 13. Comparing Movie-Depicted Nutrients With Federal Recommended Daily Values

Outcome[a]	Movie[b]	Recommended Daily Value (RDV)[c]	Difference[d] (Movie – RDV)	Movie % Difference from RDV[e]
Alcohol (g)	38.8 [37.4, 40.3]	14	24.8 [23.4, 26.3]	177% [167, 188]
Total sugar (g)	120.6 [116.3, 125.2]	-	-	-
Fiber (g)	15.4 [14.8, 16.0]	28	-12.6 [-13.2, -12.0]	-45.1% [-47.0, -42.9]
Total fat (g)	76.9 [74.2, 79.9]	78	-1.1 [-3.8, 1.9]	-1.4% [-4.9, 2.4]
Saturated fat (g)	25.0 [24.1, 26.0]	20	5.0 [4.1, 6.0]	25.0% [20.6, 29.9]
Sodium (mg)	2390 [2304, 2482]	2300	90 [4, 182]	3.9% [0.2, 7.9]

95% confidence intervals are in brackets

[a]Outcomes are reported as grams per 2,000 kcal

[b]Movie-depicted nutrient content was calculated using a linear mixed effects model (with random intercept effect of scene nested within movie) to estimate the kcal per 100 g among all foods and beverage observations in the data, which was 151.80 kcal (95% CI: [146.15, 157.42]). We then used the same model to predict quantities of each nutrient (e.g., sodium, saturated fat) per 100 g among all observations and normalized these values to 2,000 kcal by multiplying by (2,000 kcal / 151.80 kcal) to obtain the estimate, multiplying by (2,000 kcal / 146.15 kcal) to obtain the lower bound of the 95% confidence interval, and multiplying by (2,000 kcal / 157.42 kcal) to obtain the upper bound of the 95% confidence interval.

[c]Recommended daily values (RDV) from the FDA (United States Food and Drug Administration)[20]

[d]Difference between movie-depicted nutrient values and RDV was calculated by subtracting the RDV from the mean movie value for each outcome. The 95% confidence intervals in this column represent the lower limit of the 95% confidence interval of the movie estimate minus the RDV and the upper limit of the 95% confidence interval of the movie estimate minus the RDV. There is no RDV for total sugar.

[e]Percent difference was obtained by dividing the difference column by the RDV column. The 95% confidence intervals in this column represent the lower limit of the 95% confidence interval of the difference column divided by RDV and the upper limit of the 95% confidence interval of the difference column divided by the RDV.

eTable 14. Comparing Movie-Depicted Nutrients With US Individuals' Actual Intake

Outcome[a]	Movie[b]	Actual[c]	Difference[d] (Movie – Actual)	Movie % Difference from Mean Actual Consumption[e]
Alcohol (g)	38.8 [37.4, 40.3]	9.4 [8.2, 10.6]	29.4 [28.0, 30.9]	313% [298, 329]
Total sugar (g)	120.6 [116.3, 125.2]	103.5 [100.6, 106.5]	17.1 [12.8, 21.7]	16.5% [12.3, 21.0]
Fiber (g)	15.4 [14.8, 16.0]	16.1 [15.4, 16.8]	-0.7 [-1.3, -0.1]	-4.5% [-7.9, -0.8]
Total fat (g)	76.9 [74.2, 79.9]	79.5 [77.5, 81.5]	-2.6 [-5.3, 0.4]	-3.2% [-6.7, 0.5]
Saturated fat (g)	25.0 [24.1, 26.0]	26.5 [25.6, 27.3]	-1.5 [-2.4, -0.5]	-5.5% [-8.9, -1.9]
Sodium (mg)	2390 [2304, 2482]	3330 [3264, 3396]	-941 [-1026, -848]	-28.2% [-30.8, -25.5]

95% confidence intervals are in brackets

[a]Outcomes are reported as grams per 2,000 kcal

[b]Movie-depicted nutrient content was calculated using a linear mixed effects model (with random intercept effect of scene nested within movie) to estimate the kcal per 100 g among all foods and beverage observations in the data, which was 151.80 kcal (95% CI: [146.15, 157.42]). We then used the same model to predict quantities of each nutrient (e.g., sodium, saturated fat) per 100 g among all observations and normalized these values to 2,000 kcal by multiplying by (2,000 kcal / 151.80 kcal) to obtain the estimate, multiplying by (2,000 kcal / 146.15 kcal) to obtain the lower bound of the 95% confidence interval, and multiplying by (2,000 kcal / 157.42 kcal) to obtain the upper bound of the 95% confidence interval.

[c]Actual represents US individuals' mean consumption of each nutrient per 2,000 kcal, as provided by the USDA based on analyses of NHANES 2015-2016 data[21]

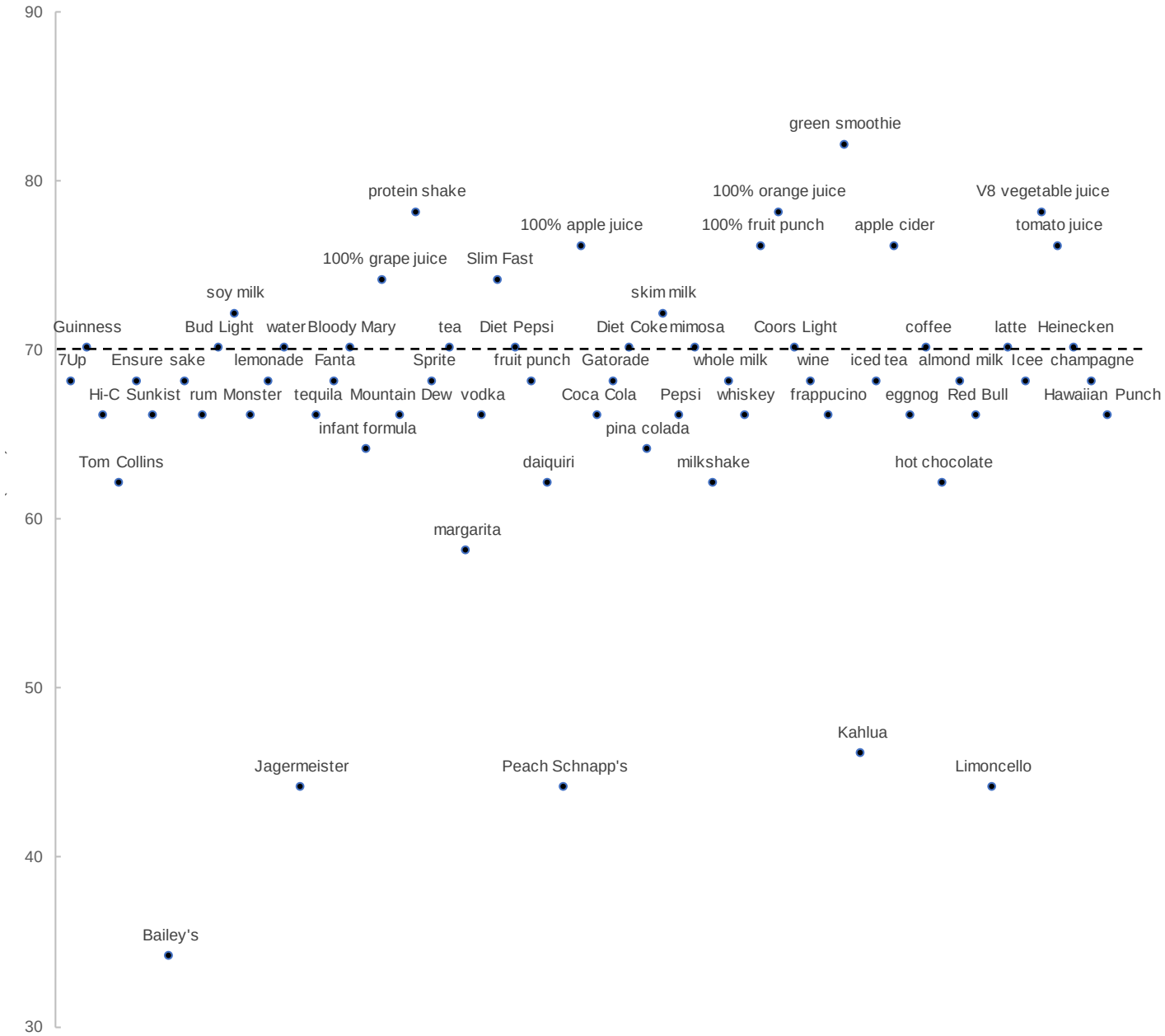
[d]Difference between movie-depicted nutrient values and actual US individuals' intake values was calculated by subtracting the mean actual value from the mean movie value for each outcome. The 95% confidence intervals in this column represent the lower limit of the 95% confidence interval of the movie estimate minus the mean actual estimate and the upper limit of the 95% confidence interval of the movie estimate minus the mean actual estimate.

[e]Percent difference was obtained by dividing the difference column by the actual column. The 95% confidence intervals in this column represent the lower limit of the 95% confidence interval of the difference column divided by the mean actual estimate and the upper limit of the 95% confidence interval of the difference column divided by the mean actual estimate.

eFigure 1. Example Nutrient Profile Index (NPI) Scores for Foods

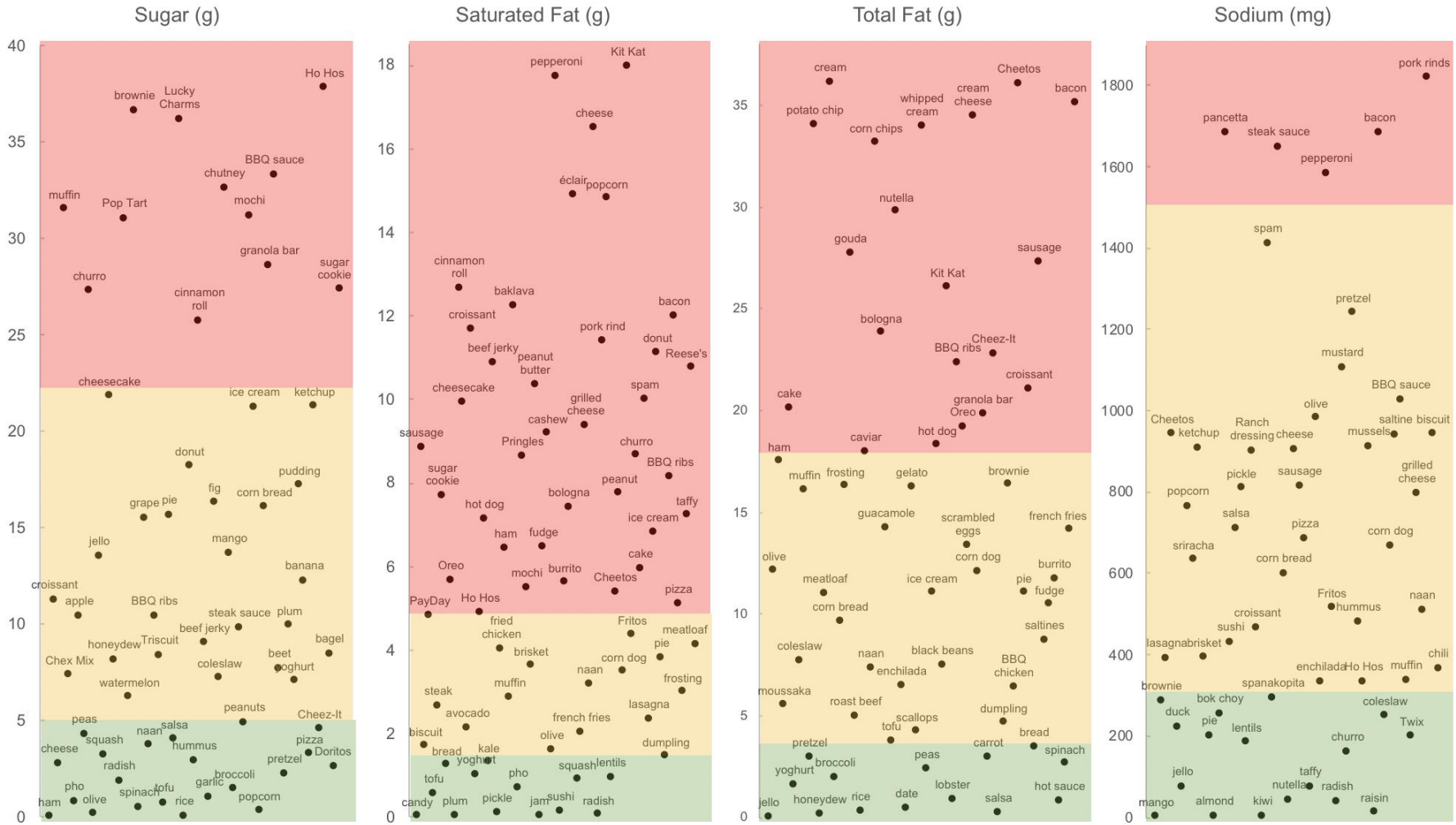
Example foods were randomly chosen to represent a range of scores for foods. The x-axis has no value (data points are randomly scattered to enhance readability). NPI scores ≥ 64 (points on or above the dotted line) are considered “healthier” and scores < 64 (points below the dotted line) are considered “less healthy” and would fail legal limits for advertising to youth in the UK.[10]

eFigure 2. Example Nutrient Profile Index (NPI) Scores for Beverages



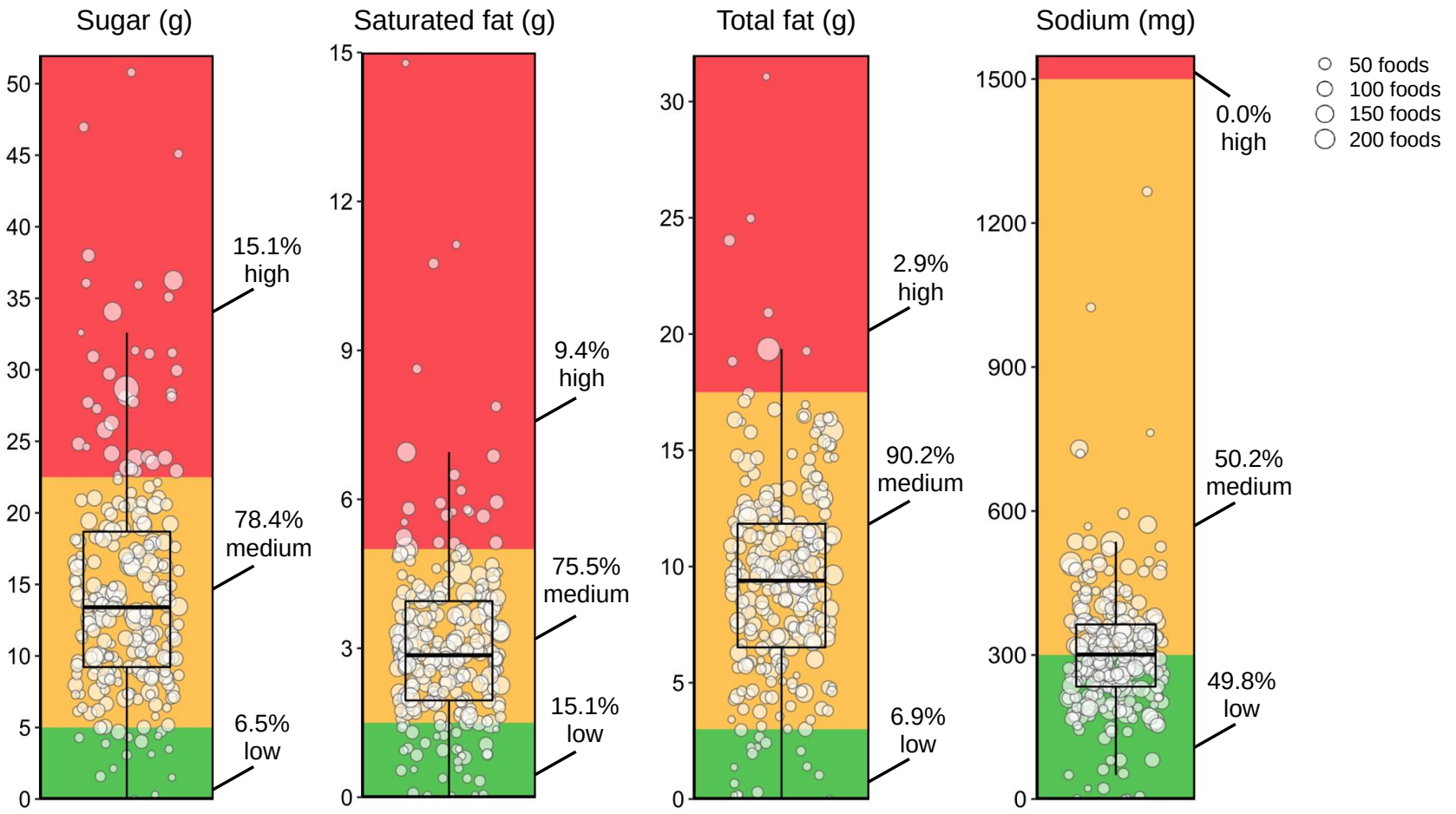
Example beverages were randomly chosen to represent a range of scores for beverages. The x-axis has no value (data points are randomly scattered to enhance readability). NPI scores ≥ 70 (points on or above the dotted line) are considered “healthier” and scores < 70 (points below the dotted line) are considered “less healthy” and would fail legal limits for advertising to youth in the UK.[10]

eFigure 3. Example Front-of-Package “Traffic Light” Ratings for Nutrient Content of Foods



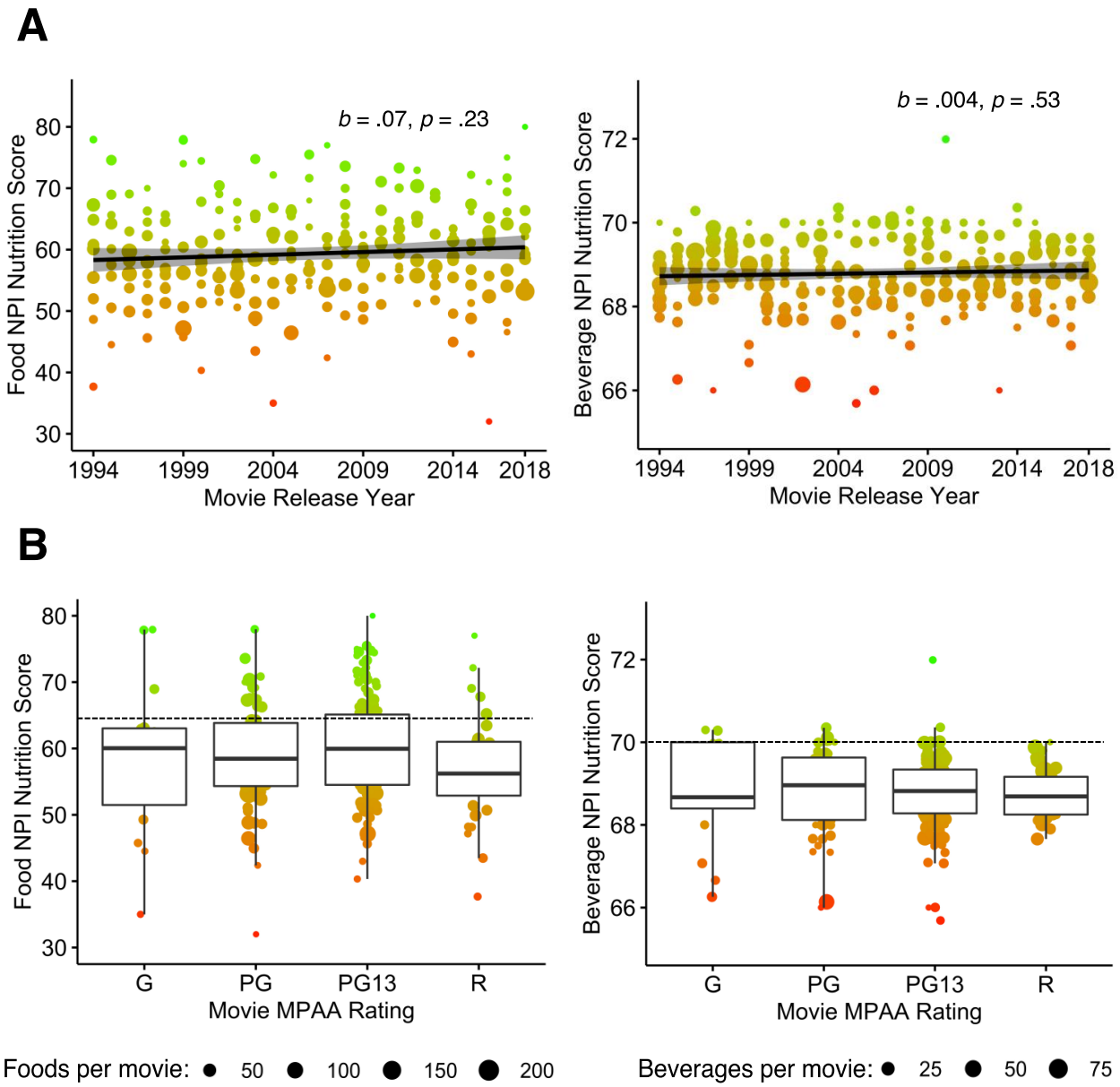
Example foods were randomly chosen to represent various foods with low (green), medium (amber), and high (red) levels of sugar, saturated fat, total fat, and sodium, based on front-of-package “traffic light” labeling guidelines in the UK.[13] The x-axis has no value (data points are randomly scattered to enhance readability). Values represent g (or for sodium, mg) per 100g of food and were obtained from the FNDDS.[9]

eFigure 4. Movie-Level Traffic Light Nutrition Ratings for Foods



Movie-level "traffic light" nutrition ratings for foods. Each dot represents one movie's sugar, saturated fat, total fat, or sodium content per 100 g of food (*n* = 245 movies). Green shading represents low levels (healthiest), amber represents medium, and red represents high levels of each nutrient (least healthy), per "traffic light" labeling guidelines.[13] Each boxplot inner horizontal line represents the median, boxes represent the interquartile range (25th and 75th percentiles), and vertical whiskers represent 1.5 times the interquartile range. Dot size corresponds to the number of foods or beverages per movie.

eFigure 5. Trends in NPI Nutrition Scores Over Time and by MPAA Rating



(**A**) NPI nutrition scores for foods and beverages by year of movie release. Each dot represents one movie, dot size corresponds to the number of food or beverage observations per movie, and dot color represents nutrition score (green = healthiest, red = least healthy). Regression lines with 95% confidence intervals are fitted.
(B) NPI nutrition score boxplots by MPAA ratings. Points below the dotted line represent "less healthy" NPI nutrition scores. Each boxplot inner horizontal line represents the median, boxes represent the interquartile range (25th and 75th percentiles), and vertical whiskers represent the furthest point within 1.5 times the interquartile range beyond the 25th and 75th percentiles. Each dot represents one movie, dot size corresponds to the number of food or beverage observations per movie, and dot color represents nutrition score (green = healthiest, red = least healthy).

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