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Title: Diet quality of items advertised in supermarket sales circulars compared to diets of the US population, as assessed by the Healthy Eating Index-2010

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ABSTRACT

Background: Supermarkets use sales circulars to highlight specific foods, usually at reduced prices. Resulting purchases help form the set of available foods within households from which individuals and families make choices about what to eat.

Objective: The purposes of this study were to determine how closely foods featured in weekly supermarket sales circulars conform to dietary guidance and how diet quality compares to that of the U.S. population's intakes.

Materials and Methods: Food and beverage items (n = 9,149) in 52 weekly sales circulars from a small Midwestern grocery chain in 2009 were coded to obtain food group, nutrient and energy content. Healthy Eating Index-2010 (HEI-2010) total and component scores were calculated using algorithms developed by the National Cancer Institute. HEI-2010 scores for the US population ages 2+ were estimated using data from the 2009-2010 National Health and Nutrition Examination Survey. HEI-2010 scores of circulars and population intakes were compared using Student's t-tests.

Results: Average total (42.8/100) HEI-2010 scores of circulars were lower than that of the US population (55.4; $P < 0.001$). Among individual components, Total Protein Foods was the only one for which 100% of the maximum score was met by both circulars and the population. The scores were also similar between the circulars and population for Whole Grains (22%; $P = 0.81$) and Seafood and Plant Proteins (70-74%; $P = 0.33$). Circular scores were lower than those of the population for Total and Whole Fruits, Total Vegetables and Greens and Beans, Dairy, Sodium,

and Empty Calories ($P < 0.001$); they were higher only for Fatty Acids ($P = 0.006$) and Refined Grains ($P < 0.001$).

Conclusions: HEI-2010 total scores for these sales circulars were even lower than US population scores, which have been shown repeatedly to reflect low diet quality. Supermarkets could support improvements in consumer diets by weekly featuring foods that are more in concordance with food and nutrient recommendations.

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INTRODUCTION

A large percentage of meals Americans consume are prepared away from home, but the majority of their energy intake is derived from foods at home [1], and Americans' grocery purchases score low in diet quality [2]. Food purchases are driven in large part by the food environment, one level of which is the retail level, including corner stores, super-center-type stores, and supermarkets (grocery stores). In the US, supermarkets use a broad mixture of methods to increase sales. Variety and placement of items, pricing, and promotion are all designed to nudge consumers to purchase certain food categories [3,4]. Supermarkets are often targets of nutrition interventions to increase healthier or decrease unhealthier food purchases. Many interventions occur at the point-of-purchase level, where food selection occurs, using price discounts, education, in store demonstrations, and manipulation of placement and availability of foods, and have been extensively reviewed [5-9]. However, the influence of intervening on the planning stage of grocery shopping trips has generally not been addressed. One understudied method of marketing and potential intervention level is weekly sales circulars, which communicate price and highlight sale items to consumers. Sales circulars are widely read both in print and online and influence purchasing decisions [10-14]. As they shape food purchases by focusing consumer attention to specific foods, circulars have the potential to impact food purchases and subsequent food intake [15]. Recent studies report that supermarket sales circular contents are discordant with the US MyPlate [16] nutrition education icon [17,18]. Given the potential of supermarket marketing strategies to affect food purchasing and eating behavior in either positive or negative ways, an examination

of the nutritional quality of items advertised in weekly newspaper sales circulars can provide direction for nutrition interventions partnering with supermarkets.

The Healthy Eating Index (HEI)-2005 and subsequent HEI-2010 were developed by the National Cancer Institute and the US Department of Agriculture (USDA) for the purpose of measuring how well a set of foods conforms to federal dietary guidance [19-22]. The HEI-2010 reflects the recommendations of the Dietary Guidelines for Americans 2010 as implemented by the USDA Food Patterns [23-25]. The HEI has been used to measure the food environment on various levels, such as the US food supply [26-28], federal food assistance programs [29], and restaurants [27,30]. The diet quality of individual food choices including grocery purchases [2] and dietary intake [31,32] have also been assessed using the HEI. Because the index uses a universal set of standards and is calculated using a density approach, it can measure the diet quality of any mix of foods. This means it can be applied across levels of the food supply chain and, regardless of the level, the scores are comparable.

This report expands upon previous research describing the content of supermarket sales circulars[17] by quantifying the diet quality of the items promoted using the HEI-2010 scoring system. The purposes of this study were to 1) determine how closely the contents of one years' worth of weekly supermarket sales circulars from a small Midwestern supermarket chain conformed to current dietary guidance as measured by the HEI-2010, and 2) to compare the HEI-2010 scores of the circulars to those of the diets of the US population.

MATERIALS AND METHODS

Coding of sales circulars

Fifty-two weekly supermarket sales circulars dating from January 1 to December 31, 2009, were collected from a Grand Forks, N.D. supermarket chain. Approximately 100,000 circulars are either delivered in the Sunday edition of the local newspaper or are available in-store each week. For this study, circulars were obtained from newspapers, stores, and store archives. Each food item in the weekly circulars was dual-coded by trained research personnel to assure data entry reliability; discrepancies were resolved by a supervisory research Registered Dietitian Nutritionist. Nonfood items were excluded, and alcoholic beverages were not included as the chain did not sell or advertise alcohol for the entire year. Of the 9245 food and beverage items listed in the weekly circulars, 9149 (99.0%) were coded by a Registered Dietitian Nutritionist using the Food and Nutrient Database for Dietary Studies (FNDDS), version 5.0 (2012) [33]. Nutrient values for FNDDS 5.0 are based on values in USDA National Nutrient Database for Standard Reference, Release 24 (SR24; 2011)[34]. Excluded items included spices such as taco seasonings that did not have a match in FNDDS. Acceptable matches were determined based on item descriptions. Common measure units (e.g., oz., fl. oz., etc.) were determined for each item. When a range of weights was listed in the ad (e.g. 12-14 oz.), the midpoint of the range was recorded. Items sold per pound were entered as 1 lb. The package measure was multiplied by the quantity per ad price to determine the total measure amount for the item(s) advertised. For example, 12-packs of 12 fl. oz. cans of soda on sale as three 12-packs for $9.00; each 12-pack contains 144 fl. oz.; quantity per ad price is three; total measure amount advertised is 432 fl. oz. All common measure units were converted to gram amounts. FNDDS 5.0 was also used to determine calorie, sodium, saturated fat, monounsaturated fat, and polyunsaturated fat content of the advertised items. To estimate amounts of food groups, added sugars, and solid fats in these items, the FNDDS codes were linked to the MyPyramid Equivalents Database (MPED) 2.0

(2008) [35], the CNPP MyPyramid Equivalents Databases for Whole Fruit and Fruit Juices for NHANES 2003-04 [36] and the CNNP Addendum to MyPyramid Equivalents Database (MPED), 2.0B (2011). The HEI-2010 score was calculated using the relevant FNDDS nutrients and MPED food groups.

U.S. population estimates

This analysis used data from the 2009-2010 Centers for Disease Control and Prevention, National Center for Health Statistics (NCHS), National Health and Nutrition Examination Survey (NHANES) and the USDA/Agricultural Research Service (ARS) What We Eat in America (WWEIA) dietary intake component of NHANES (n = 10,537). NHANES is a continuous cross-sectional survey of the civilian, non-institutionalized US population. The survey uses a complex, multistage probability sampling design and sample weights are provided to produce nationally representative estimates. Data are released in 2-year cycles and details may be found elsewhere [37,38]. WWEIA includes two non-consecutive, interviewer-administered 24-hour recalls derived using the USDA/ARS Automated Multiple-Pass Method [39]. NHANES protocols were approved by the NCHS Ethics Review Board and all participants provided informed consent. Estimates are from day 1 intake data reported by 9,522 individuals aged 2 and older deemed reliable by the interviewer.

Description of the HEI-2010

The HEI-2010 is composed of 12 food group and nutrient components. Of these, 9 are components for which Americans are at risk of inadequate intake: 1) Total Fruit, 2) Whole fruit, 3) Total Vegetables, 4) Greens and Beans, 5) Whole Grains, 6) Dairy, 7) Total Protein Foods, 8)

Seafood and Plant Proteins, and 9) poly- and mono-unsaturated Fatty Acids. The remaining 3 are components that should be consumed in moderation: 10) Refined Grains, 11) Sodium and 12) Empty Calories (calories from solid fats, added sugars, and alcohol). Depending on the component, scores range from zero to 5, 10, or 20. All components are scored on a density basis; for all components other than Fatty Acids, amounts are assessed per 1,000 kcal, with Empty Calories reported as a percentage. For instance, to receive the maximum score of 5 for the Total Vegetables component, the group of foods being evaluated must contain at least 1.1 cup equivalents per 1,000 kcal (**Table 1**). Fatty Acids are assessed as the ratio of poly-and mono-unsaturated to saturated fatty acids. Once each of the 12 component ratios is calculated, scores are assigned and the scores can be summed to derive the total HEI-2010 score which ranges between 0-100. Individual component scores are meaningful and should be included, along with total scores, as a part of any evaluation. Because the index uses a universal set of standards which are density-based, the index is appropriate for the comparison of any set of foods. The HEI-2010 has been extensively validated [22], and details can be found elsewhere [21].

Statistical analysis

The code for deriving HEI-2010 scores was downloaded from http://appliedresearch.cancer.gov/tools/hei/tools.html [40]. On this website, SAS code is provided for calculating HEI-2010 scores using 1-day dietary intakes reported by participants in WWEIA, NHANES surveys or using 24-hour recall data for a single day in other datasets. The latter code was modified to calculate the HEI-2010 scores for the weekly circulars. In the calculations, each circular was treated as if it was a person reporting a single days' food intake, i.e. the amount of each dietary constituent, including calories, was summed over all items in each circular. Density

ratios were derived and used to calculate the HEI-2010 scores for that circular. Densities for all components used to calculate HEI-2010 scores are reported as means of the 52 circulars, as are component and total scores.

The program used to derive HEI-2010 component and total scores for the US population accounted for the complex sampling design of the WWEIA, NHANES survey. A Monte Carlo simulation step was included to obtain estimates of the standard errors for the HEI-2010 scores. Results are reported as mean ± standard error (SE). T-tests were used to compare HEI-2010 component scores and totals of the US population to the circulars. Seasons were categorized as: winter (December-February), spring (March-May), summer (June-August), and fall (September-November). Differences by season in component and total circular scores were tested using one-way analysis of variance (ANOVA) followed by Tukey contrasts. SAS Version 9.4 (SAS Institute, Inc., Cary, NC; 2012) was used for all analyses.

RESULTS

There was an average of 178 (range: 135-253) items advertised in each weekly circular, representing an average of 363,859 kcal (range: 235,076-686,711). There was no significant difference in total HEI-2010 scores by season (Table 2, available online at www.andjrnl.org). However, the Total Fruit score was higher in winter than other seasons ($P = 0.01$), and the Empty Calories score was lower in summer than in other seasons ($P < 0.01$), meaning the quantity of empty calories per 1,000 calories was higher. As there were few seasonal differences, the following results are presented for the full year.

The mean density amounts of each component used to calculate the HEI-2010 scores, along with the scores themselves, are found in **Table 3**. Among the foods that are encouraged for

consumption, the amounts were higher in the circulars than the population only for Total Protein Foods and the Fatty Acids ratio. The amounts of Whole Grains were identical and the amounts of Seafood and Plant Proteins were similar. Among components which are targeted for limited consumption, amounts in the circulars were higher than the population in both Sodium and Empty Calories.

The total score for the US population's intake (55.4 ± 0.7) was higher than that for the circulars ($P < 0.001$). The HEI-2010 total score for the circulars was less than half of the maximum possible points (42.8 out of 100), and ranged from 32.4 to 61.9 across the 52 circulars. Scores were lowest for the Whole Grains (2.2 out of a maximum of 10 points) and Greens and Beans (1.2 out of a possible 5 points) components, and the Total and Whole Fruits, Total Vegetables, Dairy, Fatty Acid Ratio, Sodium and Empty Calories components were also low. Although the amount used to derive the circular score was higher, both the circulars and the population received a score of 5 for Total Proteins, because the component scores are truncated.

Figure 1 shows the circular and population component scores as a percentage of their maximum. For the circulars, the HEI component with the highest score was Total Protein Foods, which received a score of 100%. Otherwise, only the Seafood and Plant Proteins and Refined Grains groups were over 50% of the optimal score. Among other components for which consumption is recommended and intake is low, sales circular scores were lower than the US population for Total and Whole Fruits, Total Vegetables, Greens and Beans, and Dairy. For items to be consumed in moderation, lower scores reflect *more* of the component, not less, and the scores for Sodium and Empty Calories were also lower in the circulars. For the US population, scores for eight components exceeded half of the maximum: Total and Whole Fruits, Total Vegetables, Total Protein Foods, Seafood and Plant Proteins, Dairy, Refined Grains, and

Empty Calories. Greens and Beans, Whole Grains, the Fatty Acid ratio and Sodium all were below half of the maximum score.

DISCUSSION

A first step to improving dietary intake is to have healthier foods available in the home. This evaluation of the diet quality of one year's grocery store circulars found that most, although not all, food groups advertised have low diet quality and the total diet quality score was also low. The overall diet quality of the promoted items did not vary by season and was lower than that of the US population intake.

The population scores in this study are consistent with a previous evaluation of the HEI-2010 scores of the US population using data from 2007-2008. Compared to that report, the population total score reported here was slightly higher (55.4 vs 53.5) [32]. Recently, Miller et al., used the HEI-2010 to evaluate the 2010 food supply and found that the overall score was 55, the same as that found in the 2009-10 population estimate in this paper [28]. Volpe and Okrent used the previous version of the index, HEI-2005, to measure the diet quality of household food purchases [2]. The average overall score was 56.4, which is similar to the population diet quality score in the present study, although the two indices are not directly comparable [22]. Both versions of the HEI are density based and comprised of 12 components which score to a maximum of 100 points; however, each is designed to assess concordance with a particular version of the Dietary Guidelines for Americans which evolve over time. Nonetheless, the scores indicate that the quality of the foods featured in these circulars, average purchases in the US, and the typical American diet is only about half as high as recommended.

Sales circulars may be nudging consumers in the direction of unbalanced diets by promoting items that, compared to population intakes, are even lower in vegetables, fruits and dairy and higher in salt and empty calories. On the other hand, circulars do not appear to be promoting more refined grains than people are currently consuming. Circulars often advertise items as "loss-leaders" or products that are priced such that the profit margin is low. The purposes of this advertising and pricing strategy are to entice customers to enter the store in hopes that they will purchase items in a variety of categories, and to encourage the purchase of higher profit-margin items [41]. For instance, advertisements for ground beef can increase sales of steak [42]. As Protein foods are one of the least-likely food groups to be under consumed by Americans [43], it is unsurprising that Protein Foods component scores are so high in the circulars. A subset of Total Protein Foods, the Seafood and Plant Proteins component, scored highly in both the circulars and population. This concordance is reflected in other US research, with 80% of people reporting eating seafood in the previous month, although the amounts consumed are below intake recommendations [44]. The scores for Whole Grains were also similar, approximately one-fifth of the optimal score, in both sets of data; these scores are consistent with other reports of very low intake of whole grains in the US [45]. Advertising of more whole grain foods may help overcome barriers to consumption by bringing them to consumers' attention, particularly if price discounts are applied.

Supermarkets offer a point of ingress for public health interventions to improve dietary intake, especially for budget-conscious food shoppers [14]. Consumers often perceive that healthy diets are expensive, but healthier choices can be made on many budget levels [46]. The literature is mixed regarding the effectiveness of promotions and of discounts to increase purchases of healthier foods, usually vegetables and fruits. There is evidence that large price discounts may

237 increase vegetable and fruit purchases [15,47] and coupons or other price promotions may be more
238 effective than discounts alone because, like weekly circulars, they also function as product
239 advertisements. There are many reasons for the selection of items included in the flyers.
240 Influencing retailers to improve the healthfulness of advertised products will require an
241 understanding of why products are chosen and, importantly, how to preserve retail profits when
242 promoting more healthful items.
243
244 This is the first study to assess the quality of the mix of foods featured in supermarket
245 circulars in the US. Strengths include the use of a year's worth of circulars and the use of the
246 HEI-2010, a validated measure of dietary quality that uses a density approach so that it can be
247 used to compare individual and food environment assessments. This research has some
248 limitations in addition to its strengths. The results cannot be generalized to all US grocery store
249 circulars. The circulars are from a small Midwestern grocery chain and items may not be
250 representative of advertisements by larger chains or of stores nationally. Previous research [17]
251 found that the proportions of MyPlate food groups advertised in this chain were similar to those
252 found in a national sample [18], suggesting that the magnitude of bias may not be substantial.
253 Nonetheless, circulars from other chains in other areas, especially those positioned as "health
254 food stores," would be expected to have different levels of dietary quality. The city in which the
255 circulars were collected is relatively affluent and the advertisers may be expected to market
256 products to reflect the socio-economic status of its target audience. However, as the
257 economically heterogeneous general US population reported higher diet quality scores, it does
258 not appear to have been a source of bias. Other researchers are encouraged to replicate the
259 procedure used here for circulars in other markets to add to the growing literature on the diet

quality of the food environment in the US and other countries. Circular items were hand-coded using the FNDDS, which is a database of foods and recipes as consumed, not sold. Therefore, items such as pasta listed in the circulars as unprepared were coded as prepared, while items such as bread or soda which are listed as prepared are coded in the same form. In this conversion, some under consumed items will have loss factors, such as waste from the preparation of seafood, vegetables and fruits. Other items, such as pasta, would have gain factors. Beverages would not be expected to have loss or gain. Another issue is that ingredients added during preparation (e.g. eggs and oil to brownie mix) are reflected in the results of this study but are not part of the items as actually purchased, leading to potential over-estimation of some food groups. As with all dietary studies, databases underlying the analyses do not contain values for all items in the changing food supply, therefore although brand information was available for the circular items, they were often matched to the codes of default items. Brand-specific databases of nutrient and food group composition would substantially improve the precision of such studies, especially if available for foods as purchased rather than as consumed. The population estimates from the WWEIA, NHANES survey are based upon self-reported dietary intake, which is subject to misreporting. Although advertising is linked to food purchasing behavior, there is only limited evidence of the strength of the relationship between purchases and intake [15]. Perishable items, such as vegetables and fruits in particular, often spoil at home and are discarded by well-intentioned purchasers.

CONCLUSIONS

This study demonstrates the applicability of the HEI-2010 as a means to evaluate the healthfulness of items featured in grocery store circulars. It shows that the diet quality of foods

advertised in this Midwestern area is low. If retailers wish to help consumers choose more healthful diets, they could increase advertising and price promotions of vegetables and fruits, whole grains, low-fat dairy, seafood, nuts and oils and decrease those for refined grains, sodium-rich and empty calorie foods. Researchers conducting supermarket nutrition interventions should consider incorporating changes to circular content when promoting healthier food purchasing. Registered Dietitian Nutritionists may wish to use this information when counseling consumers about healthy shopping on a budget. Future research could include manipulating the content of sales circulars and measuring change in food purchase data, as well as directly linking circular data to purchase behavior and subsequent intake.

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