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Short communication

Neighborhood sociodemographic characteristics and healthfulness of store checkouts in Northern California

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ABSTRACT

Placement of products at food store checkouts has been shown to trigger impulse purchases and child purchasing requests. Therefore, food companies pay substantial amounts of money to ensure their products are placed at checkout, and these products are mostly unhealthy (e.g., sugar-sweetened beverages [SSBs], candy, chips). To improve the healthfulness of store environments, Berkeley, CA, U.S. became the first jurisdiction globally to implement a healthy checkout policy. This study examined associations between store neighborhood characteristics and healthfulness of foods and beverages offered at checkout to understand the potential for healthy checkout policies, such as Berkeley's healthy checkout ordinance (HCO), to promote equitable food environments. Data on a near census of food and beverage facings (n = 26,758) at sampled checkouts were collected from 102 food stores (supermarkets, grocery stores, drugstores, dollar stores, specialty food stores, and mass merchandisers) across four Northern California cities (Berkeley, Oakland, Davis, and Sacramento) in February 2021. Bivariate regression analyses revealed that neighborhoods with lower socioeconomic status (SES) and higher Black and Hispanic residential composition had a higher prevalence of foods and beverages that did not meet HCO standards, including associations with a higher prevalence of sweets, higher prevalence of SSBs, and/or lower prevalence of healthy foods at checkout. Findings suggest that the checkout environment may be one of many contributors to diet-related health disparities. Additionally, healthy checkout policies may have the potential to increase nutrition equity by improving food environments across neighborhoods and especially in areas with lower SES and higher Black and Hispanic composition.

1. Introduction

In the U.S., diet-related diseases are the leading causes of mortality and morbidity (Mokdad, et al., 2018). The burden of diet-related diseases is not uniform; for example, Black and Hispanic populations have a higher prevalence, and high-socioeconomic status (SES) groups have a lower prevalence, of type 2 diabetes and obesity (Stierman et al., 2021). Populations disproportionately affected by diet-related diseases are also more likely to live in unhealthy food environments: Black, Hispanic, and lower-SES communities have lower availability of healthy foods (Zenk et al., 2014) and higher exposure to unhealthy food marketing (Powell et al., 2014; Isgor et al., 2016).

One important setting for improving diet quality and nutrition equity is retail food stores, from which 67% of calories are purchased in the U.S. (Liu et al., 2021). In-store marketing, including product placement, has been shown to influence consumer purchases of both healthy and unhealthy foods and beverages (Hecht et al., 2020; Almy & Wootan, 2015). In particular, product placement at store checkouts—the only place all customers must pass through—can trigger impulse purchases and child purchasing requests. Thus, many large food companies pay stores "slotting fees" to place products—which are mostly unhealthy—at checkouts (Hecht et al., 2020 Almy & Wootan, 2015; Cohen & Babey, 2012; Falbe et al., 2023). The unhealthfulness of checkout is concerning because nearly one-third of adults purchase items at checkout $\geq$ 1 time per week (Falbe et al., 2021) with Black, Hispanic, and American Indian or Alaska Native adults, adults with lower incomes, and parents being more likely to purchase foods or beverages found at checkout (Falbe et al., 2021).

To ensure that food stores "offer healthy options and do not actively encourage the purchase of unhealthy foods," Berkeley, CA, U.S., became the first jurisdiction globally to implement a healthy checkout policy in March of 2021 (Berkeley, CA Ordinance 7734-NS, 2020). According to

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the healthy checkout ordinance (HCO), large retail food stores (total floor area > 2,500 square feet and selling ≥ 25 linear feet of food) in Berkeley can offer non-food items and only unsweetened beverages and specific categories of foods containing ≤ 5 g of added sugars and ≤ 200 mg of sodium per serving at checkout (Berkeley, CA Ordinance 7734-NS, 2020). To understand the potential for healthy checkout policies to promote equitable food environments, it is important to assess variation in the healthfulness of foods and beverages offered at checkout by neighborhood characteristics. Only a small number of studies, mostly assessing non-U.S. stores, have studied this topic, finding mixed results (Barker et al., 2015; Horsley et al., 2014; Schultz et al., 2021; Thornton et al., 2012). Using product facing data from food store checkouts in four Northern California cities, we examined associations between neighborhood sociodemographic characteristics and the healthfulness of checkout products to describe racial, ethnic, and SES differences in exposure to unhealthy food environments.

2. Material and methods

2.1. Data and analytic sample

As part of an evaluation of Berkeley's HCO, data on checkout product facings were collected from a sample of 102 food stores in Berkeley, Oakland, Davis, and Sacramento, CA, U.S. (Falbe et al., 2023) in February 2021, one month prior to policy implementation. The 3 comparison cities were selected based on similar urbanicity, racial and ethnic diversity, and economic indicators to Berkeley (U.S. Census Bureau, 2016-2020). Product facings were defined as individual products (e.g., specific brand, flavor, and size of a soda) that face consumers but did not include products stacked behind the facing. Each facing was assessed separately, including facings that were identical (e.g., two side-by-side facings of the same soda brand, flavor, and size would be considered two facings). In Berkeley, the store sample included a census (n = 24) of supermarkets, grocery stores, drugstores, dollar stores, specialty food stores, and mass merchandisers subject to the HCO. Stratified random sampling was used to match comparison stores to Berkeley stores by chain, when possible, and store type, resulting in a similar disribution of store types from each city (Falbe et al. 2023).

A reliable photo-based Store CheckOUt Tool (SCOUT) (Powell et al., 2022) was used to record information on all product facings at up to 3 checkouts per store. Checkout included the checkout lane and register area, checkout endcaps, snaking section (i.e., single winding lane that typically leads to multiple registers), and standalone displays ≤ 1 foot from the checkout area. The SCOUT was used to record details of each product facing (e.g., brand, size, flavor), which was linked with nutritional data retrieved from manufacturer, retail, and food database websites. A total of 28,550 food and beverage facings were recorded, of which 1,792 (6%) were excluded because they were out of stock, had poor photo quality, or had insufficient nutritional data available. Degree of missingness was similar across cities (4–7% per city). Of the 102 stores in the sample, 101 had ≥ 1 food or beverage facing; 101 had ≥ 1 food facing; and 75 had ≥ 1 beverage facing. The final analytic sample included 26,758 facings.

2.2. Checkout measures

Food and beverage facings were classified by category (e.g., candy, water) and whether they met the standards outlined in Berkeley's HCO. Beverages meeting the HCO standards contained no added sugars and no non-nutritive sweeteners. Foods meeting HCO standards had ≤ 5 g of added sugars and ≤ 200 mg of sodium per serving and fell under the following categories: fruits, vegetables, nuts, seeds, legumes, yogurt or cheese, whole grains, and mints and gums with no added sugars.

The following store-level outcomes were calculated: (1) the primary outcome of percentage of food and beverage facings that did not meet HCO standards and additional outcomes of (2) percentage of beverage facings that were sugar-sweetened beverages (SSBs; i.e., any beverage containing added sugars), (3) percentage of beverage facings that were water, (4) percentage of food facings that were sweets, (5) percentage of food facings that were salty snacks, and (6) percentage of food facings that were healthy foods. The categories for SSBs, water, sweets, salty snacks, and healthy foods were mutually exclusive; facings classified as SSBs, sweets, and salty snacks did not meet HCO standards. Water included still, sparkling, and flavored unsweetened water. Sweets included candy, chocolate, baked goods, and other sweets. Salty snacks included products such as chips, pretzels, dried meats, and crackers. Healthy foods included fruits, vegetables, cheese, yogurt, whole grains, legumes, nuts, and seeds that met HCO standards but excluded gum and mints due to negligible nutritional value.

2.3. Store neighborhood sociodemographic measures

Explanatory variables were drawn from American Community Survey 5-year estimates (U.S. Census Bureau, 2016-2020) and included the percentage of the census-tract population: (1) living below the poverty line, (2) with educational attainment above a high school degree, and that were (3) children (age < 18), (4) Black, (5) Asian, (6) White, (7) Multiracial, and (8) Hispanic (any race).

2.4. Analysis

Summary statistics on checkout and neighborhood sociodemographic characteristics were calculated across all stores. Bivariate linear regressions with robust standard errors examined associations between each outcome and explanatory variable. Because the outcomes were percentages, a sensitivity analysis was conducted using generalized linear models with a logit link and binomial family. Finally, estimates from linear regression models were used to predict values of percentage of food and beverage facings not meeting standards for the lowest and highest quartiles (at quartile median) of poverty, percentage Black, and percentage Hispanic neighborhood characteristics to illustrate the magnitude of the associations. Analyses used two-sided alpha = 0.05 and were conducted in Stata/SE17.0 (StataCorp, College Station, TX).

3. Results

Table 1 shows characteristics of store neighborhoods and checkout facings. The mean neighborhood poverty rate was 11% (range: 0%-48%), the same as the national poverty rate (11%) (U.S. Census Bureau, 2016-2020). On average, 78% of the population had more than a high school degree (range: 32%-95%) vs. 62% nationally (U.S. Census Bureau, 2016-2020). The sample was racially and ethnically diverse, with large variation across store neighborhoods (e.g., percentage Black range: 0%-44%; percentage Hispanic range: 3%-69%). Store-level checkout outcomes revealed that most foods and beverages (70%) did not meet HCO standards. SSBs were more prevalent than water at checkout (52% vs. 16% of beverages), and sweets were more prevalent than healthy foods (48% vs. 7% of foods).

Table 2 shows results from the bivariate regressions. Coefficients represent the percentage point difference in the outcome for each 1-percentage point higher prevalence in the explanatory variable. Higher poverty, lower educational attainment, and higher Black and Hispanic compositions of neighborhoods were associated with a higher prevalence of foods and beverages at checkout that did not meet HCO standards. In contrast, stores in neighborhoods with a higher White composition had a higher prevalence of checkout foods and beverages that met HCO standards. Regarding beverages, higher poverty and Hispanic composition were associated with a higher prevalence of SSBs at checkout. Stores in neighborhoods with higher poverty and Multiracial composition were less likely to offer water at checkout. Regarding foods, higher poverty, lower educational attainment, and higher Black and Hispanic compositions were associated with a higher prevalence of

Table 1
Characteristics of store-level neighborhoods and food and beverage product facings at store checkouts in Northern California, 2021.

	Mean	Std Dev	Median	Min	Max
Neighborhood Sociodemographic Characteristics					
% Children (age < 18)	17	8	18	2	31
Socioeconomic Status					
% Below the Poverty Level	11	11	8	0	48
% > High School Degree	78	17	86	32	95
Race/Ethnicity					
% Black [a]	11	10	7	0	44
% Asian [a]	17	10	14	2	52
% White [a]	54	19	57	10	88
% Multiracial [a]	9	3	8	2	17
% Hispanic, any race	20	15	16	3	69
Store Checkout Facing Composition					
% Food and Beverage Facings that Did Not Meet Healthy Checkout Standards	70	16	71	17	100
% Beverage Facings SSBs	52	23	54	0	100
% Beverage Facings Water	16	18	11	0	100
% Food Facings Sweets	48	21	47	0	100
% Food Facings Salty Snacks	11	11	8	0	48
% Food Facings Healthy Foods	7	10	4	0	55

Note: N = 102 retail food stores (33 chain drugstores, 16 chain supermarkets, 14 independent grocery stores, 11 chain specialty food stores, 10 independent supermarkets, 10 dollar stores, and 8 chain mass merchandisers). Salty snacks included products such as chips, pretzels, dried meat, and crackers. Sweets included candy, chocolate, baked goods, and other sweets such as desserts, cakes, brownies, cookies, pastries, frozen desserts, sweet snack packs, pudding, syrups and other pourable toppings, sprinkles, and candy-covered pretzels and dried fruit. Water included still, sparkling, and flavored waters without sweeteners. Foods that met healthy checkout standards included fruits, vegetables, cheese and yogurt, whole grains, legumes, nuts, and seeds that contained ≤ 5 g added sugars and ≤ 200 mg sodium. Census tract-level data on store neighborhood sociodemographic characteristics were collected from the American Community Survey 5-year estimates (2016–2020).
SSBs—Sugar-Sweetened Beverages.
[a] Includes Hispanic and non-Hispanic ethnicity.

sweets at checkout, whereas higher neighborhood White composition was associated with a lower prevalence of sweets at checkout. Additionally, neighborhoods with more children, higher poverty, lower educational attainment, and higher Hispanic composition were less likely to have healthy checkout foods, while neighborhoods with a higher White composition were more likely to have healthy checkout foods. There were no significant associations between neighborhood characteristics and percentage of checkout foods that were salty snacks. The results of our sensitivity analysis matched the main analysis in terms of statistical significance and direction and magnitude of the estimated coefficients.

Predicted values calculated for the highest and lowest quartiles for poverty and Black and Hispanic residential composition demonstrated meaningful differences in checkout environments. Stores located in a neighborhood with a high vs. low poverty rate had a 12% higher prevalence of foods and beverages not meeting HCO standards (74% vs. 66%). Stores in neighborhoods with a high vs. low Black and Hispanic composition had a 12% and 15%, respectively, higher prevalence of food and beverage facings not meeting HCO standards (Black: 75% vs. 67%; Hispanic: 76% vs. 66%).

4. Discussion

Neighborhoods with lower SES and a higher percentage of Black and Hispanic residents had a higher prevalence of unhealthy foods and beverages, particularly sweets and/or SSBs, at checkout. While most foods and beverages at checkout were unhealthy across neighborhoods, being in a high vs. low poverty, percentage Black, or percentage Hispanic community was associated with a 12–15% higher prevalence of foods and beverages that did not meet HCO standards. Additionally, neighborhoods with more children, lower SES, and a higher percentage of Hispanic residents had a lower prevalence of healthy checkout foods.

These findings cannot be directly compared to the only other U.S. study evaluating differences in food store checkout healthfulness by community characteristics, which was based on a dichotomous measure of fresh fruit and vegetable presence at checkout (Barker et al., 2015). We did not examine differences in fresh fruits and vegetables at checkout because these products represented < 0.3% of sample facings. However, Barker et al. found lower income neighborhoods were less likely, and majority Hispanic neighborhoods more likely, to have fresh fruits and vegetables at checkout (Barker et al., 2015). Those results are consistent with our finding that lower SES neighborhoods had a lower prevalence of healthy foods but differed from our finding that a higher composition of Hispanic residents was associated with a lower prevalence of healthy foods. Three other studies conducted in UK and Australian cities examined associations between SES and prevalence of healthy/unhealthy products at checkout (Horsley et al., 2014; Schultz et al., 2021; Thornton et al., 2012). In contrast to our study, the Australian studies revealed no significant differences in supermarket checkouts by SES (Schultz et al., 2021; Thornton et al., 2012). In a small sample of supermarkets, the UK study found stores located in low-SES areas were less likely to have healthy foods at checkout, though the finding was not robust to the exclusion of one outlier store (Horsley et al., 2014).

Study strengths include the use of a reliable tool to collect detailed product and nutritional data on a large sample of product facings (n = 26,758) and the assessment of a near census of products from sampled checkouts. Study limitations include the omission of convenience stores, and because all stores were located in Northern California, generalizability to other regions is uncertain. Finally, this study did not evaluate causal mechanisms that underlie differences in exposure to unhealthy checkout products; it is important that future studies investigate these mechanisms.

5. Conclusions

Overall, this study found that stores in Northern California neighborhoods with a lower SES and higher compositions of Black and Hispanic residents had a higher prevalence of unhealthy food and beverage facings at checkout (i.e., ones not meeting HCO standards). These results suggest that checkout environments may be one of many contributors to nutrition and health disparities by SES, race, and ethnicity. In turn, healthy checkout policies have the potential to increase nutrition equity by improving food environments across neighborhoods and especially in areas with a lower SES and higher Black and Hispanic composition.

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CRediT authorship contribution statement

Samantha Marinello: Methodology, Formal analysis, Writing – original draft. **Lisa M. Powell:** Conceptualization, Methodology, Writing – review & editing, Supervision, Funding acquisition. **Jennifer**

Table 2
Association between store-level neighborhood sociodemographic characteristics and composition of product facings at store checkouts in Northern California, 2021.

	% Food and Beverage Facings Not Meeting HCO Standards	% Beverage Facings: SSBs	% Beverage Facings: Water	% Food Facings: Sweets	% Food Facings: Salty Snacks	% Food Facings: Healthy Foods
	β (95% CI)	β (95% CI)	β (95% CI)	β (95% CI)	β (95% CI)	β (95% CI)
Number of stores	N = 101	N = 75	N = 75	N = 101	N = 101	N = 101
% Children (age < 18)	0.34	0.48	-0.39	0.21	0.15	-0.17*
	(-0.03, 0.71)	(-0.23, 1.18)	(-0.83, 0.05)	(-0.29, 0.70)	(-0.10, 0.41)	(-0.34, -0.01)
Socioeconomic Status						
% Below the Poverty Level	0.34**	0.45*	-0.30*	0.47**	-0.07	-0.17*
	(0.10, 0.58)	(0.09, 0.82)	(-0.55, -0.05)	(0.14, 0.80)	(-0.24, 0.10)	(-0.32, -0.01)
% > High School Degree	-0.25**	-0.30	0.06	-0.33**	0.01	0.15**
	(-0.44, -0.07)	(-0.60, 0.01)	(-0.17, 0.28)	(-0.58, -0.08)	(-0.11, 0.13)	(0.05, 0.25)
Race/Ethnicity						
% Black[a]	0.34*	0.28	-0.17	0.39*	0.04	-0.15
	(0.03, 0.64)	(-0.24, 0.80)	(-0.53, 0.20)	(0.02, 0.75)	(-0.16, 0.24)	(-0.32, 0.02)
% Asian[a]	-0.22	-0.48	0.24	0.00	-0.09	0.00
	(-0.49, 0.05)	(-1.12, 0.15)	(-0.16, 0.64)	(-0.36, 0.36)	(-0.28, 0.11)	(-0.14, 0.14)
% White[a]	-0.17*	-0.09	0.08	-0.26*	0.02	0.10*
	(-0.34, -0.00)	(-0.38, 0.20)	(-0.19, 0.35)	(-0.46, -0.05)	(-0.08, 0.12)	(0.01, 0.20)
% Multiracial[a]	0.52	-0.02	-0.93*	0.57	0.00	0.19
	(-0.33, 1.36)	(-1.37, 1.32)	(-1.81, -0.05)	(-0.62, 1.76)	(-0.67, 0.66)	(-0.31, 0.69)
% Hispanic, any race	0.31**	0.36*	-0.14	0.31*	0.00	-0.17**
	(0.12, 0.50)	(0.04, 0.67)	(-0.37, 0.09)	(0.04, 0.57)	(-0.16, 0.16)	(-0.28, -0.06)

Note: β-coefficients and 95% CIs are from bivariate linear regression models using robust standard errors to account for heteroskedasticity. β-coefficients represent the percentage point difference in the outcome for each 1-percentage point higher prevalence in the explanatory variable. Salty snacks included products such as chips, pretzels, dried meat, and crackers. Sweets included candy, chocolate, baked goods, and other sweets such as desserts, cakes, brownies, cookies, pastries, frozen desserts, sweet snack packs, pudding, syrups and other pourable toppings, sprinkles, and candy-covered pretzels and dried fruit. Water included still, sparkling, and flavored waters without sweeteners. Foods that met healthy checkout standards included fruits, vegetables, cheese and yogurt, whole grains, legumes, nuts, and seeds that contained ≤ 5 g added sugars and ≤ 200 mg sodium.
*p < 0.05, **p < 0.01.
HCO—Healthy Checkout Ordinance; SSBs—Sugar-Sweetened Beverages; β—β-coefficient from linear regression models.
[a] Includes Hispanic and non-Hispanic ethnicity.

Falbe: Conceptualization, Methodology, Writing – review & editing, Supervision, Funding acquisition.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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