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School food and beverage availability and children's diet, purchasing and obesity: Evidence from a natural experiment

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Abstract

Background—Existing evidence on relationships between school food environments and children's in-school purchases, dietary behaviors and body composition is based on observational studies that are vulnerable to residential selection bias.

Methods—This study leveraged exogenous variation in school environments generated by the natural experiment due to military parents' assignment to installations. We analyzed 1010 child-wave observations from the Military Teenagers Environments, Exercise, and Nutrition Study collected during 2013–2015. Using multiple linear and logistic regression, we examined whether the number of competitive food and beverage (CF&B) items available for purchase in school, overall and by type (*unhealthy*, *healthy*, *neutral*), was associated with in-school food purchases, dietary behaviors, and body mass index (BMI) outcomes. Covariates included child and family characteristics and the healthiness of the home food environment.

Results—*Unhealthy* item availability was positively associated with purchasing any sweets (AOR: 1.30 $p<0.01$), snacks (AOR: 1.23 $p<0.01$), and sugar-sweetened beverages (AOR: 1.19 $p=0.01$). However, there were no significant associations with overall food and beverage intake (e.g., sweets, soda) nor BMI outcomes. The home food environment was significantly associated with all outcomes.

Conclusions—Access to unhealthy CF&B items may influence in-school purchases but does not appear to influence overall dietary behaviors and BMI outcomes. Substitution of caloric intake

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across locations within versus outside of school may play a role in explaining why purchases were associated with unhealthy CF&B availability but overall diet and downstream BMI were not.

Keywords

Body mass index; Childhood obesity; Competitive foods and beverages; School policies

Introduction

Federal, state and local policies target improving the quality of foods and beverages available in schools as a means to improve diet and reduce child obesity.[1–3] Competitive foods and beverages (hereafter CF&Bs) are offered to students during the school day, outside of federally reimbursable and nutritionally regulated school meal programs. CF&Bs may provide children access to nutritionally poor, energy-dense foods and may contribute to child obesity.[3, 4] Policymakers have regulated the types of CF&Bs available to children in school.[3] The federal “Smart Snacks” rule of the Healthy Hunger Free Kids Act of 2010 requires that foods and beverages sold at school during the school day must meet nutrition standards that include more fruits, vegetables, low-fat dairy, whole grains and lean proteins as main ingredients starting in the 2014–2015 school year. In addition, a variety of concurrent efforts at the state and local effort have aimed to further improve the nutritional quality of CF&Bs.[5]

Stronger nutritional requirements for CF&Bs follows the assumption that improving the school food environment will translate into healthier dietary behaviors and ultimately better health. Some evidence supports this rationale.[3] After implementing CF&B regulations in California, high school students reported consuming fewer calories than students in 14 states with no CF&B regulations.[6] While increasing evidence suggests that stricter CF&B policies can positively impact child health, studies are limited by a lack of granularity. At the state level, CF&B policies were associated with lower zBMI and lower odds of overweight or obesity, and better dietary outcomes, relative to no policy.[7] However, policies were based on state laws regulating CF&Bs so information about what was available within schools was lacking. In another study of CF&B state-wide policy, based in California, children’s weight status improved after CF&B policies were enacted, however school-level variation in policy implementation was not captured.[8] Understanding the quality of the school food environment is needed to evaluate the impact of school nutrition policies. Other studies have found that policies may improve the school food environment but they do not translate to improvements in children’s consumption[9, 10] or BMI.[10] Mixed findings may be due to observational study designs, ecological data (e.g., state-based policy), ignoring home food environments, as well as residential selection and reverse causality. On the one hand, states may implement more stringent policies if they have high childhood obesity rates, which could bias findings toward the null.[10] On the other hand, where families decide to live can determine children’s exposure into school policies at the same time unobserved characteristics that play a role in residential location can also drive child BMI. For example, if more health-conscious families prefer schools with healthier environments, then this would bias results away from the null.

Our cross-sectional study uses data from a cohort of children in military families, who are "assigned" to Army installations. Thus, we can consider children's exposure to their schools and CF&B availability as exogenous. While our data are cross-sectional, the natural experiment provides a unique opportunity to leverage plausible exogenous variation in exposure not normally available in cross-sectional studies. Specifically, military families are exogenously "assigned" to Army installations based on the needs of the military. Our natural experiment design attempts to address residential selection bias and reverse causality concerns that may undermine other studies. We leverage this natural experiment to test how the number and type of CF&Bs available in schools might influence children's in-school purchases, dietary behaviors (e.g., snacks), as well as zBMI, and overweight/obesity. In addition, we account for confounding by using a measure of the home food environment that reflects the quality of the foods/beverages available in the child's home.

Methods

Data were collected during the Military Teenagers Environment Exercise and Nutrition Study (M-TEENS), previously described in detail with geographical locations.[11] U.S. enlisted service members located at 14 installations who had a dependent child aged 12 or 13 years were contacted from March 2013 through December 2013 via emails and postal mail with invitations to assess eligibility: service member did not intend to leave the military within the coming year; eligible child resided with the service member at least half of the time; and the eligible child was enrolled in a public school or a Department of Defense Education Activity school. Among eligible families, 1073 consented and completed an online self-administered parent survey. An email was sent to the parent with a link to their survey as well as an additional link for the child to complete the child survey.

In 2014, M-TEENS conducted another wave of data collection, where families that participated in Wave 1 were asked to complete follow-up parent and child surveys online. New families (Wave 2: N=446) that met the original eligibility criteria were added to the existing cohort and asked to complete baseline and child online surveys. Due to budget limitations, no height/weight measurements were conducted by field staff in Wave 2. During the third wave (March-September 2015), all families that participated during Wave 1 and/or Wave 2 (N=1519) were asked to complete Wave 3 follow-up parent and child surveys online (N=826). In addition, trained field staff visited 14 installations to measure children's height and weight.

Due to differential timing of recruitment we compared baseline characteristics between families recruited at Wave 1 to those recruited at Wave 2. Those that were recruited in Wave 2 (47%) were less likely to live on post (47% versus 58%), more likely to have a rank of Sergeant First Class or higher (45% versus 35%), less likely to be married (85% versus 94%), less likely to have been on base for 4 years or more (9% versus 26%), the child was more likely to report buying any SSB at school (26% versus 18%), child was older (170 versus 158 months) than those in Wave 1.

We also compared those who did and did not return for follow-up at Wave 3. The only difference was that children of families lost to follow-up were more likely (32% versus 25%) to report buying any SSB at school.

The study was approved by the Institutional Review Boards at RAND, University of Southern California, and the Army's Human Research Protection Office.

Measures

BMI and overweight/obesity—Both the child and parent reported the child's height and weight. Trained study staff collected measures for a subsample of children (wave 1: N=522 and wave 3: N=329) who attended the installation visits. There were no statistically significant differences between the measured and unmeasured children in terms of their self-reported BMI or overweight/obese measured and unmeasured children in terms of their self-reported BMI or overweight/obese status or in family background characteristics, except those who were measured were more likely to live on-installation at wave 1, which could be expected given that the measurements were conducted at the installation youth centers. At wave 3, measured children were still more likely to live on-installation and were also slightly younger and more likely to live with married parents than children who were unmeasured. The subsample with measurements was used as a validation sample to correct the self-reported measures using regression calibration.[12] These "corrected" height and weight reports were used to construct age- and gender-specific zBMI and BMI percentile based on the 2000 BMI-for-age and gender growth charts issued by the Centers for Disease Control and Prevention. A child was classified as obese or overweight if the BMI percentile was greater than or equal to 85.

Dietary behaviors—We collected children's dietary behaviors, via survey that included a modified version of the Beverage and Snack Questionnaire[13] which asks about intake frequency of fruits, vegetables, soda, and types of salty snacks and sweets, among other beverages and foods during the past 7 days. The survey response categories (never, 1–3 in past 7 days, 4–6 in past 7 days, 1 per day, 2 per day, 3 per day, 4+ per day) were converted into times per week (0, 2, 5, 7, 14, 21, 28+). We created a weekly measure of sugar-sweetened beverages (SSBs), salty snacks, and sweets by summing responses to the relevant questions: SSBs (fruit drinks; sports drinks; flavored waters such as Propel or vitamin waters; regular soda or pop; energy drinks; smoothies, lattes, or similar), salty snacks (low-fat or non-fat chips; regular chips; other salty snacks) and sweets (candy; doughnuts or other pastries; cookies, brownies, pies and cakes; low fat or nonfat frozen desserts; regular ice cream and milkshakes). Similarly, we created weekly measures of fruit and vegetable consumption: fruit (fruit such as a banana, apple or grapes), and vegetables (vegetables such as green salad, peas, green beans, or corn).

Purchasing behaviors—Children were also asked how often they bought 1) candy, ice cream, cookies, cakes, brownies or other sweets; 2) potato chips, corn chips (Fritos, Doritos), Cheetos, pretzels, popcorn, crackers or other salty snack foods; 3) soda pop (for example, Coke, Pepsi, 7-Up), sports drinks (such as Gatorade), or fruit drinks that are not 100% fruit juice (such as Kool-Aid, Hi-C, Fruitopia, Fruitworks) in school during the past 7

days. Response categories were converted into dichotomous variables for none versus any purchases (0, 1). While parents may have observed child's responses, we expect this was unlikely since 76% of parents completed their survey before their children started the surveys. Survey access was then closed once the surveys were completed.

CF&B availability—Principals (or other knowledgeable staff) in schools attended by the M-TEENS sample responded to online surveys that asked about foods and beverages available to students for purchase during school hours, either from vending machines, school store, canteen, snack bar or a la carte items from the cafeteria. We created 11 dichotomous variables for any availability of sugar-sweetened beverages (SSBs), salty snacks, sweets, fruit, vegetables, juice, bread, sandwiches/burgers/pizza, French fries, water, and milk using the indicator responses to the relevant questions (Appendix Table 1).

To examine how the number of CF&Bs available associated with child outcomes, we constructed the sum of the eleven CF&Bs that are available for purchase. To better understand how the type of CF&B available might influence outcomes, we also constructed three mutually exclusive categories: number of *unhealthy* (French fries, SSBs, salty snacks, sweets, and juice), number of *healthy* (fruit, vegetables, water, and milk), and number of *neutral* (sandwiches/burgers/pizza and bread) items.

Home food environment—We measured "healthiness" of the foods/beverages available in the home using a subscale of the validated Comprehensive Feeding Practice Questionnaire[14] by summarizing how much parents agree (strongly disagree, somewhat disagree, neutral, somewhat agree, and strongly agree) with the following statements about the food environment in their home: 1) most of the food in the house is healthy; 2) there are a lot of salty snacks in our house (reverse coded); 3) there are a lot of sweets in our house (reverse coded); 4) there are a lot of other high-fat foods in our house (reverse coded); 5) there are a lot of sweetened beverages in our house (reverse coded); and 6) a variety of healthy foods is available to my child at each meal served at home. The response categories included. These six items were summed to create an overall score for the home food healthiness. Higher scores indicated a healthier home food environment.

Covariates—We included child and family covariates that may influence dietary and BMI outcomes such as the child's age in months, gender, race/ethnicity (non-Hispanic white, non-Hispanic black, Hispanic/Latino, other), highest education level among both parents (less than high school, high school graduate or equivalent, some college, and college graduate or higher), household income (<=$40,000; $40,001–$50,000; $50,001–$75,000; $75,001 or higher), marital status, number of children in household, whether the family lives on-installation, parent's military rank (Sergeant or lower (<=E5), Staff Sergeant (E6), Sergeant First Class or higher (>=E7), and months at current installation (12 months or less, 13–24 months, 25–48 months, 49 months or more).

Analytic sample—We excluded observations from analyses if the following were missing: child survey (N=233), BMI (N=23), child reported dietary behaviors (N=164), child in-school purchasing (N=21), principal survey (N=843), principal report of CF&B availability

(N=51). Our analytic sample included 1,010 person-wave (Wave 1: N=510, Wave 2: N=167, Wave 3: N=333) observations from 815 children.

Statistical analyses

All analyses were conducted using Stata 15.0 (StataCorp, College Station, TX). Using multiple linear and logistic regression models we estimated associations between the number of CF&Bs available (total, and by type of item) with each child outcome. We estimated three sets of models; 1) univariate models; 2) adjusted with covariates except home food environment; and 3) adjusted with home food environment. Models controlled for covariates, described above. Missing data for these covariates ranged from 0.6% missing education levels of both parents to 2.6% missing for child's race/ethnicity and were imputed using multiple imputation methods. Measures were repeated within schools and students, so we used the Stata command 'xtmixed' to estimate three-level models with random intercepts for schools and students, and students were nested within schools.

Due to the large number of significance tests conducted in our analyses, we adjusted for multiple testing using the Benjamini-Hochberg (B-H) approach to address the risk of inflated type I error.[15]

Sensitivity analyses—We estimated models to assess whether our findings were robust to different categorizations of unhealthy, healthy, and neutral items. We categorized items as unhealthy (French fries, sandwiches/burgers/pizza, SSBs, salty snacks, and sweets), healthy (fruit, vegetables, and water), and neutral (juice, milk, and bread).

Because our analyses include repeated observations for a subset of children, we also assessed whether limiting the analysis to one observation per child would impact our results. Therefore, we estimated models using only either the first observation or the last observation (N=815) for each child. Standard errors in these models were clustered at the school-level.

Since children are clustered in schools, we estimated fully adjusted models with multilevel analysis.

Because children's weight outcome may be a result of the schools' exercise-promoting environment we estimated models of child BMI and overweight/obese outcomes controlling for 1) the number of days per week 5th grade participated in physical education and 2) the number of days per week 5th grade participated in recess.

Results

The children in this study (N=815) attended 126 schools and on average the number of children attending the same school was 18.1 (median: 13, range: 1–48). Table 1 provides descriptive statistics of the characteristics of our sample at the time when they were first observed in the study. Mean age of children in the sample was 164.3 months (13.7 years). Consistent with the military population overall, almost 40% of the sample were white non-Hispanic (38.0%), 20.9% were black non-Hispanic, 25.4% Hispanic/Latino, 12.9% were categorized as other, and 2.8% were missing race/ethnicity.

Schools typically had a variety of CF&Bs available for purchase. Over 60% of children attended schools with 8 or more CF&Bs available for purchase. Only 3.1% of the children attended schools that did not have any CF&Bs available. When the number of CF&Bs are broken down by type, 52% of children attended schools that allowed all of the CF&B's categorized as neutral (e.g., bread), 32.3% of children attended schools that allowed all 5 of the unhealthy CF&Bs for purchase, and 43.1% of children attended schools that allowed all of the 4 of the healthy (e.g., fruit) CF&Bs for purchase. A minority of children reported buying sweets (29.9%), salty snacks (25.9%) and soda (19.6%) at school during the last 7 days. With respect to overall diet (rather than in-school purchases), children reported consuming about 2 SSBs per day within the last 7 days. In contrast, children reported consuming only about 1 vegetable per day and 1 fruit per day within the last 7 days, on average. About a quarter of the children were overweight or obese.

Table 2 reports unadjusted (Panel 1) and adjusted (without (Panel 2) and with (Panel 3) home food environment) associations between the number of CF&B available and children's outcomes. We report full model estimates with the covariates in Appendix Table 2. Number of CF&Bs available was not associated with children purchasing in school nor children's dietary behaviors or BMI outcomes. The home food environment was associated with all child outcomes in the expected direction. Healthier home food environments were inversely associated with purchasing sweets, salty snacks, and soda at school, children's consumption of sweets, snacks, and SSBs, and the likelihood of children being overweight or obese. Healthier home food environments were also positively associated with consumption of fruits and vegetables.

Table 3 reports unadjusted (Panel 1) and adjusted associations (Panels 2 and 3) between the type of CF&B available and children outcomes. We report full model estimates with the covariates in Appendix Table 3. Across all models, the number of unhealthy items available for purchase was positively associated with children's in-school purchasing of sweets, salty snacks, and soda. The availability of one additional unhealthy item was associated with increased odds of in-school purchases of sweets (OR: 1.30, $p<0.01$), salty snacks (OR: 1.23, $p<0.01$), and soda (OR: 1.19, $p=0.01$), even after controlling for the home food environment (Panel 3). There were no significant associations for number of healthy nor neutral CF&Bs available. Children's overall diet and BMI outcomes were not associated with the types of CF&B available. However, the home food environment was significantly associated with purchases, diet and BMI outcomes.

Sensitivity analyses

Table 4 presents our sensitivity model results. When we revised the categorizations of items, the results were very similar to our findings above (Panel 1).

Whether we used the first or last child-wave observation, we found a similar pattern of association for the types of CF&B available and child purchasing outcomes compared to the models where we used the full sample. However, there was one difference. The number of healthy CF&B items available was significantly and inversely associated with purchasing SSBs in school in the models using only the first observation (OR: 0.72, $p<0.05$) (Panel 2).

In multilevel analyses, associations were nearly identical to those in the fully adjusted models, with one exception. The number of unhealthy items available for purchase was no longer associated with children's in-school purchasing of SSB (OR: 1.18, p=0.076).

When controlling for school physical education and recess policies results did not differ from the fully adjusted models.

Discussion

While national, state, and local policymakers recognize the need for improved nutritional requirements for food and beverages in schools, child obesity remains a major public health challenge. Despite a possible plateau in the rates of childhood obesity, rates are still high at 17% and are even higher among those in low-income populations.[16][16,17] The HHFKA of 2010 focused on increasing the nutritional requirements of school meals.[2] In 2014–15 the law's "Smart Snacks" rule required that CF&Bs sold to students must also meet total fat, saturated fat, total sugar, calorie, and sodium standards.[2] Previously, the only existing federal requirement for CF&Bs was that foods and beverages with <5% of the Recommended Dietary Allowances per serving for eight key nutrients, could not be sold in school foodservice areas during meal times. While the impacts of the HHFKA and "Smart Snacks" remain unknown, earlier work has examined how other CF&B policies may influence child health.

In Chiriqui et al.'s review, stronger CF&B policies were associated with child consumption and/or availability in the expected direction.[3] However, most studies were observational, which may explain some mixed findings. Moreover, variation in school food policies in these studies are largely endogenous because unobserved parental characteristics may be tied to both school choice and child health behaviors and BMI. Previously, we leveraged this same natural experiment of change of station assignment to assess state CF&B policies. We found that strong or weak state policies for CF&Bs appeared to matter for children's BMI, overweight/obesity, and food and beverage intake.[7] However, schools may implement CF&B policies differently, which could impact CF&B availability and child outcomes.

We examined how the number and type of CF&Bs available in school were associated with children's in-school purchasing and overall dietary behaviors, and BMI outcomes using exogenous variation generated by military parents' assignments. We found that unhealthy CF&B availability was the only type of CF&B positively associated with in-school purchases of sweets, snacks and soda. These findings suggest that unhealthy CF&B availability - rather than overall CF&B availability or neutral/healthy CF&B availability - plays a role in in-school purchases. Importantly, this finding remains even after accounting for the home food environment, which has not been addressed previously. However, we did not find evidence that CF&B availability was associated with overall consumption or BMI outcomes, which may suggest substitution of caloric intake between school and outside school.[10] Child diet and BMI outcomes are the result of multiple determinants that occur within and outside of school. So, while CF&B availability in-school may contribute to overall intake and BMI outcomes, the effects may be too small to detect or to be practically

meaningful. In contrast, the home food environment was associated with all tested outcomes, suggesting a potential role for home environment in addressing childhood obesity.

Several studies have shown that CF&Bs are widely available in schools.[17–21] Our study also found a high number of CF&Bs were available. Over 60% of the children attended schools with 8 or more CF&Bs available. Additional studies have examined in-school CF&B availability in relation to child diet,[22–25] and BMI.[23, 26] While some findings suggest CF&Bs may improve diet[24, 27] and BMI[26] others have not.[28, 29] In one of the few large longitudinal studies in the Early Childhood Longitudinal Study Kindergarten Cohort (ECLS-K), the authors used fixed effects and found no support for the idea that competitive food sales in schools contributes to children's weight gain.[29] In our prior work with ECLS-K data and an instrumental approach to address selection bias, we also found no association between the presence or sale of competitive foods and children's fifth grade weight status.[10] Similar to our current findings, that study found evidence for substitution of caloric intake between school and outside school. However, prior studies were unable to account for the home food environment which plays a strong role in child diet and BMI.[30, 31]

Few studies have examined CF&B availability in relation to child in-school purchases[32, 33] and their findings do suggest a link between CF&B availability and children purchasing more nutrient poor and energy-dense foods as schools. While this is in-line with what we found, these studies are based on small samples and cross-sectional designs that are vulnerable to residential selection bias.

Our study has some limitations. First, generalizability may be one potential concern. Military families are often two-parent families where at least one of the parents is employed full-time (by the military) and may have higher socioeconomic status. However, most children in military families attend public schools (>85%), live off-base in civilian communities (70–80%),[34–36] and have similar rates of childhood overweight/obesity as children living in civilian families.[37] Therefore, findings from this study may still have implications that generalize to civilian populations. Second, we used principal report to quantify the types of CF&Bs that were available within schools. We did not assess how knowledgeable the Principal survey respondent was about these policies nor their attitude toward school healthy food environments. However, given that the study requested that the "principal" or the person most familiar with these issues complete the survey so we expected they would be knowledgeable about the CF&B policies. Future research may want to use observational audits to capture objective measures of CF&B availability. Other limitations of our study include - coarseness of our dietary measures (i.e. self-reports, lack of portion size), BMI measurements for a subsample, and limited geographic representation. However, our study also included data from both parents and children that included children's report of in-school purchases, and overall dietary behaviors. Parents provided information about the home food environment that could have confounded our analyses had we not accounted for it. Our findings support links between unhealthy CF&B availability and the in-school purchasing of sweets, snack, and soda, and are robust to multiple testing and whether we use the first or last observation only.

Conclusion

Limiting unhealthy CF&B availability may be a means to reduce child purchases of junk food in school. Substitution of caloric intake across locations within and outside of school may play a role in why unhealthy CF&B availability was associated with purchases, but not overall diet and downstream BMI.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Abbreviations

CF&B	competitive foods and beverages
BMI	body mass index

References

1. Johnson DB, et al., Effect of the Healthy Hunger-Free Kids Act on the Nutritional Quality of Meals Selected by Students and School Lunch Participation Rates. Jama Pediatrics, 2016 170(1).
2. United States Department of Agriculture. Healthy Hunger-Free Kids Act. School Meals 2017 5/29/18]; Available from: https://www.fns.usda.gov/school-meals/healthy-hunger-free-kids-act.
3. Chriqui JF, Pickel M, and Story M, Influence of school competitive food and beverage policies on obesity, consumption, and availability: a systematic review. JAMA Pediatr, 2014 168(3): p. 279–86. [PubMed: 24473632]
4. Larson N and Story M, Are ‘competitive foods’ sold at school making our children fat? Health Aff (Millwood), 2010 29(3): p. 430–5. [PubMed: 20194984]
5. Health, T.f.A.s., F as in Fat: How obesity threatens America’s future 2013. 2013: Washington, DC.
6. Taber DR, Chriqui JF, and Chaloupka FJ, Differences in Nutrient Intake Associated With State Laws Regarding Fat, Sugar, and Caloric Content of Competitive Foods. Archives of Pediatrics & Adolescent Medicine, 2012 166(5): p. 452–458. [PubMed: 22566546]
7. Datar A and Nicosia N, The Effect of State Competitive Food and Beverage Regulations on Childhood Overweight and Obesity. J Adolesc Health, 2017 60(5): p. 520–527. [PubMed: 27836530]
8. Sanchez-Vaznaugh EV, et al., Association between competitive food and beverage policies in elementary schools and childhood overweight/obesity trends: differences by neighborhood socioeconomic resources. JAMA Pediatr, 2015 169(5): p. e150781. [PubMed: 25938657]

9. Taber DR, et al., Banning All Sugar-Sweetened Beverages in Middle Schools Reduction of In-School Access and Purchasing but Not Overall Consumption. Archives of Pediatrics & Adolescent Medicine, 2012 166(3): p. 256–262. [PubMed: 22064875]
10. Datar A and Nicosia N, Junk Food in Schools and Childhood Obesity. J Policy Anal Manage, 2012 31(2): p. 312–337. [PubMed: 23729952]
11. Datar A, et al., Neighborhood environment and children's physical activity and body mass index: evidence from military personnel installation assignments. Child Obes, 2015 11(2): p. 130–8. [PubMed: 25658385]
12. Ghosh-Dastidar MB, et al., Accuracy of BMI correction using multiple reports in children. BMC Obes, 2016 3(1): p. 37. [PubMed: 27648293]
13. Neuhouser ML, et al., Development and validation of a beverage and snack questionnaire for use in evaluation of school nutrition policies. J Am Diet Assoc, 2009 109(9): p. 1587–92. [PubMed: 19699839]
14. Musher-Eizenman D and Holub S, Comprehensive Feeding Practices Questionnaire: validation of a new measure of parental feeding practices. J Pediatr Psychol, 2007 32(8): p. 960–72. [PubMed: 17535817]
15. Benjamini Y and Hochberg Y, Controlling the False Discovery Rate - a Practical and Powerful Approach to Multiple Testing. Journal of the Royal Statistical Society Series B-Statistical Methodology, 1995 57(1): p. 289–300.
16. Ogden CL, et al., Prevalence of Obesity Among Youths by Household Income and Education Level of Head of Household - United States 2011–2014. Mmwr-Morbidity and Mortality Weekly Report, 2018 67(6): p. 186–189. [PubMed: 29447142]
17. Wildey MB, et al., Fat and sugar levels are high in snacks purchased from student stores in middle schools. Journal of the American Dietetic Association, 2000 100(3): p. 319–322. [PubMed: 10719405]
18. Harnack L, et al., Availability of a la carte food items in junior and senior high schools: a needs assessment. J Am Diet Assoc, 2000 100(6): p. 701–3. [PubMed: 10863576]
19. French SA, et al., Food environment in secondary schools: A la carte, vending machines, and food policies and practices. American Journal of Public Health, 2003 93(7): p. 1161–1167. [PubMed: 12835203]
20. Wechsler H, et al., Food service and foods and beverages available at school: results from the School Health Policies and Programs Study 2000. J Sch Health, 2001 71(7): p. 313–24. [PubMed: 11586874]
21. Probart C, et al., Competitive foods available in Pennsylvania public high schools. Journal of the American Dietetic Association, 2005 105(8): p. 1243–1249. [PubMed: 16182640]
22. Fox MK, et al., Availability and consumption of competitive foods in US public schools. J Am Diet Assoc, 2009 109(2 Suppl): p. S57–66. [PubMed: 19166673]
23. Terry-McElrath YM, et al., The school food environment and student body mass index and food consumption: 2004 to 2007 national data. J Adolesc Health, 2009 45(3 Suppl): p. S45–56. [PubMed: 19699436]
24. Cullen KW and Zakeri I, Fruits, vegetables, milk, and sweetened beverages consumption and access to a la carte/snack bar meals at school. American Journal of Public Health, 2004 94(3): p. 463–467. [PubMed: 14998815]
25. Templeton SB, Marlette MA, and Panemangalore M, Competitive foods increase the intake of energy and decrease the intake of certain nutrients by adolescents consuming school lunch. Journal of the American Dietetic Association, 2005 105(2): p. 215–220. [PubMed: 15668677]
26. Fox MK, et al., Association between School Food Environment and Practices and Body Mass Index of US Public School Children. Journal of the American Dietetic Association, 2009 109(2): p. S108–S117. [PubMed: 19166665]
27. Kubik MY, et al., The association of the school food environment with dietary behaviors of young adolescents. American Journal of Public Health, 2003 93(7): p. 1168–1173. [PubMed: 12835204]
28. Vericker TC, Limited evidence that competitive food and beverage practices affect adolescent consumption behaviors. Health Educ Behav, 2013 40(1): p. 19–23. [PubMed: 22491007]

29. Van Hook J and Altman CE, Competitive Food Sales in Schools and Childhood Obesity: A Longitudinal Study. Sociol Educ, 2012 85(1): p. 23–39. [PubMed: 22611291]
30. Shier V, Nicosia N, and Datar A, Neighborhood and home food environment and children's diet and obesity: Evidence from military personnel's installation assignment. Social Science & Medicine, 2016 158: p. 122–131. [PubMed: 27135542]
31. Couch SC, et al., Home food environment in relation to children's diet quality and weight status. J Acad Nutr Diet, 2014 114(10): p. 1569–1579 e1. [PubMed: 25066057]
32. Snelling AM, Korba C, and Burkey A, The national school lunch and competitive food offerings and purchasing behaviors of high school students. J Sch Health, 2007 77(10): p. 701–5. [PubMed: 18076416]
33. Nollen NL, et al., Competitive foods in schools: availability and purchasing in predominately rural small and large high schools. J Am Diet Assoc, 2009 109(5): p. 857–64. [PubMed: 19394472]
34. Booth B, et al., hat we know about Army families: 2007 Update, W. Prepared for the U.S. Army Family and Morale, and Recreation Command, Editor. 2007, ICF International: Fairfax, VA.
35. Clever M and Segal DR, The demographics of military children and families. Future Child, 2013 23(2): p. 13–39. [PubMed: 25518690]
36. Bissell KL, Crosslin RL, and JL H, Bissell KL, Crosslin RL, Hathaway JL, L.G. Consulting, Editor. 2019.
37. Ogden CL, et al., Prevalence of Obesity and Trends in Body Mass Index Among US Children and Adolescents, 1999–2010. Jama-Journal of the American Medical Association, 2012 307(5): p. 483–490.

Implications and Contribution

Policy makers may want to consider limiting unhealthy competitive foods and beverage availability as means to reduce child obesity.

Table 1.

M-TEENS sample (n=815, students' first observation) characteristics

Sample characteristics	Percentages or mean (median)
Child gender is female	47.6
Child age in months	164.3 (164)
Child race/ethnicity	
White Non Hispanic	38.0
Black Non Hispanic	20.9
Hispanic/Latino	25.4
Other (multi/AIAN/NHPI)	12.9
Missing	2.8
Parents married	
No	8.2
Yes	90.9
Missing	0.9
Enlisted Parent's Rank	
Sergeant or lower (<=E5)	32.3
Staff Sergeant (E6)	29.3
Sergeant First Class or higher (>=E7)	36.6
Missing	1.8
Number of children in household	
1	11.7
2	32.1
3 or more	54.2
Missing	2.1
Household Income	
$40,000 or less	12.9
$40,001–$50,000	31.0
$50,001–$75,000	54.4
$75,000 or higher	1.7
Missing	1.0
Parents' Highest Education Level	
Trade school, some college, or less	39.5
Associates degree	27.1
College degree or higher	32.6
Missing	0.7
Months at current base	
12 months or less	10.9
13–24 months	25.0
25–48 months	38.9
49 months or more	22.7
Missing	2.5

Sample characteristics	Percentages or mean (median)
Live on-installation	
No	45.0
Yes	52.9
Missing	2.1
Home food environment	21.8 (22)
School food environment variables	
Number of CF&Bs available (across 11 policies)	
0	3.1
1	1.8
2	0.4
3	6.7
4	4.4
5	9.1
6	8.7
7	4.9
8	12.4
9	10.2
10	17.5
11	20.7
Number of healthy CF&Bs available (fruit, vegetables, water, milk)	
0	3.3
1	6.4
2	16.0
3	31.3
4	43.1
Number of unhealthy CF&Bs available (french fries, SSBs, salty snacks, sweets, juice)	
0	8.1
1	8.5
2	5.2
3	24.8
4	21.2
5	32.3
Number of neutral CF&Bs available (sandwiches/burgers/pizza and bread)	
0	28.5
1	20.0
2	51.5
Outcomes	
Child bought sweets at school last 7 days	29.9
Child bought salty snacks at school last 7 days	25.9
Child bought soda at school last 7 days	19.6
Number of sweets consumed	12.3 (9)
Number of snacks consumed	7.3 (5)

Sample characteristics	Percentages or mean (median)
Number of SSBs consumed	14.5 (10)
Number of fruits consumed	8.4 (7)
Number of vegetables consumed	7.8 (7)
zBMI	0.4 (0.5)
Overweight or Obese	26.1

Notes: all sample sizes were n=815

Abbreviations: competitive food and beverage (CF&B) sugar-sweetened beverage (SSB)

Table 2.

Multiple imputed unadjusted, adjusted[1] (excluding home food environment), and adjusted[1] (including home food environment) models estimating associations between the number of CF&B availability, child report of what they ate and what they bought at school, overweight/obese, and BMI Z-score (N=815 children and 1,010 observations for each outcome)

Outcomes	Child food purchasing at school			Child dietary behaviors					Child BMI	
	Any vs no sweets	Any vs no snacks	Any vs no SSBs	Number of sweets	Number of snacks	Number of SSBs	Number of fruits	Number of vegetables	Overweight or obese vs normal weight	BMI Z-score
	OR (CI)	OR (CI)	OR (CI)	Coeff (CI)	Coeff (CI)	Coeff (CI)	Coeff (CI)	Coeff (CI)	OR (CI)	Coeff (CI)
Panel 1. Models- unadjusted										
Number of CF&Bs	1.07 (1.01,1.12)	1.03 (0.98,1.08)	1.02 (0.96,1.08)	−0.14 (−0.41,0.14)	−0.08 (−0.27,0.11)	−0.06 (−0.39,0.27)	0.00 (−0.16,0.17)	0.05 (−0.10,0.20)	0.98 (0.93,1.03)	0.01 (−0.01,0.03)
Panel 2. Models- adjusted (excluding home food environment)										
Number of CF&Bs	1.06 (1.01,1.12)	1.03 (0.97,1.08)	1.00 (0.94,1.07)	−0.12 (−0.39,0.15)	−0.07 (−0.26,0.12)	−0.01 (−0.34,0.33)	0.01 (−0.16,0.18)	0.05 (−0.10,0.20)	0.98 (0.93,1.03)	0.00 (−0.02,0.02)
Panel 3. Models- adjusted (including home food environment)										
Number of CF&Bs	1.07 (1.01,1.13)	1.03 (0.98,1.09)	1.02 (0.95,1.08)	−0.06 (−0.32,0.21)	−0.04 (−0.23,0.15)	0.06 (−0.27,0.39)	−0.02 (−0.18,0.15)	0.03 (−0.12,0.17)	0.98 (0.93,1.03)	0.00 (−0.02,0.03)
Home food environment	0.97* (0.94,1.00)	0.95** (0.92,0.98)	0.93** (0.90,0.97)	−0.62** (−0.81,−0.43)	−0.32** (−0.44,−0.20)	−0.70** (−0.93,−0.47)	0.31** (0.20,0.42)	0.29** (0.19,0.39)	0.97* (0.93,1.00)	−0.01* (−0.03,−0.00)

*p<0.05

**p<0.01

Abbreviations: competitive food and beverage (CF&B); Odds Ratio (OR); standard error (se); Linear regression coefficient (Coeff); Versus (vs); confidence interval (CI)

[1]Controlling for child's age in months, gender, race/ethnicity (non-Hispanic white, non-Hispanic black, Hispanic/Latino, other), highest education level among both parents (less than high school, high school graduate or equivalent, some college, and college graduate or higher), household income (<=$40,000; $40,001–$50,000; $50,001–$75,000; $75,001 or higher), marital status, and number of children in household, whether the family lives on-installation, parent's military rank (Sergeant or lower (<=E5), Staff Sergeant (E6), Sergeant First Class or higher (>=E7), and months at current installation (12 months or less, 13–24 months, 25–48 months, 49 months or more).

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Table 3.

Multiple imputed, unadjusted, adjusted[1] (excluding home food environment), and adjusted[1] (including home food environment) models estimating associations between the categories of CF&B availability, child report of what they ate and what they bought at school, overweight/obese, and BMI Z-score (N=815 children and 1,010 observations for each outcome)

Outcomes	Child food purchasing at school			Child dietary behaviors					Child BMI	
	Any vs no sweets	Any vs no snacks	Any vs no SSBs	Number of sweets	Number of snacks	Number of SSBs	Number of fruits	Number of vegetables	Overweight or obese vs normal weight	BMI Z-score
	OR (CI)	OR (CI)	OR (CI)	Coeff (CI)	Coeff (CI)	Coeff (CI)	Coeff (CI)	Coeff (CI)	OR (CI)	Coeff (CI)
Panel 1. Models- unadjusted										
Number of healthy CF&Bs[2]	0.89 (0.74,1.07)	0.97 (0.81,1.16)	0.93 (0.75,1.15)	0.77 (−0.30,1.84)	−0.08 (−0.84,0.69)	0.79 (−0.45,2.04)	−0.35 (−1.01,0.32)	−0.51 (−1.11,0.08)	1.03 (0.85,1.25)	0.02 (−0.06,0.10)
Number of unhealthy CF&Bs[2]	1.25** (1.11,1.39)	1.20** (1.06,1.35)	1.15* (1.00,1.31)	−0.22 (−0.92,0.47)	0.20 (−0.21,0.61)	−0.07 (−0.83,0.70)	0.30 (−0.09,0.70)	0.33 (−0.02,0.67)	1.00 (0.89,1.13)	0.00 (−0.05,0.05)
Number of neutral CF&Bs[2]	0.99 (0.80,1.23)	0.83 (0.67,1.04)	0.91 (0.71,1.17)	−1.14 (−2.44,0.17)	−0.62 (−1.44,0.20)	−1.15 (−2.71,0.40)	−0.14 (−0.92,0.64)	0.25 (−0.47,0.98)	0.89 (0.71,1.12)	−0.00 (−0.10,0.09)
Panel 2. Models- adjusted (excluding home food environment)										
Number of healthy CF&Bs[2]	0.81 (0.67,0.99)	0.90 (0.74,1.09)	0.83 (0.66,1.03)	0.42 (−0.69,1.54)	−0.22 (−1.04,0.60)	0.48 (−0.78,1.73)	−0.32 (−1.02,0.38)	−0.56 (−1.16,0.04)	1.01 (0.82,1.23)	0.02 (−0.06,0.10)
Number of unhealthy CF&Bs[2]	1.29** (1.14,1.45)	1.21** (1.07,1.38)	1.17* (1.01,1.35)	−0.18 (−0.88,0.52)	0.23 (−0.19,0.65)	0.14 (−0.65,0.93)	0.31 (−0.11,0.72)	0.35 (−0.00,0.70)	1.00 ((0.88,1.13)	−0.01 (−0.06,0.04)
Number of neutral CF&Bs[2]	1.05 (0.83,1.32)	0.89 (0.71,1.12)	0.98 (0.76,1.26)	−0.68 (−1.97,0.61)	−0.45 (−1.26,0.36)	−0.90 (−2.43,0.62)	−0.13 (−0.94,0.67)	0.28 (−0.45,1.01)	0.91 ((0.71,1.15)	0.01 (−0.09,0.11)
Panel 3. Models- adjusted (including home food environment)										
Number of healthy CF&Bs[2]	0.82 (0.67,0.99)	0.90 (0.75,1.10)	0.84 (0.67,1.05)	0.46 (−0.62,1.54)	−0.20 (−1.01,0.61)	0.51 (−0.72,1.75)	−0.33 (−1.03,0.36)	−0.57 (−1.16,0.01)	1.01 (0.82,1.24)	0.02 ((−0.06,0.10)
Number of unhealthy CF&Bs[2]	**1.30** ** **(1.15,1.47)**	**1.23** ** **(1.08,1.40)**	**1.19** * **(1.04,1.37)**	−0.00 (−0.69,0.68)	0.32 (−0.10,0.75)	0.34 (−0.45,1.13)	0.22 (−0.18,0.63)	0.27 (−0.07,0.61)	1.01 (0.89,1.14)	−0.01 (−0.06,0.05)
Number of neutral CF&Bs[2]	1.04 (0.82,1.31)	0.88 (0.70,1.10)	0.95 (0.74,1.22)	−0.82 (−2.07,0.43)	−0.52 (−1.32,0.28)	−1.06 (−2.55,0.44)	−0.07 (−0.86,0.72)	0.34 ((−0.38,1.05)	0.90 (0.71,1.14)	0.01 (−0.09,0.10)

Outcomes	Child food purchasing at school			Child dietary behaviors					Child BMI	
	Any vs no sweets	Any vs no snacks	Any vs no SSBs	Number of sweets	Number of snacks	Number of SSBs	Number of fruits	Number of vegetables	Overweight or obese vs normal weight	BMI Z-score
	OR (CI)	OR (CI)	OR (CI)	Coeff (CI)	Coeff (CI)	Coeff (CI)	Coeff (CI)	Coeff (CI)	OR (CI)	Coeff (CI)
Home food environment	0.96* (0.93,1.00)	0.95** (0.92,0.98)	0.93** (0.90,0.96)	−0.62** (−0.82,−0.43)	−0.33** (−0.45,−0.21)	−0.70** (−0.94,−0.47)	0.31** (0.20,0.42)	0.29** (0.19,0.39)	0.96* (0.93,1.00)	−0.01* (−0.03,−0.00)

* p<0.05

** p<0.01

Results bolded in the table are significant after Benjamini-Hochberg multiple testing adjustment at the 5% significance level

Abbreviations: competitive food and beverage (CF&B) sugar-sweetened beverage (SSB); Odds Ratio (OR); standard error (se); Linear regression coefficient (Coeff); Versus (vs); confidence interval (CI)

1 Controlling for child's age in months, gender, race/ethnicity (non-Hispanic white, non-Hispanic black, Hispanic/Latino, other), highest education level among both parents (less than high school, high school graduate or equivalent, some college, and college graduate or higher), household income (<=$40,000; $40,001–$50,000; $50,001–$75,000; $75,001 or higher), marital status, and number of children in household, whether the family lives on-installation, parent's military rank (Sergeant or lower (<=E5), Staff Sergeant (E6), Sergeant First Class or higher (>=E7), and months at current installation (12 months or less, 13–24 months, 25–48 months, 49 months or more).

2 Number of healthy CF&Bs (fruit, vegetables, water, milk) available; Number of unhealthy CF&Bs (french fries, SSBs, salty snacks, sweets, juice) available; Number of neutral CF&Bs (sandwiches/ burgers/pizza and bread) available

Table 4.

Sensitivity models[1] for categories of CF&B availability using 1) different groupings of healthy, unhealthy, and neutral items; 2) using first observation; and 3) using last observation (N=815 children and observations for each outcome)

Outcomes	Child food purchasing at school			Child dietary behaviors					Child BMI	
	Any vs no sweets	Any vs no snacks	Any vs no SSBs	Number of sweets	Number of snacks	Number of SSBs	Number of fruits	Number of vegetables	Overweight or obese vs normal weight	BMI Z-score
	OR (CI)	OR (CI)	OR (CI)	Coeff (CI)	Coeff (CI)	Coeff (CI)	Coeff (CI)	Coeff (CI)	OR (CI)	Coeff (CI)
Panel 1. Sensitivity models using different grouping										
Number of healthy CF&Bs[2]	0.89 (0.69,1.14)	0.83 (0.65,1.05)	0.78 (0.60,1.03)	0.86 (−0.33,2.05)	−0.03 (−0.87,0.82)	0.23 (−1.35,1.80)	−0.03 (−0.81,0.75)	−0.57 (−1.26,0.11)	1.06 (0.82,1.38)	0.03 (−0.08,0.13)
Number of unhealthy CF&Bs[2]	1.32** (1.16,1.51)	1.24** (1.08,1.41)	1.18* (1.02,1.36)	−0.03 (−0.74,0.68)	0.40 (−0.06,0.86)	0.31 (−0.53,1.15)	0.02 (−0.39,0.42)	0.12 (−0.23,0.47)	0.95 (0.83,1.08)	−0.03 (−0.08,0.03)
Number of neutral CF&Bs[2]	0.89 (0.73,1.09)	0.94 (0.77,1.16)	1.00 (0.81,1.25)	−0.96 (−2.01,0.09)	−0.77 (−1.61,0.06)	−0.51 (−1.85,0.83)	−0.07 (−0.75,0.61)	0.44 (−0.15,1.02)	0.96 (0.79,1.18)	0.04 (−0.04,0.11)
Home food environment	0.97* (0.94,1.00)	0.95** (0.92,0.98)	0.93** (0.90,0.97)	−0.62** (−0.81,−0.43)	−0.32** (−0.44,−0.20)	−0.70** (−0.93,−0.47)	0.31** (0.20,0.42)	0.29** (0.19,0.39)	0.97* (0.93,1.00)	−−0.01* (−0.03,−0.00)
Panel 2. Sensitivity models using first observation (n=815) and clustered on school										
Number of healthy CF&Bs[3]	0.79 (0.62,1.01)	0.91 (0.72,1.15)	0.72* (0.55,0.95)	0.34 (−0.75,1.42)	−0.45 (−1.36,0.45)	0.38 (−1.12,1.87)	−0.35 (−1.16,0.45)	−0.51 (−1.10,0.08)	1.08 (0.91,1.29)	0.05 (−0.03,0.13)
Number of unhealthy CF&Bs[3]	1.33** (1.15,1.54)	1.23** (1.05,1.44)	1.25* (1.05,1.49)	0.11 (−0.59,0.81)	0.39 (−0.07,0.84)	0.52 (−0.29,1.32)	0.19 (−0.28,0.66)	0.27 (−0.09,0.62)	1.00 (0.89,1.12)	−0.01 (−0.06,0.04)
Number of neutral CF&Bs[3]	1.09 (0.81,1.47)	0.93 (0.69,1.24)	1.13 (0.82,1.57)	−0.86 (−1.96,0.25)	−0.43 (−1.24,0.39)	−0.93 (−2.38,0.51)	0.08 (−0.59,0.76)	0.41 (−0.25,1.06)	0.85 (0.67,1.07)	−0.01 (−0.12,0.11)
Home food environment	0.96* (0.93,1.00)	0.94** (0.91,0.97)	0.94** (0.90,0.98)	−0.59** (−0.76,−0.42)	−0.31** (−0.43,−0.19)	−0.65** (−0.87,−0.43)	0.30** (0.17,0.42)	0.26** (0.17,0.35)	0.96* (0.93,1.00)	−0.02* (−0.03,−0.00)
Panel 3. Sensitivity models using last observation (n=815) and clustered on school										
Number of healthy CF&Bs[3]	0.8 (0.64,1.02)	0.91 (0.71,1.17)	0.94 (0.73,1.21)	0.04 (−1.05,1.12)	−0.58 (−1.63,0.47)	0.27 (−1.19,1.73)	−0.16 (−1.03,0.71)	−0.71 (−1.45,0.03)	0.98 (0.81,1.19)	0.01 (−0.07,0.09)

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Outcomes	Child food purchasing at school			Child dietary behaviors					Child BMI	
	Any vs no sweets	Any vs no snacks	Any vs no SSBs	Number of sweets	Number of snacks	Number of SSBs	Number of fruits	Number of vegetables	Overweight or obese vs normal weight	BMI Z-score
	OR (CI)	OR (CI)	OR (CI)	Coeff (CI)	Coeff (CI)	Coeff (CI)	Coeff (CI)	Coeff (CI)	OR (CI)	Coeff (CI)
Number of unhealthy CF&Bs[3]	1.30** (1.13,1.51)	1.22* (1.04,1.43)	1.16 (0.99,1.36)	0.42 (−0.30,1.14)	0.61* (0.07,1.15)	0.64 (−0.12,1.41)	0.20 (−0.28,0.67)	0.36 (−0.01,0.73)	0.96 (0.87,1.06)	−0.02 (−0.07,0.02)
Number of neutral CF&Bs[3]	0.99 (0.74,1.34)	0.83 (0.62,1.10)	0.85 (0.64,1.13)	−0.72 (−2.17,0.74)	−0.68 (−1.75,0.40)	−1.15 (−2.71,0.42)	−0.17 (−1.04,0.71)	0.61 (−0.19,1.41)	1.05 (0.83,1.32)	0.06 (−0.05,0.17)
Home food environment	0.97 (0.94,1.01)	0.95** (0.93,0.98)	0.92** (0.88,0.96)	−0.61** (−0.85,−0.36)	−0.37** (−0.54,−0.20)	−0.75** (−1.02,−0.47)	0.25** (0.12,0.38)	0.28** (0.18,0.37)	0.96* (0.93,1.00)	−0.01 443135 (−0.02,0.00)

*p<0.05

**p<0.01

Abbreviations: competitive food and beverage (CF&B) sugar-sweetened beverage (SSB); Odds Ratio (OR); standard error (se); Linear regression coefficient (Coeff); Versus (vs); confidence interval (CI)

[1]Controlling for child's age in months, gender, race/ethnicity (non-Hispanic white, non-Hispanic black, Hispanic/Latino, other), highest education level among both parents (less than high school, high school graduate or equivalent, some college, and college graduate or higher), household income (<=$40,000; $40,001–$50,000; $50,001–$75,000; $75,001 or higher), marital status, and number of children in household, whether the family lives on-installation, parent's military rank (Sergeant or lower (<=E5), Staff Sergeant (E6), Sergeant First Class or higher (>=E7), and months at current installation (12 months or less, 13–24 months, 25–48 months, 49 months or more).

[2]Number of healthy CF&Bs (fruit, vegetables, water); Number of unhealthy CF&Bs (french fries, sandwiches/burgers/pizza, SSBs, salty snacks, sweets); Number of neutral CF&Bs (juice, milk, bread)

[3]Number of healthy CF&Bs (fruit, vegetables, water, milk) available; Number of unhealthy CF&Bs (french fries, SSBs, salty snacks, sweets, juice) available; Number of neutral CF&Bs (sandwiches/burgers/pizza and bread) available