

Kids in a Candy Store: An objective analysis of children's interactions with food in convenience stores

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Abstract

Background: Increasing rates of childhood obesity worldwide has focused attention on the obesogenic food environment and how it influences dietary behaviour and bodyweight in children. The neighbourhood convenience store is a key setting in children's food environments. The Kids'Cam study enabled the objective measurement of the world in which children live. This paper reports on an analysis of children's interaction with food in convenience stores.

Methods: Kids'Cam NZ was a cross-sectional study conducted from July 2014 to June 2015 in the Wellington region of New Zealand, in which 168 randomly selected children aged 11-14 years old wore a wearable camera for a 4-day period. The camera captured a 136° image of the children's surroundings every seven seconds. In this ancillary study, 'Kids'Cam Convenience Stores', images from children who visited a convenience store were manually coded for food and drink availability, marketing, purchase and consumption.

Results: Twenty-two percent of children (n=37) visited convenience stores on 62 occasions during the 4-day data collection period. Non-core items dominated the food and drinks available to children in convenience stores at a rate of 8.3 to 1 (means, 300 non-core and 36 core, respectively). The food and drinks marketed in-store were overwhelmingly non-core, and promoted using accessible placement, price offers, product packaging, and signage. Most of the 70 items purchased by children were non-core foods or drinks (94.6%) and all of the purchased food or drink subsequently consumed by children was non-core. Confectionary and sugary drinks were the items most frequently purchased and consumed.

Conclusions: This research highlights convenience stores as a key source of unhealthy food and drink for children, where unhealthy food and drinks are marketed, available, and subsequently purchased and consumed. Policies are urgently needed to reduce the role of convenience stores in the obesogenic food environment in which children live.

Background

Increasing rates of childhood obesity worldwide are a major public health concern (1). In 2016 it was estimated that 50 million girls, and 74 million boys were obese, and a further 213 million children were overweight, increasing their risk of non-communicable disease over the life-course, especially type 2 diabetes (2). Research attention has therefore focused on the obesogenic food environment and how it influences dietary behaviour and bodyweight in children (3–7). Of interest to the study of children's food environments, is the neighbourhood convenience store (8, 9).

Convenience stores are a unique setting; the food and drinks available are overwhelmingly unhealthy and ultra-processed (10, 11). They are often located within children's neighbourhoods, especially around schools. In many countries, there is a higher density of convenience stores in close proximity to schools in socioeconomically deprived areas (12–14). This is of concern, as the proximity and density of

convenience stores in a child's neighbourhood, including their home and school neighbourhoods, is positively associated with unhealthy eating behaviours (15, 16), and overweight (7, 17) .

The need for research to better measure children's interaction with convenience stores has been identified (7). Wearable cameras are a relatively new research tool. They have been used to document children's health behaviours related to the environment in which they live (18, 19). The innovative Kids'Cam New Zealand (NZ) study (20) has enabled objective analysis of the world in which children live, including the availability of drinks in children's lives (21) and children's exposure to food and alcohol marketing (22, 23).

New Zealand children have the second highest rates of obesity in OECD countries (24) and this is patterned by socioeconomic deprivation and ethnicity (25). New Zealand children grow up in obesogenic environments, of which convenience stores are a feature (12). Food retailers, including convenience stores, feature prominently in NZ children's lives (26). The FoodSee methodology was developed to analyse people's interaction with the in-store food environment (27). Using the FoodSee methodology with the Kids'Cam data, this study aimed to examine children's interaction with convenience stores, specifically: food and beverage availability, marketing, purchasing and consumption.

Method

Kids'Cam NZ (28) was a cross-sectional study conducted from July 2014 to June 2015 in the Wellington region of NZ, in which 168 randomly selected children aged 11-14 years old wore a wearable camera for a 4-day period (Thursday to Sunday). The camera captured a 136° image of the children's surroundings every 7 seconds generating approximately 1.3 million images. The sampling strategy resulted in representation from children with a range of ethnic and socioeconomic backgrounds. Ethical approval was obtained to analyse the data for any issue of public health interest. Therefore, the children were blinded to the specific aims of Kids'Cam NZ studies, including the current study. Further details of the methods used for Kids'Cam NZ have been published previously (22, 28).

In this ancillary study, 'Kids'Cam Convenience Stores', children who had image data showing the inside of a convenience store or service station were eligible for inclusion. Service stations were included as they are a source of energy-dense snack foods with limited healthy options (29, 30) and it is likely that children may use service stations in a similar way to a convenience store.

Coding and data analysis

Each of the images from a convenience store visit was manually coded according to the FoodSee study protocol (27). The study protocol and definitions are available at (www.heppru/protocols). The images were coded for 'availability', which was measured by counting the number of individual unique 'food and drink items' in each image. For example, each individual chocolate bar in an image was counted. Care was taken to ensure each item was only coded once per visit. The items were also coded for product category based on those used in previous Kids'Cam studies and modified to reflect the convenience store environment e.g. by accounting for the different varieties of confectionary sold including single serve

confectionary (confectionary such as lollipops that is sold as an individual item) and lolly-mixtures (individual candies grouped into bags), and chocolate which included chocolate products such as single serve bars, or chocolate products such as Easter eggs (27). Product categories also included 'iced-confectionary' (ice-cream or ice-blocks/lollies), 'snack foods' (potato crisps), 'cookies, cakes and pastries' (cakes, muffins, sweet biscuits, sweet and savoury pies, sweet and savoury pastries, slices, scones, sausages rolls) and 'sugar-sweetened beverages (SSBs) and fruit juices'. These included carbonated beverages and soft drinks including sports drinks; energy drinks; flavoured milks (chocolate milk), fruit drinks; powered drinks (Milo, Raro); cordial; fruit juices; fruit drinks; iced tea; breakfast drinks and flavoured waters. Diet drinks were not included in the sugary drinks category, but were coded separately as 'Diet drinks'. For analysis, foods and drinks were then categorised into healthy (core) or unhealthy (non-core) (31).

The placement of food and drink items within the convenience store was noted, with the position of the food and drink coded as 'accessible' if it was within easy reach of the child. As the images were taken from a camera at a child's height, products at the forefront of an image were considered 'accessible'(27). The position of food and drink items relative to the counter-top was also coded. Aspects of food and drink marketing coded for included product packaging, price promotions, branded displays and promotional signs. If an item was packaged and its 'brand' name was visible, it was coded. Visible price promotions for products were also coded, for example Figure 1 has an image with two items for NZ 0.30c. The number of branded displays which included fixtures supplied by a manufacturer to display their products were coded, for example promotion boxes containing chocolate, as well as branded ice-cream freezers or branded drinks refrigerators as shown in Figure 1. Promotional signs such as posters were also coded. 'Food or Drink Purchases' were coded if a financial transaction occurred at a shop counter in exchange for a food or drink item. Food or drink consumption was coded if a sequence of images then showed the food or drink item being consumed.

A Microsoft Excel spread-sheet was used for the coding of image data. Excel and Stata 14 (Statacorp, College Station TX, US) were used for descriptive statistical analysis. Children's demographic characteristics, types of food and drink available, marketing exposure, and purchase and consumption behaviours were summarised using descriptive statistics (counts and percentages for categorical data, and means and standard deviations, or medians and interquartile ranges, for continuous data). Means and 95% confidence intervals (CI) were calculated for core/non-core food and drink availability. The difference in core/non-core marketing exposure was calculated for each child and summarised as means with 95% CI.

Thirty seven children or 22% of the Kids'Cam NZ participants collected image data that showed a convenience store visit. Most children who visited a convenience store did so only once during their four-day data collection period. A small number visited more than once, with the maximum number of visits being six by one participant, 68 visits in total (see Table 1). In all, 38 individual stores were visited, six more than once.

To identify convenience stores, Google Street View was used to determine if the stores were different, or if the children were visiting a small number of the same stores repeatedly. The images of each visit were analysed for distinguishing geographical features, such as signage with the name of the store, or nearby street names. Thirty-eight different convenience stores or service stations were identified. There were not enough data to identify five of the convenience stores or service stations. Thirty-two stores were visited once; however, six stores were visited more frequently with the most visited store frequented six times by two different children. Nevertheless, there was enough variation in the sample to combine the data from each convenience store visit to provide information to determine the mean of the different food and drink types available to each child. Analysing child-level data rather than store-level data was in keeping with the study aim to examine children's interaction with convenience stores.

The images showing convenience store visits were a small proportion of the total number of images collected by each child. All children theoretically had the opportunity to visit a convenience store in the hours that they did not attend school, however not all children had complete data over the four-day period. The proportion of usable images collected from convenience stores or service stations divided by the total number of usable images for each participant not including school hours was 0.37%. This small proportion indicates that of approximately 1.4 million images collected overall, there were 11 images, on average, for each convenience store visit (27). Of the children who did collect usable image data for the current study, their demographic characteristics were comparable to the overall Kids'Cam NZ sample in terms of gender, age, ethnicity, BMI, or school decile stratum as shown by Table 2.

Results

Types of food and drink items available

Non-core food and drink items dominated the food and drink available to children in convenience stores at a rate of 8.3 to 1, as illustrated in Figures 1 and 2. A mean of 300 (95%CI 220-389), non-core food and drink items and 36 (95%CI 19.2-53.2) core items were available to each child across convenience store visits. The most commonly recorded non-core category available was confectionary with a mean of 160.2 items per child, followed by sugary drinks; 88.4, and snack food including potato crisps; 44.6. The confectionary category was dominated by single-serve confectionary with a mean of 65.1 items per child followed by chocolate (58.1), and lolly-mixes (15.8). Other non-core foods available included cookies, cakes and pastries (14.0), and iced-confectionary (3.3). The category 'Other non-core food or drinks' (e.g., butter and cream) were available at a mean of 8.2 items per child. Of the 36 core food and drink items available to children, on average the most common categories were fruits and vegetables (included canned or frozen products,), meat and alternatives, and bread, milk, and water.

The food and drink available to children was similar by ethnicity. Children of Pacific ethnicity had, on average, slightly more non-core food and drink items (325.7) available per child than NZ European (288.0), or Māori (291.5) children. However caution should be taken in interpreting the differences due to a small

Placement of food and drink items by category

The placement of food and drink items available within convenience stores differed by food and drink category. As shown in the top left image of Figure 3, there was a substantial amount of confectionary items, especially chocolate and single serve confectionary and lolly-mixes, on or beside the counter top, and directly underneath the counter, at a height accessible to children. A mean of 16.9 items of single-serve confectionary, 9.9 items of chocolate and 8.0 items of chewing gum were available on the counter, per visit. The placement of these food items required children purchasing a food item to reach over single-serve confectionary food items placed on the counter top.

Promotion

The 37 children who visited a convenience store were exposed to marketing for non-core food and drinks through a variety of mediums. As shown in Table 3, there was a mean of 7.9 exposures per child to non-core packaging, 6.8 exposures to non-core signs, 4.2 exposures to non-core branded displays and 2.8 exposures to non-core price promotions. This was substantially higher than exposures across all mediums to marketing for core food and drinks, with mean differences between core and non-core exposures of 6.1 (95%CI 4.9-7.4) for packaging, 5.4 (95%CI 4.0-6.8) for signs, 3.6 (95%CI 2.8-4.5), for branded displays and 2.7 (95%CI 2.0-3.4) for price promotions.

Most food and drink items in the convenience store environment are packaged, and this package often includes a branded promotion, for example, a logo. Commonly packaged products were confectionary, followed by sugary drinks. Branded displays were also used to display items, especially individual chocolate bars, cookies that were displayed in boxes for individual purchase or lollipops displayed on counters. Chewing gum was displayed in a branded display usually on counter tops. Sugary drinks were displayed in branded fridges and iced-confectionary in branded freezers. The non-core food and drink categories also dominated the items promoted by pricing, in particular confectionary, which was typically available for very low prices, e.g. NZ 0.10c. In each convenience store there were also several signs promoting food and drinks, especially chocolate, iced-confectionary products, and cookies.

Food or drink purchase and consumption

Overall 70 food or drink items were purchased during children's convenience store visits (see Figure 3). The purchases were made by the participant or by a companion of the participant, who were children of a similar age or an adult. The majority of items purchased were non-core foods or drinks (94.6%); only four core food items were purchased (see Table 4). The most frequently purchased food and drink category was confectionary which, when combined with lolly-mixes and chocolate, numbered 33 items, followed by sugary drinks (20) and ice-cream (11). There were 33 separate instances of food or drink consumption by participants following purchase at a convenience store, all of which were non-core, most frequently confectionary and sugary drinks.

Discussion

In this study, over one-fifth (22%) of the sample (n = 37) visited convenience stores on 62 occasions during their 4-day data collection period. They encountered, on average, 300 non-core food and drink item/child, at a rate 8.3 times that of core food and drink items (mean 36 core food and drink items/child). Most of the non-core food and drink available was confectionary items, especially single-serve confectionary, chocolate and sugary drinks. Snack foods, including potato crisps and packaged single-serve cookies were also widely available. These findings are consistent with previous research that has found the product assortment in convenience stores is dominated by non-core food and drinks (10, 32).

Sanders-Jackson et al, found half the US adolescents (13-16y) in their sample visited a convenience store at least once a week (9). Our study did not include data collection over the week, and the participants in our study were younger. However, it is concerning that more than one in five (22%) children in our sample visited a convenience store during a 4-day period, some more than once. Moreover, we also know that the children in Kids'Cam NZ study visited other stores where non-core food is sold, such as fast food outlets, and do so regularly (26).

The non-core foods and drinks the children in this study encountered were promoted through a variety of mechanisms, including placement, price promotions, packaging, branded displays and signage (30, 33, 34). The placement of single-serve confectionary directly on the counter top, or immediately underneath or beside the counter, was especially conspicuous. When children were paying for a food item, they often had to reach over single-serve confectionary food items placed on the counter top. In addition, the confectionary displayed underneath the counter top featured prominently in the images, being proximal to a child's chest height and therefore could be easily reached.

In a previous analysis of the Kids'Cam data that measured marketing to children, it was found children were exposed to 27 non-core and 12 core marketing exposures per day (22). Exposures in convenience stores and supermarkets were excluded from the analysis as the marketing examples were too numerous to count (22). In the current study, children who visited a convenience store had a mean of 7.9 exposures to packaged non-core products, 4.8 exposures to non-core branded displays, and 6.8 exposures to non-core signs. There was a significant difference across all marketing mediums between exposure to non-core and core food and drink marketing in convenience stores. Therefore, the children in the Kids'Cam study who visited convenience stores had greater overall marketing exposure to non-core food and drinks.

Non-core food and drink items were also the dominant food and drinks promoted by pricing, at a mean rate of 2.8 items per child. For example, single-serve confectionary was often promoted at low prices (at NZ\$1 or less), as seen in Fig. 3. International evidence shows that the low price of food at convenience stores is appealing to children (35, 36).

Almost all of the food purchased (n = 70) and all the food consumed by the participants (n = 33), was non-core, which in turn substantially contributes to children's overall energy intake (35) This finding is consistent with other studies (16, 37, 38) that have associated convenience stores with unhealthy food purchase and consumption. Although we did not determine the motivation behind children's food

purchasing decisions, it is possible that the prominent marketing and availability of non-core food and drink in convenience stores was a contributing factor.

To our knowledge, this is the first study to objectively measure the food and drink available and marketed to children in convenience stores in their everyday life, and with the children's food and drink purchase and consumption. The use of wearable cameras overcame previous methodological limitations, such as the use of food diaries or dietary recall, to measure consumption, or the collection of receipts to measure food purchase. The methodology enabled the food and drink available and marketed to children in a convenience store to be measured, from their perspective, and to observe their subsequent behaviour.

While this research provides evidence on the food and drink available to children in convenience stores, and their food and drink purchase and consumption, it has some limitations. The study was cross-sectional in design, therefore only associations can be drawn from the data. The method could not determine if a child saw the food and drink that was available in the image. It is possible that they were looking in a different direction. However, given the amount of non-core food and drinks available in convenience stores, it is likely the children could see non-core food and drinks not captured in the images. It is also likely that the amount of food and drink available was underestimated, as some items were unable to be coded. For example, iced-confectionary in freezers was not visible unless a child was directly standing over a freezer, likewise single-serve confectionary stacked underneath other items in a box on a counter. Future research could use the FoodSee methodology to describe children's interaction with other food settings supermarkets or takeaway outlets. Future research could also focus on specific ethnic or socioeconomic groups in the sample to describe any differences by those factors.

This research focuses on the convenience store setting as a source of unhealthy food and drink in children's lives that contributes to unhealthy food and drink consumption. To reduce and prevent childhood obesity, strategies to limit the impact of convenience stores need to be considered. Policy options include limiting the density and proximity of convenience stores located near schools such as in South Korea where green food zones, which ban convenience stores within 200 m of a school, have been implemented (39, 40).

There is international evidence on programmes that involve working with convenience store owners to improve the range of healthy food and drinks that are available and promoted (32, 41), and reduce the availability and promotion of unhealthy food and drink products, such as removing them from counter tops (42). Other such strategies could include limiting price promotion of unhealthy food and drinks and reducing branded displays (41). However, these strategies would be challenging in the NZ environment as convenience stores are mostly independently owned. National policies, such as introducing plain packaging (43) or the introduction of a tax on sugary drinks, would likely impact purchasing and dietary intakes (44). Confectionary was the major non-core food and drink category available and purchased. Policy makers should also consider strategies to limit its availability and promotion alongside those that limit sugary drinks

Convenience stores are located centrally within communities and are an important food source for people with limited mobility due to age, income or disability (41). Given that substantial changes to the in-store environment would need to occur in order to impact food and drink purchasing behaviour of children (38), future research could also explore the role of convenience stores in the community. Communities have the right to a local source of healthy food options and it is time to question if the current model is delivering this.

Conclusion

This research highlights convenience stores as a key source of unhealthy food and drink for children, and associates their purchase and consumption of unhealthy food and drink products to this setting. It also measures aspects of the in-store environment from the child's perspective and describes the myriad of promotion strategies used within convenience stores to encourage unhealthy food and drink purchases. The findings provide evidence to enable policy makers and public health advocates to better target policies and interventions to limit food and drink marketing and unhealthy food availability to children.

Declarations

Ethical approval and consent to participate

Ethical approval was given by the University of Otago Human Ethics Committee (Health) (13/220) to study any aspect of the world that children live in. All participating children, parents and schools signed written consent to participate in the study.

Consent for publication

Participants consented to have all anonymized data available for publication.

Availability of data and materials

The dataset used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing Interests

The authors declare no conflict of interest

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Authors' Contributions

CM, MS, and LS conceived the idea and developed the study protocol. CM and MS developed the coding schedule. LS, MS collected the data. CM coded the data, and CM and JW analysed the data. LS provided overall leadership of the research. All authors contributed to the manuscript and approved the final version.

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Tables

Table 1. Number of convenience store visits by a child

Total number of visits	Frequency (n)	Percentage (%)
0	131	77.9
≥1	37	22
1	24	14.3
2	9	5.4
3	1	0.6
4	1	0.6
5	1	0.6
6	1	0.6
Total	168	100

Table 2 Demographic characteristics of Kids'Cam Convenience Store sample

Demographic Variable	Convenience store sample		Total Kids'Cam sample		
	N	%	N	%	
Total	37		168		
Gender	<i>Male</i>	18	48.6	80	47.3
	<i>Female</i>	19	51.4	88	52.7
Total	37		168		
Age*	<i>11</i>	4	10.8	13	8.0
	<i>12</i>	25	67.6	122	75.3
	<i>13</i>	8	21.8	26	16.1
	<i>14</i>	0	0	1	0.6
Mean	<i>12.6</i>				
Total	37		162		
Ethnicity	<i>NZ European</i>	15	40.5	66	39.3
	<i>Māori</i>	12	32.4	60	35.7
	<i>Pacific</i>	10	27.0	42	25.0
Total	37		168		
BMI category**	<i>Underweight</i>	2	5.4	9	5.4
	<i>Healthy weight</i>	21	56.7	87	52.1
	<i>Overweight/obese</i>	14	37.8	71	42.5
School Stratum	<i>Low (Decile 1-3)</i>	15	40.5	64	38.1
	<i>Medium (Decile 4-7)</i>	10	27.0	54	32.1
	<i>High (Decile 8-10)</i>	12	32.5	50	29.8

*Age missing for 6 participants (questionnaire not completed)

**BMI missing for 1 participants as child declined to be measured.

**BMI missing for 1 participant as child declined to be measured.

***Publically-funded schools in NZ are ranked by decile for funding purposes. Schools in decile 1 have the largest proportion of students from low socioeconomic backgrounds. Schools in decile 10 have the smallest proportion of these students. <http://www.education.govt.nz/school/running-a-school/resourcing/operational-funding/school-decile-ratings/>

Table 3: Marketing exposure to food and drinks in convenience stores, mean per child

Marketing Medium	Core		Non-Core		Difference		
	Mean	SD	Mean	SD	Mean	SD	95%CI
Packaging	1.7	1.7	7.9	4.3	6.1	3.9	4.9-7.4
Signs	1.4	1.5	6.8	4.9	5.4	4.2	4.0-6.8
Branded Display	0.6	0.8	4.2	3.0	3.6	2.7	2.8-4.5
Price Promotion	0.1	0.3	2.8	2.0	2.7	2.0	2.0-3.4

Table 4: Purchases and consumption of food and drinks from convenience stores

Items	Number purchased	%	Number Consumed	%
Total	74		33	
<i>Non-core</i>				
Confectionary (includes single serve)	22	29.7	7	21.2
Lolly-mix	8	10.8	6	18.2
Chocolate	3	4.0	1	3.0
Sugary drinks	20	27.0	9	27.3
Ice-cream	11	14.9	5	15.1
Pies	3	4.0	3	9.1
Cookies	1	1.4	1	3.0
Snack foods (potato crisps)	1	1.4	1	3.0
Other (non-core)	1	1.4	0	0
Total non-core	70	94.6	33	100
<i>Core</i>				
Milk	2	2.7	0	0
Bread	1	1.4	0	0
Water	1	1.4	0	0
Total core	4	5.4	0	0

Figures



Figure 1

Non-care food and drink items available to children in convenience stores Top Left: Single-serve confectionery including lolly-mix Top Right: Sugary drinks in branded refrigerator – note branding for ‘V’ at top and on shelves. Bottom Right: Single-serve confectionery note price promotion of 2 for 30c Bottom Left: Image shows ‘arms reach’ of confectionery

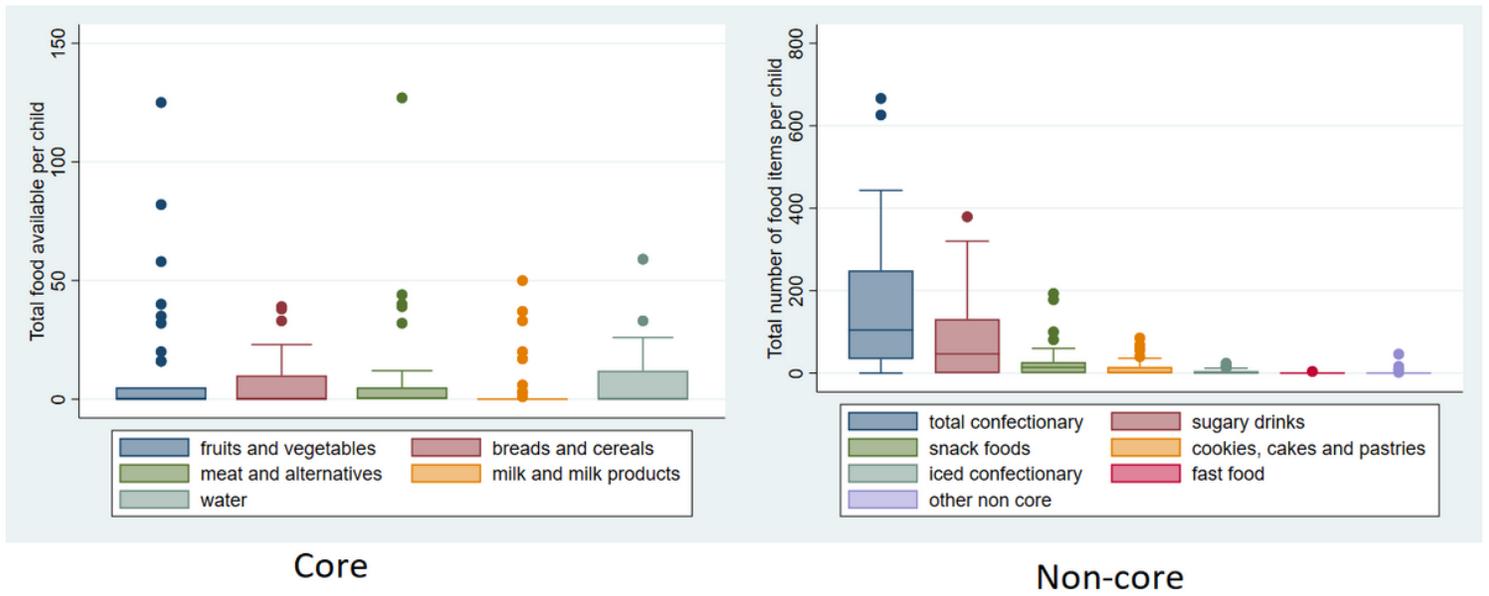


Figure 2

Median and interquartile range of non-core (top panel) and core (bottom panel) food and drink items available in convenience stores* *Note difference in axis between graphs for non-core and core food and drink. The dots represent outliers.



Figure 3

Food and drink purchase and consumption image sequence Top Left: Counter top with confectionary displayed beside and beneath the counter Top Right: Lollops selected by participant for purchase Bottom Right: Lollops in bag following purchase Bottom Left: Consumption of lollipop

Supplementary Files

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