



School food environment: Quality and advertisement frequency of child-oriented packaged products within walking distance of public schools

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ABSTRACT

Food marketing for children is a major concern for public health nutrition and many schools make efforts to increase healthy eating. Food environments surrounding schools in urban areas may undermine these efforts for healthy nutrition within school programs. Our study aim is to describe the nutrition environment within walking distance of schools in terms of food quality and food marketing and to explore the degree to which elements of the nutrition environment varies by proximity to schools. In a cross-sectional study, we analyzed the surrounding food environments of a convenience sample of 46 target schools within 950m walking distance in 7 different urban districts across Vienna, Austria. In total, we analyzed data from 67 fast food outlets and 54 supermarkets analyzing a total of 43,129 packaged snack food and beverage products, from which 85% were for adults and 15% of the products were child-oriented. Proximity to the schools did not affect the availability of child-oriented products and dedicated food advertisements for children. After applying nutrient profiling using the Nutrient Profiling Model (NPM) on child-oriented products, results showed that 15.8% of the packaged snack food were categorized as “healthy” foods and 84.2% as “less healthy”; for beverages 65.7% were categorized as “healthy” and 34.3% as “less healthy”. In conclusion, our results show that child-oriented snacks are not more frequently advertised around schools but substantially lack in nutritional quality with the potential to undermine efforts for promoting healthy eating practices within schools.

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1. Introduction

Schools are potential targets for public health nutrition interventions to improve children's eating behavior (Lowe et al., 2004; Upton et al., 2015). These measures are important in the face of persistently high levels of childhood obesity (Ogden et al., 2014). However, schools' efforts to improve eating behavior may be limited to the extent of co-evolved contextual factors. For instance, built food environments surrounding public schools might contribute to the broader concept of “obesogenic environments” (Swinburn et al., 1999). Children spend a vast amount of time inside as well as around schools, and when having the chance as well as the money, they act as potent customers with high purchasing power (Nestle, 2013). Research consistently showed that advertised foods on TV are in stark contrast to national dietary recommendations (Keller and Schulz, 2011; Missbach et al., 2015) and more general, marketing practices targeted at children mainly promote foods and beverages with low nutritive values (Cairns et al., 2013). In light of this “crisis in the marketplace” (Harris et al., 2009), analyzing the immediate school food environments is indicated as a pivotal area for research in public health nutrition.

1.1. Background

Food marketers have long recognized children as potential targets for marketing and advertisement which is shown in increased industry spending targeting children (Galbraith-Emami and Lobstein, 2013). The availability of energy-dense and nutrient poor (EDNP) foods and the presence of child-oriented marketing substantially influence children's food choices increasing the likelihood for childhood obesity (Harris et al., 2009; Brownell and Gold, 2012). Arguably the built school food environment may undermine potential efforts made within school programs to improve healthy eating (Walton et al., 2009). Recent research suggests, that convenience store availability within walking distance to public schools notably increases BMIz scores of schoolchildren by 0.004 units per additional available store (95% CI: 0.001, 0.007) (Baek et al., 2016a). BMIz scores measure the relative weight adjusted for both child age and sex and are therefore a useful measure for body weight. In addition, recent research showed that convenience store availability within 1 mile (1.6 km) was associated with higher BMIz independently of schoolchildren characteristics (sex, ethnicity and study success) (Baek et al., 2016b).

Supermarkets and food outlets can serve as primary food suppliers for schoolchildren in schools without school food programs. Even when school lunch is offered within schools, students still buy local

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snacks that are within walking distance during school breaks, on their way to school or on the way back home from school. In an observational study analyzing 833 intercept surveys in corner stores within walking distance of 10 schools, Borradaile et al. showed that urban elementary schoolchildren were most likely to purchase EDNP products (chips, candy, sugar-sweetened drinks) (Borradaile et al., 2009). Indeed, snacking constitutes to around 27% of children's daily caloric intake and an increase in snacking habits over the past several decades has been observed (Piernas and Popkin, 2010). Epidemiological studies have shown that snacking pattern and especially snack quality substantially contributes to overweight and obesity outcomes (O'Connor et al., 2015; Njike et al., 2016).

Addressing the school food environment is not a straightforward task. We argue that not only walking distance and the mere availability of supermarkets and food outlets, but also the quality and quantity of accessible food products are relevant predictors for children's purchasing (and consumption) behavior. Proximity, brand loyalty and marketing techniques should be considered as well because these factors bias food consumption in children (Chandon and Wansink, 2012). A systematic review of 11 studies showed that familiar media character branding influence children's food preferences, choices and intake (Kraak and Story, 2015). This can be problematic when advertised foods are mainly EDNP (candy, cookies or chocolate) and not desirable "healthy" foods (fruits, vegetables). Ebster, Wagner & Neumueller found that in supermarkets, children are more driven towards food items that are easy to consume (candy) or are more likely to purchase foods if other promotional giveaways are present (toys) (Ebster et al., 2009).

Previous studies showed that child-oriented marketing is available within short walking distance to public schools in low and middle-income countries (Kelly et al., 2015). For instance, Chacon et al. demonstrated that within a 200 m radius from two pre-schools and two primary schools in Guatemala, most advertised child-oriented food products were for sweetened beverages and soft drinks (Chacon et al., 2015). From all advertisements 1/3 of the snack advertisements were targeted at children and advertised products were available within short walking distance (<170 m). Some data collected from western countries also suggest frequent food advertisement around schools (Walton et al., 2009; Gebauer and Laska, 2011; Kelly et al., 2008; Maher et al., 2005), however to date there is no comprehensive research within large parts of urban environments of one major European city investigating both food quality and marketing techniques. Especially for urban environments, a decisive approach that analyzes food advertisement, food quality and in-store product presentation within school walking distance is missing in the literature. A key question here is: what food environments do schoolchildren find when stepping out of their school buildings and what are the main features in terms of food product quality and food marketing?

1.2. Study aims

In light of aforementioned aspects, the aims of this exploratory study are twofold and within the scope to improve our understanding of the built food environments around public schools in urban spaces. First, we collect data about exterior (outside) and interior (inside) child-oriented food advertisement strategies in supermarkets and fast food outlets in the urban region of Vienna, Austria. In a second step, we analyze the quality (healthfulness), quantity (frequency) and in-store presentation of packaged snack products and beverages within walking distance.

2.2. Methods

We conducted an exploratory cross-sectional field study in three consecutive months during fall semester of a regular school year (September–December 2015). In a first step, we systematically identified target schools ($n = 46$) and constructed a checklist to assess data from all available packaged snack food products. After data assessment,

in a final step, we coded the food data according to the Nutrient Profiling Model (NPM) criteria to classify foods and beverages as "healthy" or "less healthy" (Department of Health, 2011). In this study no human subjects were involved as we only looked at the food environment and not actual behavior of the schoolchildren. This study was conducted in line with the principles of the Declaration of Helsinki regarding data management and ethics of conduction.

2.1. Sample sites

We included public schools with different educational levels (elementary schools, primary schools, schools with technical focus) comprising a total of 46 schools in 7 different urban districts across Vienna (Landstraße, Josefstadt, Favoriten, Hietzing, Ottakring, Floridsdorf, Donaustadt). Target schools were schools with schoolchildren age 6–14 (excluding Kindergarten). Together, the immediate school food environments cover a total area of 1.8 km (Upton et al., 2015) (Fig. 1). To get a fairly heterogeneous sample, we chose districts representing areas with substantially varying socioeconomic background (identified by GDP per capita in €). For instance, we included districts below the mean average income (Ottakring) and districts above the mean average income (Hietzing). We analyzed the immediate school food environment that is accessible for schoolchildren. We defined the maximum walking distance as the distance that can be covered by an average schoolchildren within 20 min of walking (max. 950 m = 0.6 miles radius). In Vienna, there are currently 696 schools. The analyzed areas covered 56.6% of all Viennese schools.

2.2. Data collection and target foods

For data collection, we conducted on-site visits by exploring the dedicated areas by foot, using mobile phones to track geo-locations. We analyzed both fast food outlets and supermarkets assessing all available child-oriented packaged snack foods and beverages. We identified child-oriented products according to a dichotomous categorization scheme adapted from Chapman et al. (see Supplementary material for coding scheme; S1) (Chapman et al., 2006) and counted the number of available items. For both target sites, we assessed general information (name of the target site, exact geo-location and the date of the survey); followed by items about the food advertisements around/inside/outside the supermarket or fast food outlet. In detail, we recorded the availability and how food advertisements were presented (posters, stickers, board advertisements or illuminated advertisements).

For food and beverage categorization, we divided this checklist into 8 different product categories and their subcategories. Product categories were defined according to the EU Pledge Nutrition Criteria White Paper for advertisement on TV, print, and internet in the European Union (EU Pledge Nutrition Criteria). The EU Pledge Nutrition Criteria does not allow advertising sugary-based products (chocolate, candy bars, box of chocolates, gummy bears, candies and chewing gum) and non-alcoholic beverages in the form of sodas, this is why we added these categories. Following categories were identified:

- Category 1: Fruits, vegetables and nuts (apple, cucumber, dried apricots, trail mix);
- Category 2: Dairy products (vanilla milk, strawberry yogurt, whey drink, chocolate pudding);
- Category 3: Cereal-based products (waffles, chocolate croissant, cereal bar, cornflakes);
- Category 4: Sweets and candies (chocolate bar, gummi bear, chewing gum, drops);
- Category 5: Ready-to-eat ice-cream;
- Category 6: Ready-to-eat meat-based products (salami sticks);
- Category 7: Ready-to-eat meals (sandwich, salad); and
- Category 8: Non-alcoholic beverages (water, fruit juice, soft drink, energy drink, sport drink).



Fig. 1. Radius around analyzed schools (950 m).

The main part of the data assessment was to identify all available packaged snack food products and beverages including the information about the amount, placement and labeling of the products. Therefore, we excluded unpackaged food products from the analysis (Doner Kebab, Viennese Schnitzel). In addition, child-oriented packaged snack food that stem from seasonal offerings were also excluded from the analysis (Halloween, Christmas, Easter offerings), because we wanted to assess the regular product line.

2.3. UK nutrient profile model (NPM)

For nutrient profiling, we categorized the available food products using the three-step NPM. Basically, the NPM allocates points to food products based on nutrients of interest (energy, saturated fat, total sugar, sodium fibre and protein) and additionally allocates points for fruit, vegetable and nut content per 100 g of each food product. Two groups of nutrients are defined: 'A'-class nutrients (energy, saturated fat, total sugar and sodium) and 'C'-class nutrients (fruits, vegetables and nut content, fibre and protein). The final NPM score is a result of subtracting the 'C'-class nutrients from the 'A'-class nutrients. Foods with an overall score > 4 points and beverages scoring > 1 point are categorized as "less healthy". All other foods are defined as "healthier". The NPM allows for a maximum of 40 and a minimum of -15 overall score. The profiling model classifies products in a manner that is consistent with the decisions made by dietitians (Scarborough et al., 2007), showing overall good construct validity (Arambepola et al., 2008) and was previously applied to classify products shown in TV advertisements outside the UK (Jenkin et al., 2009; Romero-Fernandez et al., 2013; Royo-Bordonada et al., 2016).

Several coding steps were necessary prior to assessing the quality of the child-oriented products with the NPM. First, we identified all 308 child-oriented packaged foods and beverages that could be coded with the NPM. Identical snack food products (e.g., fruit gums/jellies, dextrose, Lollies, chewing gums) were classified within the same category.

Second, nutritional information was collected from the nutrient facts labeling; if not thoroughly available on the product itself, missing information was gathered from the respective company websites. Following information was extracted: product category; product name; company name; energy in kJ; protein, carbohydrates, sugar, total fat, saturated fat, fibre, and sodium per 100 g of each food product (salt content divided by 2.5). Additionally, if a product contains fruits, vegetables and/or nuts, the proportions by weight of fruits, vegetables and nuts were extracted.

2.4. Statistical analyses

Statistical analyses were conducted using IBM SPSS 21. Chi-square tests statistics were used to explore the relationship between the type of advertising (indoor/outdoor), proximity to schools (> 500 m vs. < 500 m) and the quality of the products (healthy vs. less healthy). Normal distribution of the continuous variables was tested with Shapiro-Wilk test. For normally distributed continuous variables, we used parametric methods (Pearson). We performed bootstrapping to get robust confidence Intervals (CI), $n = 1000$; accelerated bootstrap 95% CIs are reported in square brackets. Nonparametric methods were used for non-normally distributed data (Kruskal-Wallis; Mann-Whitney). Results were considered significant with $p \leq 0.05$.

3. Results

We identified 67 fast food outlets and 54 supermarkets (for a comprehensive overview about the geo-location, see Supplementary material S2a–g). From all analyzed fast food outlets, 27 were bakeries (40.3%), 13 (19.4%) were food outlets with mixed offerings, 7 (10.4%) were Wurst stands, 7 (10.4%) were Kebab/Pizza stands, 7 (10.4%) were Schnitzel stands and 6 (9.1%) were other fast food outlets (American Diner, chinese restaurants). From all analyzed supermarkets 47 (87%) were regular supermarkets, while 7 (13%) were discounter

supermarkets. All included retail stores encircling schools were within walking distance with a mean radius of $M = 375 \pm 170$ m (range: 53–950 m walking distance). Mean walking distance from schools did not differ comparing fast food outlets (386.3 ± 157.1 m) and supermarkets (374 ± 187.1 m), $U = 2089$, $z = 1.46$, $p = 0.143$, $r = 0.13$.

3.1. Packaged snack food and beverage products

In total, we identified 41,311 (96%) available products from supermarkets and 1,818 (4%) products sold in fast food outlets. We identified a total of 43,129 packaged snack food and beverage products, from which 36,823 (85%) were not child-oriented and 6,306 (15%) products were child-oriented. In both, supermarkets and fast food outlets, most frequently offered food and beverage products were for cereal-based products 14,288 (33%), sweets and candies 13,631 (32%) and non-alcoholic beverages 6,546 (15%).

The most prominent child-oriented food products were ready to eat ice-cream (34%), ready-to-eat meat-based products (23%) and sweets and candies (23%) (see Fig. 2). There was no significant association between the walking distance to food retailer and the frequency of child-oriented food and beverage products, $r = 0.0003$ [−0.131; 0.109], $p = 0.99$.

3.2. Food and beverage quality (child-oriented products)

Food quality scores were calculated for 308 different child-oriented food and beverage products by applying the NPM (268 packaged snack food products; 40 packaged beverage products). Across six product categories (category 7 was excluded because only one product was allocated to this group), the overall score for packaged snack food products was $M = 12.9$ [CI: 11.7; 14.1]. Within these categories, 15.8% were categorized as “healthy” foods and 84.2% as “less healthy” accordingly (Fig. 3).

The overall score for beverage products was $M = 1.0$ [CI: 0.36; 1.64]. Within the beverage category, 65.7% were categorized as “healthy” and 34.3% as “less healthy” beverages according to the NPM. There was a significant association between category (food vs. beverage) and NPM outcome category (healthy vs. less healthy), $\chi^2(1) = 43.46$, $p < 0.01$. Based on the odds ratio, the odds for less healthy foods were 10.19 times higher in packaged snack food than in beverage products (Fig. 4).

3.3. Food advertisement (child-oriented)

From 121 food retailers (supermarkets and food outlets together), 83% showed exterior advertisement for food and beverages. From all exterior advertisements, 60% were displayed as posters, 19% as sticker advertisements, 11% as board advertisements, 6% as illuminated advertisements and 4% as miscellaneous signs. From all exterior advertisements, 94% were not directed towards children while 6% of the advertisements were child-oriented. Indoor advertisement was present in 11 of 54 supermarkets (20.4%), while child-oriented advertisement was displayed for one product (1.9%; sweets).

Food retailers closely located to schools (≤ 500 m) did not display outdoor advertisement more frequently $\chi^2(1) = 2.07$, $p = 0.19$ compared to food retailers located farther from schools (> 500 m). Based on the displaying frequency, exterior advertisement for foods was found in 94.7% in stores located farther away from schools (> 500 m) and in 81.4% in closer located stores (≤ 500 m). Indoor advertisement in supermarkets did not show significant differences related to proximity $\chi^2(1) = 2.07$, $p = 0.43$.

4. Discussion

There are several results from this exploratory study. First, our results showed that child-oriented food and beverage advertisement is only marginal in the analyzed areas of interest. We analyzed large areas of urban school food environments surrounding 46 schools in Vienna (950 m walking distance). Exterior as well as interior child-oriented advertisement was not substantially present; most advertisements were targeted at adult consumers. This result is somewhat contradictory. On the one hand it fits well into the literature (Walton et al., 2009; Gebauer and Laska, 2011; Kelly et al., 2008; Maher et al., 2005), however our data did not show that advertisement increased depending on the school proximity (Chacon et al., 2015).

From this perspective, the idea that child-oriented marketing is especially present in areas with increased consumer frequency of certain target groups cannot be confirmed based on our data. Even though 83% of the analyzed food retailers (supermarkets and food outlets) showed exterior advertisement for their products, these advertisements were mostly targeted at adults representing product offers displayed as posters, stickers or board advertisements. Observational marketing

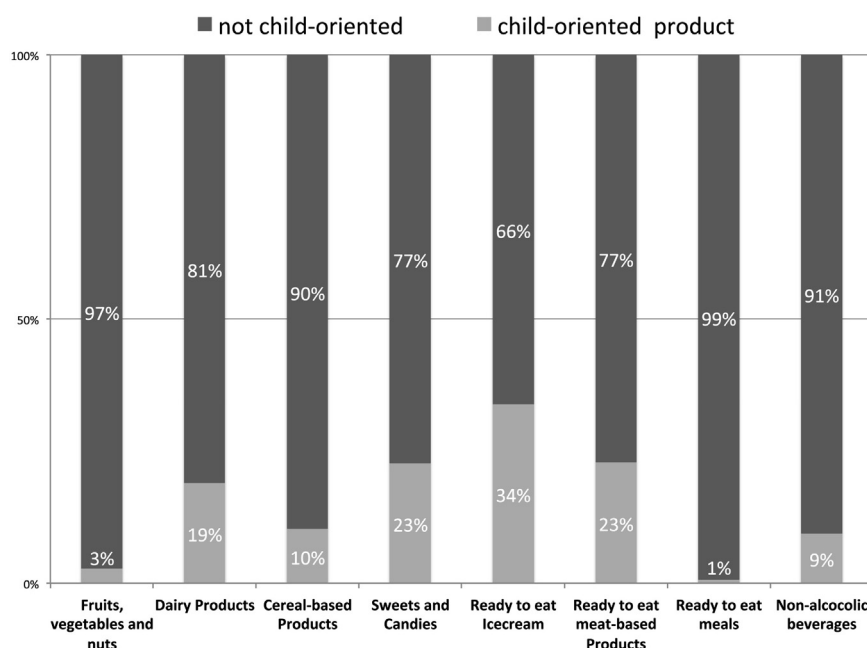


Fig. 2. Available products across food and beverage categories stratified by directedness (child-oriented vs. not child-oriented).

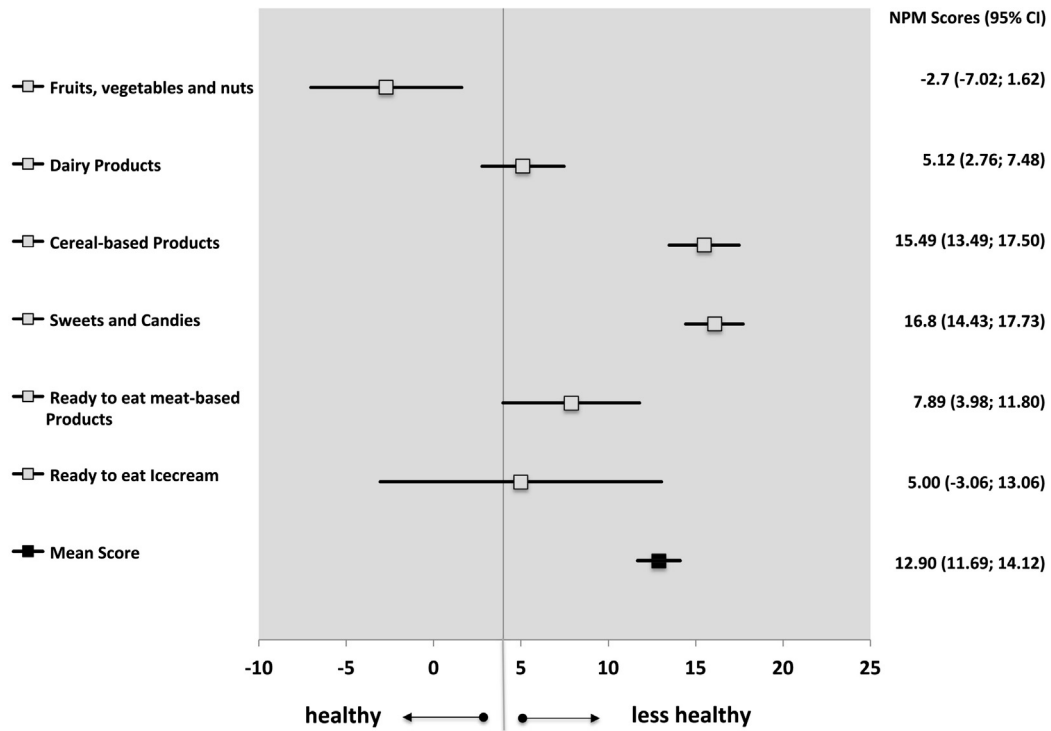


Fig. 3. Forrest plot showing mean NPM data across food categories ($n = 267$). Notes. Product category “ready-to-eat meals” were excluded from the analysis because there was only 1 product analyzed within this group; NPM scores >4 are defined as less healthy; <4 as healthy food products.

studies showed, that segmentation efforts in marketing is prevalent in other fields as well (Hofstede et al., 1999; Riefler et al., 2012), for instance specifically targeting cosmopolitan consumers for more sustainable product choices (Grinstein and Riefler, 2015). In the case of supermarket marketing strategies, we can only speculate why supermarkets do not adapt to potential target groups such as schoolchildren in their immediate environments as this does not show in increased advertisement frequency. Research showed that especially child-oriented advertisement can influence purchasing behavior (Ebster et al., 2009). However, target group segmentation is not the case in food retailers around schools, which may be interpreted as a positive sign for public health nutrition. With this in mind, stakeholders working in public

health nutrition improving school food environments are encouraged to target the quality of child-oriented products based on our results.

Despite the fact that child-oriented food advertisement is only marginally present in school food environments, the available products described and evaluated in this study show that more child-oriented products tend to be “less healthy” than “healthy” as assessed by the NPM. This differs between categories, however overall scores indicate a strong tendency towards “less healthy”. This result mirrors a more general trend regarding the quality of marketed products for children as persistent exposure to unhealthy food and beverage products affects food and drink preferences leading children and adolescents to unhealthy food choices (Cairns et al., 2013; Harris et al., 2009). Some progress has been made towards restricting child-oriented food marketing. The WHO Resolution WHA63.14 states that the widespread and extensive food marketing towards EDNP food should be restricted. Measures have been taken since the WHO Resolution came into force since 2010 (Kraak et al., 2016). For this, countries have restricted their food advertisements targeted at children on TV. For instance, Chilean law now restricts advertisements targeted at children <14 of age for foods with high energy density, saturated fatty acids, sugar, and sodium (WCRF, 2016). These signs regarding restricting food advertisement towards children in some countries do not spill-over to the offerings present in supermarkets, as these products are still highly prevalent.

4.1. Limitations & future research

There are some limitations that need to be addressed. First, the nutrient profiling model which was used in this study to evaluate the quality of the presented child-oriented foods has been previously criticized. Even though many nutrient profiling schemes are very reasonable in agreeing on the items that need to be permitted, there is only little agreement over which advertisements should be permitted. For instance, Scarborough et al. reported, that depending on the applied profiling scheme on a large dataset of TV advertisements for food products, a range from banning 2.1% [CI: 0.4%; 3.7%] to almost half of the advertisements 47.4% [CI: 42.1%; 52.6%] could have been performed

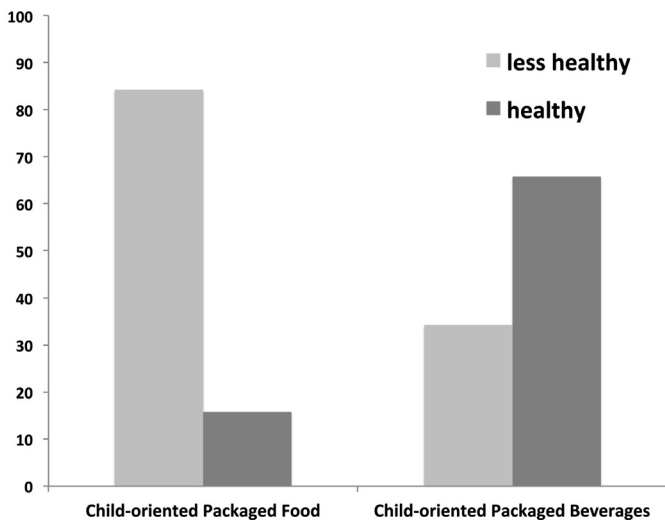


Fig. 4. Frequency of “healthy” vs. “less healthy” packaged food and beverage products in %. Notes. Classification according to NPM scores.

(Scarborough et al., 2013). This finding demonstrates the heterogeneity among profiling schemes for child-oriented marketing that may entail potential obstacles and therefore our results should be interpreted with caution (Rayner et al., 2013). It also calls out for developing novel methods to make determining what should and what should not be advertised more straightforward. One additional limitation is embedded in our study design in which we only show a snapshot rather than longitudinal developments. Future studies should consider longitudinal changes in food environments when, for instance new schools are established in new areas and how this affects novel settlements of food retailers in these areas. In addition, we did not perform inter-observer reliability check for detecting advertisement orientation of the products which limits the precision of our data. However, child-orientation is well described in the literature and easy to detect for adults (Jenkin et al., 2014). A more general limitation is that the schoolchildren's journey to and back home from school are not considered in this research approach. Individual routes might be more relevant than the actual circular environment of the school itself (Williams et al., 2014). We only analyzed the immediate (circular) and not the complete possible routing of schoolchildren (circular + linear) which potentially limit the conclusions of our study. We limited our analysis to an extensive radius around schools within walking distance (950 m), to make sure to get a full picture of the reachable consumption opportunities during school time. While we did not analyze the entire Viennese area, our study sites overlapped with 56.6% of schools in Vienna. As a result, our dataset exceeds the dedicated target schools adding to the strength of our study.

5. Conclusions

This study contributes to some important issues in the field describing the availability and quality of foods within walking distance of schools in urban environments. Low frequency of food advertisement targeted at children is accompanied by low quality of the present packaged snack food and beverages that mostly represent unfavored and less healthy items. In a nutshell, although child-oriented food advertisement is not particularly deployed within walking distance of schools, packaged snack food and beverage products that might contribute to unhealthy food choices are prevalent.

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Conflict of interest

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