


Children and adolescents' exposure to food and beverage marketing in social media apps

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Summary

Background: Unhealthy food marketing is a powerful determinant of unhealthy diets and obesity among children. Although it is known that food marketers target young people on social media, no study has yet quantified children's exposure on these platforms.

Objectives: To compare the frequency and healthfulness of food marketing seen by children and adolescents on social media apps as well as estimate their weekly exposure.

Methods: 101 children and adolescents (ages 7-16 years) completed a survey on their media use and were recorded using their two favourite social media apps for 5 minutes each on the mobile device they usually use. Recordings of app use were reviewed to identify food marketing exposures.

Results: Overall, 72% of participants were exposed to food marketing. Of the 215 food marketing exposures identified, most promoted unhealthy products such as fast food (44%) and sugar-sweetened beverages (9%). Adolescents viewed more instances of food marketing, on average, per 10-minute period compared with children (Mean [SD] = 2.6 [2.7] versus 1.4 [2.1], $U = 1606$, $z = 2.94$, $P = 0.003$). It was also estimated that children and adolescents see food marketing 30 and 189 times on average per week on social media apps, respectively.

Conclusions: Statutory regulations restricting unhealthy food marketing to adolescents and children on social media should be considered.

KEYWORDS

adolescent, alcohol, celebrity endorsement, children, food marketing, product placement, self-regulation, social media

1 | INTRODUCTION

The ubiquitous marketing of energy-dense and nutrient-poor foods is considered a powerful environmental determinant of unhealthy diets

and obesity among children.¹⁻³ Although television has been the primary medium by which food companies advertise to children, evidence shows that companies are shifting their ad spending in favour of digital marketing where multiple promotional techniques are being employed to reach and engage young people online, particularly on social networking platforms.⁴ Such techniques include display and video advertising, direct consumer-brand interactions using corporate

Abbreviations: PAHO NPM, Pan-American Health Organization's Nutrient Profile Model; UK NPM, United Kingdom's Nutrient Profile Model

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social media accounts, and active efforts to foster peer-to-peer marketing by encouraging users to endorse companies' promotional materials or to create and share their own branded content.⁵⁻⁸

Recent changes in marketing efforts and techniques mirror changing patterns of media use among children and adolescents. In the United States, for example, 95% of adolescents aged 13 to 17 own or have access to a smartphone, and 89% access the internet at least several times per day on a cell phone or computer.⁹ The use of social media among adolescents is also widespread. Over 8 in 10 American adolescents use YouTube while 72% use Instagram, 69% use Snapchat, 51% use Facebook, and 32% use Twitter.⁹ In Canada, 24% of children in grades 4 and 5 own a cell phone or a smartphone, and 31% access someone else's phone regularly.¹⁰ By grade 8, 68% of children own a phone, and 78% are using social media.¹⁰ As for internet use, Canadian adolescents in grades 9 to 12 spend on average 117 to 138 min/d surfing the internet.¹¹ Given the increased role of digital media in the lives of children and adolescents, the potential for marketers to reach these audiences through digital applications and novel marketing techniques is great. The access to social networking platforms through applications on mobile devices particularly facilitates and favours their widespread and prolonged use among young people.

The objective of this study was to examine differences in the frequency and healthfulness of food marketing seen by children and adolescents on social media apps and to estimate their weekly and annual exposure. It was hypothesized that adolescents would be more highly exposed to food marketing on social media apps than children. It was also hypothesized that most food marketing to which children and adolescents are exposed will promote unhealthy products.

2 | METHODS

2.1 | Study protocol

An observational study was conducted with children (ages 7-11 years) and adolescents (ages 12-16 years), recruited from four community centres in Ottawa (Canada). Participants were asked to use their two favourite social media apps for 5 minutes each on the smartphone or tablet they usually use during their leisure time. Only 10 minutes of app use were recorded because of resource constraints (ie, the time required to review each minute of video footage) and to limit the burden of participation. Participants chose from a list of apps popular among children and adolescents, including Facebook, Instagram, Snapchat, Twitter, and YouTube.⁹ Apart from the latter, participants were logged into their personal accounts when using the social media applications. In the case of YouTube, participants accessed the app the way they usually do and may or may not have been logged into an account (either their own or that of their parents if they did not personally own a mobile device). Participants wore Tobii¹² Pro Glasses 2 while using social media apps, which recorded what was in their field of vision. In addition, participants completed a self-administered questionnaire examining sociodemographic characteristics, ownership of electronic devices, and media use, either independently (for those aged 12-16 years) or alongside a parent (for those aged 6-11 years). Participants received a \$10 gift card for their participation in the

study. Informed parental consent and child assent were obtained prior to participation. The study was approved by the University of Ottawa research ethics committee (file H08-17-22).

2.2 | Content analysis of advertisements and food marketing

Tobii Pro Glasses recordings were reviewed by one bachelor-level research assistants (E-A.R.) to identify and examine exposures to food marketing. Food marketing was defined as web content in which food brand logos or branded products were promoted, and was categorized as follows: (a) food advertisements (ie, display or video ads as well as companies' posts on social media shared by their corporate account or other users); (b) user-generated content (ie, content produced and shared by a social media user that intentionally or unintentionally promoted a food brand or product, whether it was encouraged by food companies or not, eg, Snapchat photo posted by a private account featuring a McDonald's McFlurry); (c) celebrity-generated content (ie, when food products or brand logos appear in content produced and shared by celebrities or social media influencers that have a following of 10 000 or more); or (d) food marketing embedded in other web content (eg, branded food products or logos seen in web content such as recipe videos, art and craft videos, videos of streamed television content and Snapchat subscription articles, among others). All exposures were recorded regardless of their length and could vary between less than a second ($n = 9$, eg, when branded content flashed by when participants were scrolling through content) and several minutes (eg, when food products or brand logos appeared throughout an entire video).

Food marketing exposures were also categorized as promoting either a product or a brand (the former if they featured a specific product and the latter if they featured a company logo or an unidentified food item; eg, branded disposable cup). The instances of food marketing were also categorized by food company and by food category. The food categories included the following: cold cereal, cakes, cookies, and ice cream, candy and chocolate, snacks, 100% fruit juice, sugar-sweetened beverages (including regular soft drinks, sports drinks, fruit drinks, energy drinks and iced tea, among others), diet soft drinks, alcohol, tea or coffee, water, fast food restaurant, nonfast food restaurant, yogurt, cheese, supermarket (unless it featured a product), food delivery service/company, condiments/spreads, and other and mixed categories as has been used in previous research.¹³

The classification of food marketing instances as described above was done by one research assistant (E-A.R.) and reviewed by another (E.P.).

2.3 | Nutritional analysis

The energy and nutrient content of promoted products (except for alcohol) was collected from, in order of priority, the Canadian company website, the Nutrition Facts table found on packaging in store, US company website, or the Canadian Nutrient File. Information collected included calories, total fat, saturated fat, trans fat, sodium, carbohydrates, fibre, sugar, and protein per stated serving size. The volume

of beverages (mL) was converted into grams using their specific density (g/mL).¹⁴ Nutrition information for products featured in nine food marketing exposures was incomplete (n = 8) or not available (n = 1).

The healthfulness of promoted foods was assessed by a registered dietitian (E.P.) using the Pan American Health Organization Nutrient Profile Model (PAHO NPM)¹⁵ and the UK Nutrient Profile Model (UK NPM).¹⁶ The former was chosen as it only considers negative nutrients that are of concern for public health while the latter was chosen because it categorizes food based on their content in healthier and less healthy nutritional components and has been validated.^{17,18}

Marketing exposures that featured products were coded by two research assistants (E-A.R. and E.P.) as either unprocessed/minimally processed, processed, or ultra-processed according to PAHO definitions.¹⁵ Fast food restaurant meals were all classified as ultra-processed unless all products featured were minimally processed or processed. Meals advertised by nonfast food restaurants were assumed to be cooked from basic ingredients (ie, minimally processed) unless they featured an ultra-processed component. The inter-rater reliability for this PAHO categorization was 92% and was calculated using the following formula: $1 - (12 \text{ disagreements}/148)$. The PAHO NPM was modified and applied to all products, regardless of their level of processing. Products were classified as excessive or not in total fat (if total fat accounts for $\geq 30\%$ of calories), saturated fat ($\geq 10\%$ of calories), trans fat ($\geq 1\%$ of calories), sodium (mg: kcal ratio ≥ 1), and free sugars ($\geq 10\%$ of calories).¹⁵ Products were also classified as excessive or not in at least one of these nutrients. Formulas suggested by PAHO were used to estimate the content of free sugars.¹⁵

The healthfulness of promoted foods was also assessed using the UK NPM, which allocates points to foods and beverages based on the energy, saturated fat, total sugar, sodium, fruit/vegetable/nut, fibre, and protein content per 100-g serving.¹⁶ Foods that score 4 points or more and beverages that score 1 point or more are deemed "less healthy"¹⁶ while the remainder are considered "healthier."

When multiple foods appeared in the same instance of food marketing, the exposure was classified as excessive in fat, sodium, and/or free sugars or as less healthy if it featured at least one product categorized as such. Instances of marketing that promoted brands were excluded from the nutritional analysis.

2.4 | Statistical analysis

The sociodemographic characteristics of participants, their use of electronic devices, the social media apps used during the study, and the content of food marketing exposures were described using frequencies. Participants' media use and exposure to food marketing were also described using medians, ranges, means, and standard deviations (SDs). Weekly exposure to food marketing was estimated by multiplying the average number of food marketing exposures per participant per minute by the average length of time participants reported using social media apps on typical weekdays and weekend days. The following formulas were used:

Estimated average exposure to food marketing/minutes of social media app use = Total N exposures to food marketing/10 min/n participants.

Estimated weekly exposure to food marketing = (average exposure to food marketing/minute * [average # minutes spent using social media apps on a typical weekday * 5 weekdays]) + (average exposure to food marketing/minute * (average # minutes spent using social media apps on a typical weekend day * 2 weekend days)).

Analyses were conducted for the overall sample, as well as for subsamples of children (ages 7-11) and adolescents (ages 12-16). The frequency and healthfulness of food marketing seen by children and adolescents and their ownership of devices were compared using a chi-square test. The volume of exposures of both age groups and the time they spend using social media apps was compared using a Mann-Whitney U test. *P* values below .05 were considered statistically significant. Analyses were conducted using SPSS v.24.0 (IBM, 2017).

3 | RESULTS

3.1 | Characteristics of participants

A convenience sample of 108 children and adolescents were recruited to participate in the study. Following exclusion of participants who did not complete the study (n = 4) or did not follow the study protocol (n = 3), 101 participants (38 children and 63 adolescents) were included in the analysis. As shown in Table 1, 55% of participants were

TABLE 1 Socio-demographic characteristics of participants (N = 101)

| | Children (7-11 years) (n = 38) n (%) ^a | Adolescents (12-16 years) (n = 63) n (%) ^a | All Participants (N = 101) n (%) ^a |
|---|---|---|--|
| Gender | | | |
| Male | 18 (47) | 26 (41) | 44 (44) |
| Female | 20 (53) | 36 (57) | 56 (55) |
| Does not identify as a female or a male | 0 (0) | 1 (2) | 1 (1) |
| Age (years) | | | |
| 7-11 | 38 (100) | ... | 38 (38) |
| 12-16 | ... | 63 (100) | 63 (62) |
| Race | | | |
| White | 30 (79) | 41 (65) | 71 (70) |
| Other | 8 (21) | 22 (35) | 30 (30) |
| Language^b | | | |
| French | 8 (21) | 8 (13) | 16 (16) |
| English | 30 (79) | 54 (87) | 84 (84) |
| Annual household income^c | | | |
| Less than \$50 000 | 3 (8) | 7 (11) | 10 (10) |
| \$50 000-\$99 999 | 6 (16) | 9 (14) | 15 (15) |
| \$100 000-\$149 999 | 9 (24) | 13 (21) | 22 (22) |
| \$150 000 and over | 15 (40) | 19 (30) | 34 (34) |
| Do not know | 1 (3) | 0 (0) | 1 (1) |
| Refuse to answer | 4 (11) | 15 (24) | 19 (19) |

^aPercentages may not add up to 100 because of rounding.

^bLanguage in which the survey was completed.

^cIncome before taxes and deductions.

girls, and 63% were 12 to 16 years old. More than two-thirds (70%) of participants were White, and over half (56%) were from households whose annual income was \$100 000 or more.

3.2 | Ownership of electronic devices and media use

Children were more likely to own tablets (71% versus 31%, $\chi^2(2) = 18.57$, $P < 0.000$) while smartphone ownership was more frequent among adolescents (95% versus 29%, $\chi^2(2) = 51.0$, $P < 0.000$) (Table 2). On average, adolescents also reported spending more time on social media apps on typical weekdays (90 minutes; $U = 1745$, $z = 4.66$, $P < 0.000$, $r = 0.47$) and weekend days (139 minutes; $U = 1640$, $z = 3.86$, $P < 0.000$, $r = 0.39$) than children (24 and 48 minutes, respectively).

TABLE 2 Participants' ownership and use of electronic devices (N = 101)

| | Children (7-11 years) n = 38 n (%) | Adolescents (12-16 years) n = 63 n (%) | All Participants N = 101 n (%) |
|--|---|---|---|
| Ownership of a laptop or desktop computer | | | |
| Yes | 8 (21) | 41 (65) | 49 (48) |
| No, but uses the family's laptop or desktop | 24 (63) | 18 (29) | 42 (42) |
| No and does not use the family's laptop or desktop | 6 (16) | 4 (6) | 10 (10) |
| Ownership of a tablet | | | |
| Yes | 27 (71) | 19 (31) | 46 (46) |
| No, but uses the family's tablet | 8 (21) | 16 (26) | 24 (24) |
| No and does not use the family's tablet | 3 (8) | 27 (43) | 30 (30) |
| Ownership of a smartphone | | | |
| Yes | 11 (29) | 60 (95) | 71 (70) |
| No, but uses the family's smartphone | 14 (37) | 0 (0) | 14 (14) |
| No and does not use the family's smartphone | 13 (34) | 3 (5) | 16 (16) |
| Use of apps from food and beverage companies, food brand or fast food restaurants | | | |
| Yes | 4 (11) | 9 (15) | 13 (13) |
| Mean (SD) (minutes) | | | |
| Time spent using a tablet or smartphone | | | |
| On typical weekday | 58 (75) | 155 (126) | 116 (118) |
| On a typical weekend day | 126 (98) | 233 (190) | 190 (167) |
| Time spent using social media apps | | | |
| On a typical weekday | 24 (31) | 91 (91) | 65 (81) |
| On a typical weekend day | 48 (55) | 139 (139) | 103 (122) |
| Time spent playing gaming apps | | | |
| On a typical weekday | 38 (64) | 42 (59) | 41 (61) |
| On a typical weekend day | 77 (67) | 70 (91) | 73 (84) |

3.3 | Social media apps used by participants

Among children, the most commonly used social media app during the study was YouTube (95%), followed by Instagram (29%), Snapchat (13%), Facebook (3%), and Twitter (3%). As for adolescents, the most used app was Instagram (64%), followed by Snapchat (57%), YouTube (46%), Twitter (18%), and Facebook (5%). Food marketing was identified on all these platforms (data not shown).

3.4 | Children and adolescents' exposure to food marketing

Over two-thirds (72%) of participants were exposed to food marketing while using their favourite social media applications. As shown in Table 3, adolescents were more likely to be exposed than children (83% versus 55%, $\chi^2(1) = 8.801$, $P = 0.003$, OR [95% CI] = 3.8 [1.5-9.5]) and viewed more instances of food marketing, on average, per 10-minute period (Mean [SD] = 2.6 [2.7] versus 1.4 [2.1], $U = 1606$, $z = 2.94$, $P = 0.003$, $r = 0.20$).

Of the instances of food marketing seen by children ($n = 52$) and adolescents ($n = 163$), about half were advertisements while the remaining were embedded in various web content (Table 4). Most food marketing exposures seen by children and adolescents promoted products (62% and 75%, respectively) over brands. Among children, the most promoted food categories were fast food (27% of marketing exposures), sugar-sweetened beverages (10%), and candy or chocolate (10%), and the most promoted companies were McDonald's (14%), Starbucks (10%), and General Mills (10%). Similarly, the most promoted food categories among adolescents were fast food (50%), sugar-sweetened beverages (9%), and snacks (6%), and the most promoted companies were McDonald's (16%), Starbucks (13%), and PepsiCo (9%). Examples of the food marketing seen by participants are available in the supplementary information.

TABLE 3 Children and adolescents' exposure to food marketing while using social media apps (N = 101)

| | Children (7-11 years) n = 38 n (%) | Adolescents (12-16 years) n = 63 n (%) | All Participants N = 101 n (%) |
|--|---|---|---|
| Participants exposed to food marketing | | | |
| Yes | 21 (55) | 52 (83) | 73 (72) |
| Participants exposed to: | | | |
| Food advertisements | 15 (40) | 32 (51) | 47 (47) |
| Food marketing embedded within user-generated content | 2 (5) | 17 (27) | 19 (19) |
| Food marketing embedded within celebrity generated content | 9 (24) | 8 (13) | 17 (17) |
| Food marketing embedded in other web content | 8 (21) | 26 (41) | 34 (34) |
| Number of exposures | | | |
| | Mean (SD) | | |
| | 1.4 (2.1) | 2.6 (2.7) | 2.1 (2.6) |
| Median (range) | | | |
| | 1 (0-11) | 2 (0-12) | 1 (0-12) |

TABLE 4 Characteristics of food marketing exposures seen by children and adolescents when using social media apps (N = 215)

| | Food Marketing Exposures among Children 7 to 11 years (n = 52) n (%) ^a | Food Marketing Exposures among Adolescents 12 to 16 years (n = 163) n (%) ^a | Food Marketing Exposures among All Participants (N = 215) n (%) ^a |
|--------------------------------|---|--|--|
| Type of food marketing | | | |
| Advertisements | 26 (50) | 84 (52) | 110 (51) |
| User-generated content | 6 (12) | 32 (20) | 38 (18) |
| Celebrity-generated content | 9 (17) | 15 (9) | 24 (11) |
| Embedded in other web content | 11 (21) | 32 (20) | 43 (20) |
| Content | | | |
| Product | 32 (62) | 123 (75) | 155 (72) |
| Brand | 20 (38) | 40 (25) | 60 (28) |
| Food categories | | | |
| Fast food restaurants | 14 (27) | 80 (50) | 94 (44) |
| Sugar sweetened beverages | 5 (10) | 14 (9) | 19 (9) |
| Candy and chocolate | 5 (10) | 9 (6) | 14 (7) |
| Snacks | 1 (2) | 10 (6) | 11 (5) |
| Alcohol | 2 (4) | 8 (5) | 10 (5) |
| Restaurants—nonfast food | 2 (4) | 7 (4) | 9 (4) |
| Cakes, cookies, and ice cream | 3 (6) | 3 (2) | 6 (3) |
| Condiments/spreads | 0 (0) | 6 (4) | 6 (3) |
| Cold cereal | 3 (6) | 1 (1) | 4 (2) |
| Other and mixed categories | 17 (33) | 23 (14) | 40 (19) |
| Food companies | | | |
| McDonald's restaurant | 7 (13) | 26 (16) | 33 (15) |
| Starbucks | 2 (4) | 21 (13) | 23 (11) |
| PepsiCo | 5 (10) | 15 (9) | 20 (9) |
| Mars | 3 (6) | 8 (5) | 11 (5) |
| Coca Cola | 4 (8) | 7 (4) | 11 (5) |
| Restaurant Brand International | 2 (4) | 9 (6) | 11 (5) |
| General Mills | 5 (10) | 1 (1) | 6 (3) |
| Other & mixed companies | 24 (46) | 73 (46) | 97 (46) |

^aPercentage may not add up to 100 because of rounding.

As shown in Table 5, 68% and 77% of marketing instances that promoted branded products to children and adolescents, respectively, were classified as less healthy ($X^2(1) = 0.995, P = 0.319$). More than 90% of these marketing instances seen by children (94%) and adolescents (97%) were also deemed excessive in either fat, sodium, or free sugars ($X^2(1) = 1.112, P = 0.292$). There were no statistically significant differences in the healthfulness of promoted products by age group.

TABLE 5 Healthfulness of branded products seen by children and adolescents when using social media apps

| | Food Marketing Exposures among Children 7 to 11 years (n = 31) n (%) ^a | Food Marketing Exposures among Adolescents 12 to 16 years (n = 116) n (%) ^a | Food Marketing Exposures among All Participants (N = 147) n (%) ^a |
|---|---|--|--|
| Healthfulness of product ads as per the UK NPM | | | |
| Less healthy | 21 (68) | 88 (77) | 109 (75) |
| Healthier | 10 (32) | 27 (23) | 37 (25) |
| Level of processing | | | |
| Minimally processed | 4 (13) | 16 (14) | 20 (14) |
| Processed | 0 (0) | 2 (2) | 2 (1) |
| Ultra-processed | 27 (87) | 99 (85) | 126 (85) |
| PAHO NPM | | | |
| Excessive in total fat | 20 (65) | 77 (66) | 97 (66) |
| Excessive in saturated fat | 17 (55) | 67 (58) | 84 (57) |
| Excessive in trans fat | 5 (17) | 21 (19) | 26 (18) |
| Excessive in sodium | 17 (55) | 62 (53) | 79 (54) |
| Excessive in free sugars | 17 (55) | 55 (47) | 72 (49) |
| Excessive in at least one nutrient | 29 (94) | 113 (97) | 142 (97) |

Abbreviations: UK NPM, UK Nutrient Profile Model; PAHO, Pan American Health Organization Nutrient Profile Model.

^aPercentage may not add up to 100 because of rounding.

3.5 | Characteristics of food marketing in user-generated content

Of the 38 user-generated exposures to food marketing, most (84%) were seen by adolescents (Table 4). The most frequently featured company in this content was Starbucks (18%), followed by McDonald's (11%), PepsiCo (11%), Mars (11%), and Restaurant Brand International (11%). The most frequently promoted food categories were fast food (58%), sugar-sweetened beverages (13%), and candy and chocolate (13%). Among user-generated exposures that featured branded products (n = 28), 96% were excessive in either fat, sodium, or free sugars, and 89% featured products categorized as less healthy (data not shown).

3.6 | Estimated weekly exposure to food and beverage advertisements in social media applications

Based on the total frequency of food marketing exposures identified, it was estimated that children and adolescents view on average 0.14 and 0.26 instances of branded content per minute on social media applications, respectively. Based on this and the average time they

spend using social media apps, it was estimated that children on average may be exposed to food marketing 30 times per week (or 1560 times annually) while adolescents may be exposed 189 times on average per week (or 9828 times annually).

4 | DISCUSSION

This study found that children and adolescents are exposed to unhealthy food and beverage marketing on social media apps and that these originate from multiple sources including advertisements, user-generated and celebrity-generated content as well as other entertainment content. As hypothesized, adolescents were more highly exposed to food marketing in social media apps than children. Not only were adolescents more likely to be exposed to food marketing, but they also viewed more instances of food marketing on average than children during their recorded session of app use. In fact, based on the sample of social media use collected in this study and children's self-reported use of social media applications on weekdays and weekends, it was estimated that adolescents may view more than 9000 food marketing instances per year on social media applications while children may be exposed about 1500 times annually. These results can be attributable to several factors including the apps preferred by each age group, the time they spend on social media, the content they consume, and the behavioural advertising, which may have preferentially targeted adolescents based on their demographic characteristics and interests. Indeed, adolescents are prized targets among marketers as they have disposable income and can make food purchases independently.^{5,19,20} Research also suggests that adolescents are specifically susceptible to the influence of marketing owing to their stage of psychological and neurobiological development.^{21,22}

Among the social media applications examined in the current study, all either claim that their platform is not for children or require users to be at least 13 years old to register an account and/or access their content. While such policies are meant to deter the use of social media apps by children, our findings demonstrate that children regularly engage with such apps. Furthermore, our study findings highlight a gap in the regulation of food and beverage marketing to Canadian children and adolescents. In Canada, 18 large food and beverage companies, including McDonald's, PepsiCo and General Mills, have voluntarily committed to restrict unhealthy food and beverage advertising to children under 12 years of age across various media, where children make up 25% to 35% of viewers or users.²³ Given that social media apps do not meet these 25% to 35% thresholds, the Canadian food industry's self-regulatory pledges do not apply to social media apps. To limit children's exposure to unhealthy food marketing online, stringent audience thresholds that consider the absolute number of children using or consuming a given digital platform or media need to be put in place through government regulatory action.²⁴ In addition, government regulations need to consider the sophistication with which advertisements are tailored and delivered to specific demographic groups. In Canada, the Personal Information Protection and Electronic Documents Act (PIPEDA) specifies that meaningful consent is required for online behavioural tracking and targeting of internet users however it does not expressly define the age of

consent.²⁵ In addition, the Office of the Privacy Commissioner of Canada, the agency that oversees compliance with PIPEDA, recommends that companies should refrain from targeting and tracking children though it does not actively monitor company practices and its enforcement abilities are limited.^{25,26}

Children and adolescents' exposure to food marketing documented in this study is concerning not only because of the sheer volume but also because of the powerful marketing techniques being used online that blur the lines between commercial advertising and other content. Such forms of stealth marketing reached over one-third of participants who were exposed to logos or branded food embedded within celebrity-generated or other entertainment content. During the study, this exposure did not always occur when participants actively consumed content (eg, read an article or view a video). Branded products or logos were often featured in video and article thumbnails that appeared in participants' personalized social media feeds or were adjacent to other content being consumed. About one-quarter of adolescents and 5% of children were also exposed to food brands or products in content created and shared by their friends. Although it is unclear whether the instances of food marketing identified in user-generated content were encouraged by food and beverage companies, it is interesting to note that the food categories and food products depicted and their healthfulness mirrors what is being marketed through other digital means (ie, advertisements, celebrity-generated content, marketing embedded in other web content) and in other media.^{27,28}

These forms of embedded marketing, although scarcely studied in digital media,^{29,30} likely have a profound impact on young people. Experimental studies among children as old as 14 have shown that product placement within movie clips influences children's snack choices immediately after their exposure in favour of promoted foods.^{31,32} Children's brand recall, food preferences, and actual food consumption are also influenced by food advertising embedded within games.³³⁻³⁶ As for celebrity endorsement, this marketing technique increases the appeal of promoted products as well as heightens consumers' recognition and positive associations with a brand.³⁷⁻³⁹ Among children, the use of sport-celebrity endorsers has been shown to influence their food preferences and intake.^{40,41} Celebrity endorsements that appear more natural or authentic (such as a picture of an endorser using a branded product in an activity of daily life as one might see on social media), have also been shown to yield higher persuasive effects than that of traditional forms of endorsement (eg, television commercial).³⁹ As for peer endorsement, such as "sharing" or "liking" branded content on social media, a recent systematic review concluded that this form of marketing may influence young people more than advertisements sponsored by companies.⁴²

Studies also suggest that young people may have more difficulty recognizing digital marketing.⁴³⁻⁴⁵ This is concerning because the recognition of advertising is considered the first step in protecting oneself against its persuasive intent.⁴⁶ Although some instances of embedded marketing disclosed the commercial nature of their content, other seemingly sponsored materials did not. For instance, several participants were exposed to logos or branded food embedded within content on various social media accounts owned by TheSoul Publishing, a company that reaches millions of users online across multiple social

media platforms.⁴⁷ On its Brightside YouTube channel (whose branding suggests it disseminates inspiring and creative content), one 11-year old participant watched a video meant to test one's photographic memory. To do so, this video used numerous food brand logos including Burger King, Nutella, Pepsi, and Nestlé, among others.⁴⁸ Although one might reasonably assume that this content was sponsored, no financial relationship between the publisher and probable advertisers was disclosed. From an ethical perspective, online publishers need to be transparent about the sponsored nature of their content.

Since it was not possible to accurately establish whether food marketing exposures were commercially driven (in part because of a lack of disclosure), this study did not attempt to classify marketing instances on that basis. However, our classification of exposures by type of marketing (or their source), certainly reveals that most are coming directly or indirectly from companies. For example, about half of identified exposures were advertisements or content shared by corporate social media accounts. One can also suspect that most product placements within celebrity-generated and other entertainment content stems from companies. As such, we estimate that companies were responsible for more than two-thirds of food marketing instances identified in this study.

The various sources by which food marketing reaches children and adolescents on social media poses major challenges for any jurisdiction attempting to restrict food and beverage marketing to these audiences in digital media. In addition to prohibiting behavioural targeting of advertisements, regulators should require content sponsored by food and beverage companies to be prominently disclosed as such and social media and other online platforms should also be prevented from suggesting such content to children and adolescents. To effectively protect this vulnerable population from unhealthy food and beverage marketing online, multilateral coordination will likely be required.⁴⁹ By documenting children and adolescents' exposure to food and beverage marketing on social media, our findings provide critical insights needed to inform these global efforts.

4.1 | Strengths and limitations

The current study had several limitations. For instance, children's media use (eg, time spent using social media apps) was self-reported and is therefore subject to measurement error. Also, participants were asked about their use of nongaming apps (ie, apps that were not game related) that may not be limited to social media. Since this information was used to approximate children's exposure to food and beverage marketing in social media applications, our results could be somewhat inflated. Furthermore, as noted previously, this study's measurement of food marketing exposure did not account for the length of exposure, which could vary widely. Also, this study only documented participants' exposure to food marketing during 10 minutes of application use, which may not be representative of normal exposure. This study was also carried out among a small convenience sample of participants, and 55% were from household with incomes higher than \$100 000 that reflects median incomes in Ottawa but not the rest of Canada.⁵⁰ As a result, findings may not be generalizable to the Canadian population. Notwithstanding these limitations, this study,

to the best of our knowledge, is the first to examine children's exposure to unhealthy food marketing in social media applications. By requiring participants to use the smartphone or tablet they typically use, our measurement of food marketing exposure accounted for the behavioural advertising or targeting that occurs when one is online. Also, the use of Tobii Pro Glasses allowed for an objective measure of food marketing exposure.

5 | CONCLUSION

Children and adolescents are exposed to various forms of food marketing while using social media applications, most of which promotes unhealthy foods. Countries and other jurisdictions crafting statutory regulations restricting unhealthy food marketing to children and adolescents should apply these restrictions to social media.

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CONFLICTS OF INTEREST

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

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