

Association between watching TV whilst eating and children's consumption of ultraprocessed foods in United Kingdom

Renata Mariana Martines¹ | Priscila Pereira Machado^{1,2} | Daniela Almeida Neri^{1,2}  |
Renata Bertazzi Levy^{2,3} | Fernanda Rauber^{1,2} 

¹Departamento de Nutrição, Faculdade de Saúde Pública, Universidade de São Paulo, São Paulo, Brazil

²Núcleo de Pesquisas Epidemiológicas em Nutrição e Saúde, Universidade de São Paulo, São Paulo, Brazil

³Departamento de Medicina Preventiva, Faculdade de Medicina, Universidade de São Paulo, São Paulo, Brazil

Correspondence

Fernanda Rauber, Departamento de Nutrição, Faculdade de Saúde Pública, Universidade de São Paulo, Av. Dr Arnaldo 715, São Paulo, SP 01246-904, Brazil.

Email: rauber.fernanda@gmail.com

Funding information

Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP), Grant/Award Numbers: 2016/13168-5, 2016/25853-4, 2016/14302-7 and 2015/14900-9

Abstract

This study aimed to assess the association between watching TV whilst eating and consumption of ultraprocessed foods amongst children aged 4–10 years old in the United Kingdom. Cross-sectional data from the UK National Diet and Nutrition Survey (NDNS 2008–2012) were analysed. Dietary data were derived from 4-day food diaries of 1,277 children, and the dietary contribution of ultraprocessed foods was assessed. Meals were classified based on time of day in which foods were consumed (lunch: 11 pm–3 pm and dinner: 6 pm–9 pm). Crude and adjusted linear regression models were employed to verify the effect of watching TV during meals on dietary contribution of ultraprocessed foods (% of total energy intake). More than 70% of the children watched TV during meals, and 31.4% presented the behaviour on both “lunch and dinner.” Children's mean total energy intake was 1,532.3 kcal/day, of which 65.8% came from ultraprocessed foods. Findings indicated that children who watched TV whilst having both meals (lunch and dinner) consumed on average 85.5 kcal/day and 6.1% more energy from ultraprocessed foods than those who did not. Children who watched TV only during dinner consumed on average 37.1 kcal/day and 3.4% more energy from ultraprocessed foods than those who did not. The behaviour of watching TV whilst eating meals was associated with higher total daily consumption of ultraprocessed foods by children in the United Kingdom. Therefore, interventions designed to promote healthy eating habits should include aspects related to the context of meals.

KEYWORDS

behaviour, children, dietary patterns, food consumption, meals, survey methods

1 | INTRODUCTION

Obesity is a global public health problem that has reached children in major proportions (Ng et al., 2014; World Health Organization, 2003^a, 2016^b). In the United Kingdom, in 2008–2012, the prevalence of overweight reached 31% and 33% in boys and girls, respectively, between 1.5–18 years old (Bates et al., 2014). These problems, which

may emerge early or late, have been related to the occurrence of noncommunicable diseases (NCDs) still in childhood, adolescence, or adulthood (Reilly & Kelly, 2011).

Changes in the population's dietary patterns, decrease in physical activity, and adoption of sedentary lifestyles have all been pointed out as major factors contributing to the increase in overweight rates (World Health Organization, 2003^a). The increase in screen time and

watching TV whilst eating have been pointed as risk factors for excessive weight gain in children in high- and middle-income countries (Braithwaite et al., 2013; Ghobadi et al., 2018; Liang, Kuhle, & Veugelers, 2009). Studies suggest that this association occurs by influencing physical activity patterns (Dietz, 2001) and through other possible mechanisms related to changes in dietary patterns (Avery, Anderson, & McCullough, 2017).

One of the main shifts in dietary patterns across the globe is the increase in consumption of ultraprocessed foods (Pan American Health Organization, 2015; Stuckler, McKee, Ebrahim, & Basu, 2012). These foods are problematic not only because they are associated with higher dietary content of energy, fat, sugar, and sodium (Steele, Popkin, Swinburn, & Monteiro, 2017; Moubarac, Batal, Louzada, Steele, & Monteiro, 2017; Rauber et al., 2018; da Costa Louzada et al., 2018^b) but also because they are developed to be palatable, convenient, and cheap in order to encourage purchase and subsequent excessive consumption (Monteiro, Levy, Claro, de Castro, & Cannon, 2010^a; Ludwig, 2011; Moodie et al., 2013). Studies conducted in high and middle-income countries showed positive associations between consumption of ultraprocessed foods and both weight gain and chronic diseases in several age groups (Tavares, Fonseca, Rosa, & Yokoo, 2012; Rauber, Campagnolo, Hoffman, & Vitolo, 2015; da Costa Louzada et al., 2015^a; Monteiro et al., 2018^d). Another harmful effect, especially for children, is the replacement of meals based on unprocessed and minimally processed foods, leading to changes in social culture and eating behaviours such as preparing and sharing meals with the family (Monteiro, Moubarac, Cannon, Ng, & Popkin, 2013^b; Pan American Health Organization, 2015^b).

Facing these issues and considering that studies evaluating the relationship between watching TV and consumption of ultraprocessed foods are lacking, this study examined the association between watching TV whilst eating and consumption of ultraprocessed foods in a representative sample of children from the United Kingdom.

2 | METHODS

We used data from the National Diet and Nutrition Survey Rolling Programme (NDNS) cycles 2008/2009 and 2011/2012 (Years 1–4) combined, which is a cross-sectional survey conducted in the United Kingdom (England, Wales, Scotland, and Northern Ireland). The survey was designed to be representative of the UK population and provides comprehensive information on food intake. The study was approved by the ethics committees of each of the four countries. Data files and documentation on the study were obtained under licence from the UK Data Archive, available at <http://www.esds.ac.uk>.

The design and methods of the survey have been described in detail elsewhere (Bates et al., 2014). Briefly, the sample was randomly drawn from the UK Postcode Address File, which contains a list of all addresses of all countries. From each address drawn, it was selected an adult (aged 19 years old and older) and a child (aged 1.5–18 years old), if available. From some of them, only a child was selected to be part of a “child boost” in order to ensure approximately equal number

Key messages

- Watching TV during mealtime has a negative impact on children's dietary quality as it is associated with higher consumption of ultraprocessed foods.
- As parents are important agents of change, particularly in shaping children's behaviours, effective strategies should be designed to reinforce current recommendations to avoid watching TV whilst eating.
- Programs to improve children's nutrition should include actions aiming at regulating food advertising targeted towards them.
- Dietary guidelines should carefully consider avoidance of ultraprocessed foods and mealtime behaviours to target.

of children and adults. Participants (or in the case of children ≤11 years old, their parent/caregivers) completed a 4-day food diary and participated in an interview that included data on sociodemographic status, resulting in a sample of 1,277 children aged 4–10 years old to be evaluated.

Energy intake data were collected from the 4-day food diaries, which included weekdays and weekends. Parents/caregivers were instructed to record all foods and beverages consumed by the child on that day, at home or away from home. Portion sizes were estimated using household measures or portions/weights described on labels. The behaviour of watching TV whilst eating was also recorded for each eating occasion.

Once completed, diaries were checked by interviewers with respondents, and any missing details were added to improve completeness. All children whose parents/caregivers completed at least 3 days of food diary were included in the database, of which just less than 2% ($n = 15$) presented data for 3 days of food diary. Food consumption data were coded and edited using the DINO (Diet In, Nutrients Out) software (Fitt et al., 2015), and energy intakes were estimated based on the NDNS food nutrition database (Nutrient Databank; FSA, 2014).

2.1 | Food classification according to extent and purpose of processing

All foods included in food diaries were classified according to NOVA—a food classification system based on the nature, extent, and purpose of the industrial food processing (Monteiro et al., 2018^c). This classification includes four categories: unprocessed or minimally processed foods (e.g., beans, rice, fresh or frozen meats, and milk); processed culinary ingredients (e.g., vegetable oils, butter, and table sugar); processed foods (e.g., vegetables in brine; cheeses; and breads made from flour, water, and salt); and ultraprocessed foods. Ultraprocessed foods—the focus of this study—include industrial formulations made entirely or mainly of substances extracted from food (such as fats, sugar, and

starch), derived from food constituents (such as hydrogenated fats and modified starch), or synthesized in laboratory based on organic materials such as petroleum and coal (e.g., chemical additives). Examples of food items in this category include cookies, ice cream, candy, breakfast cereals, instant noodles and seasonings, packaged snacks, soft drinks and sweetened fruit drinks, sweetened yogurts and dairy beverages, ready or semiready meals, sausages and other cured meats, and amongst others (Monteiro et al., 2018⁵). The detailed description of the NOVA classification can be found in a previous publication (Monteiro et al., 2018⁵).

This study specifically assessed consumption of ultraprocessed foods and its subcategories: ultraprocessed breads, packaged ready meals, breakfast cereals, confectionary, sausages and other reconstituted meat products, biscuits, pastries, buns and cakes, industrial French fries, soft drinks and sweetened fruit drinks, milk-based beverages, packaged salty snacks, industrial pizza, margarine and other spreads, sauces, dressing and gravies, industrial desserts, and other ultraprocessed foods (baked beans, meat alternatives, and soy and other beverages as milk substitutes).

All foods in NDNS are coded as food number and grouped into subsidiary food groups ($n = 155$). When possible, subsidiary food groups were directly classified according to NOVA (see Table S1). When foods within a subsidiary food group pertained to different NOVA groups ($n = 52$), food codes were used instead of the group, and they were individually classified.

2.2 | Watching TV whilst eating

The behaviour of watching television during meals was examined considering lunch and dinner during the 4 days of dietary assessment (eight occasions) and separately at lunch (four occasions) and dinner (four occasions). To define meals, an approach based on the time of day in which foods were consumed—corresponding to lunch (11 am–3 pm) and dinner (6 pm–9 pm)—was applied (Nexo Jornal, 2017). If the child ate more than one meal at those time frames, the one with the highest caloric intake was selected as the main meal (lunch or dinner; Leech, Worsley, Timperio, & McNaughton, 2015). This variable was used to identify children who watched TV whilst eating the main meals (yes or no).

The population was divided into groups according to the behaviour of watching TV during main meals (lunch and/or dinner): “never watching TV whilst eating main meals” when that behaviour was not reported at any occasion, “watching TV only at lunch” when it was reported on at least one lunch occasion, “watching TV only at dinner” when it was reported on at least one dinner occasion, and “watching TV at lunch and dinner” when it was reported on at least one lunch and dinner occasion.

2.3 | Sociodemographic variables

Sociodemographic variables considered in this study were as follows: sex, age, ethnicity, region, and household income (equalized for

different household sizes and composition using the McClements equivalence scale [Public Health England, 2014]).

2.4 | Data analysis

The characteristics of the population were described according to sociodemographic variables and categories of watching TV whilst eating. For each child, mean daily energy intake and both absolute (1 kcal = 4.19 kJ) and relative (percentage of total energy intake) contribution of ultraprocessed foods and their subgroups were derived from all food diary data available.

TABLE 1 Characteristics of children aged 4 to 10 years old. UK National Diet and Nutrition Survey, 2008–2012 (1,277)

Sex (%)	
Female	51.16
Male	48.84
Age, mean (SE)	6.96 (0.07)
Ethnicity (%)	
White	81.78
No white	18.22
Region (%)	
England North	24.06
England Central/Midlands	13.51
England South (including London)	46.59
Scotland	7.84
Wales	4.72
Monthly household income, mean (SE) ^d	
1° quintile	£621.23 (24.54)
2° quintile	£1,200.89 (12.87)
3° quintile	£1,758.27 (15.88)
4° quintile	£2,598.51 (25.46)
5° quintile	£4,594.08 (97.34)
Watching TV during the main meals ^a (%)	
Never watching TV whilst eating ^b	29.06
Watching TV only at lunch ^c	7.39
Watching TV only at dinner ^c	32.19
Watching TV at lunch and dinner ^c	31.36

Abbreviation: SE, standard error.

^aMain meals were evaluated based on 4 days of food records, using eight occasions for the combined analysis of lunch and dinner.

^bWatching television during main meals was not been reported at any occasion.

^cWatching television during main meals was reported on at least one occasion.

^dEqualized household income (equalized for different household sizes and composition using the McClements equivalence scale).

Our outcome was the daily consumption of ultraprocessed foods, both absolute and relative contribution to total energy intake. The mean total energy and relative total energy from ultraprocessed foods and their subgroups were estimated for all children and by the behaviour of watching TV whilst eating.

Normal distribution of the outcome variables was evaluated by the Kolmogorov–Smirnov’s test. Linear regression models were used to test differences across the four categories of watching TV whilst eating (the first category as reference—“Never watching TV whilst eating”). Then, regression coefficients and 95% confidence intervals for the associations between the dietary contribution of ultraprocessed foods across categories of the behaviour watching TV whilst eating were estimated using unadjusted and adjusted linear regression models. The adjustment considered the possible confounding variables: sex (female and male), age (in years), ethnicity (White and non-White), region (England North, England Central/Midlands, England South [including London], Scotland, Wales, and Northern Ireland), and monthly household income. We created a normal probability plot of the residuals to verify the assumption of normality.

The consumption of ultraprocessed foods based on children’s behaviour of watching TV during meals was also described by sociodemographic characteristics. We performed additional analysis to test the differences in the daily consumption of ultraprocessed foods according to the frequency of the behaviour of watching TV during meals (“Never watching TV whilst eating,” “Often watching TV whilst eating,” and “Almost always/always watching TV whilst eating”) and to sociodemographic characteristics. Linear trend tests were performed across the three categories of each variable to characterize possible exposure–response relationships between levels of exposure

frequency and consumption of ultraprocessed foods (% of total energy) in the linear analyses.

Survey sample weights from the NDNS study were used in all the analyses to account for sampling, proportions of observations from each UK region, and nonresponse error. All statistical analyses were carried out using Stata Statistical Software version 14, and the significance level was defined as $p < .05$.

3 | RESULTS

Table 1 shows the sociodemographic characteristics of the children studied. Over half of them were female (51%), with mean age of 6.9 years and most were white (82%). The equalized household income mean ranged from £621.23 (US\$ 855.25) in the first quintile to £4,594.08 (US\$ 6,324.67) in the last quintile. More than 70% of children reported having watched TV whilst eating their main meals on at least one occasion. The percentages of children who watched TV only at lunch were 7.4%, whilst for those who watched only at dinner were 32.2%. Thirty one percent of children reported watching TV at both lunch and dinner.

Children’s mean total energy intake was 1,532.28 kcal/day ($SE = 12.39$), of which 65.84% ($SE = 0.45$) came from ultraprocessed foods (data not shown). Regarding the energy intake from ultraprocessed foods, the subgroups mostly consumed were ultraprocessed breads (11.1% of total energy intake), packaged ready meals (6.6%), confectionary (6.0%), and breakfast cereals (5.8%; Figure 1).

Table 2 shows the differences in total energy intake and both absolute and relative mean percent total energy from ultraprocessed

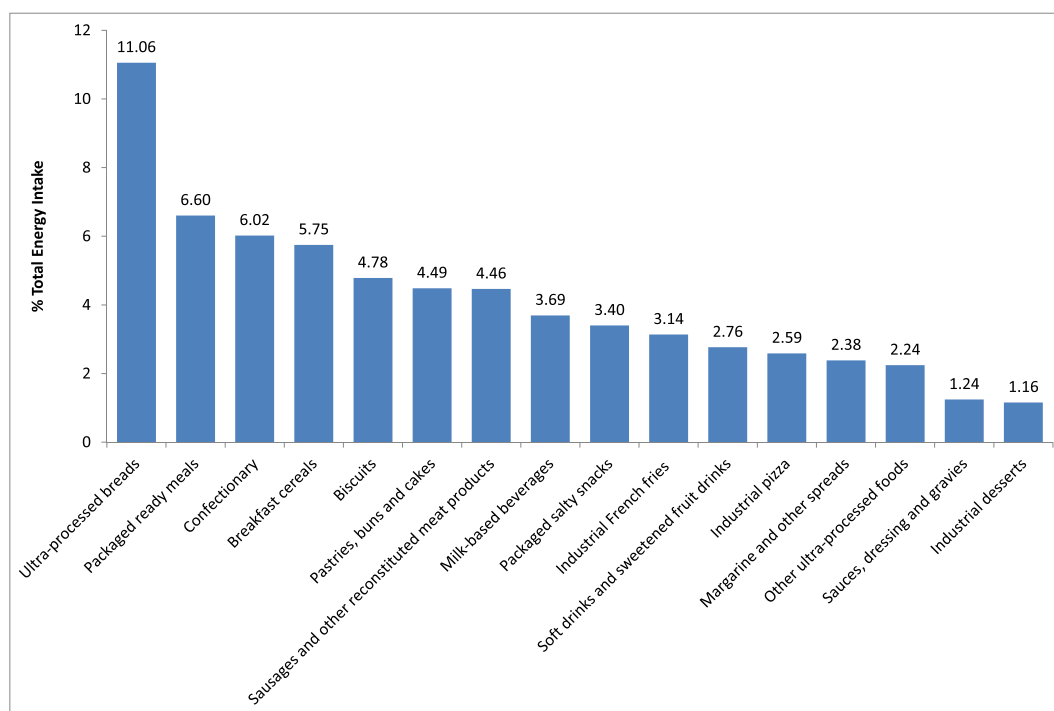


FIGURE 1 Ultraprocessed food subgroups mostly consumed by children 4–10 years of age. UK National Diet and Nutrition Survey, 2008–2012

TABLE 2 Mean daily total energy and relative and total energy contribution from ultraprocessed foods and its subgroups based on children's behaviour of watching television during meals. UK National Diet and Nutrition Survey, 2008–2012 ($n = 1,277$).

Energy and food groups	Watching TV during the main meals ^{a-d}							
	Never watching TV whilst eating Mean (SE)		Watching TV at lunch		Watching TV at dinner		Watching TV at lunch and dinner	
Total energy intake (kcal)	1,542.56	20.63	1,454.7	39.65	1,535.68	19.39	1,525.16	20.04
Ultraprocessed foods								
Absolute (kcal)	965.83	16.98	941.27	41.45	1,028.13	16.56	1062.7 ^f	20.08
Relative (% of energy)	62.49	0.80	64.00	2.02	66.65 ^f	0.67	69.37 ^f	0.86
Subgroups of ultraprocessed foods (%)								
Ultraprocessed breads	11.59	0.41	11.98	0.87	10.69	0.42	10.89	0.39
Packaged ready meals	6.00	0.46	6.44	0.76	6.13	0.36	7.72 ^f	0.42
Breakfast cereals	6.29	0.31	4.75 ^f	0.63	5.73	0.26	5.60	0.27
Confectionary	5.15	0.30	6.67	1.01	6.58 ^f	0.35	6.23 ^f	0.34
Sausage and other reconstituted meat products	4.42	0.28	4.47	0.66	4.37	0.24	4.82	0.30
Biscuits	4.84	0.30	3.65	0.56	5.20	0.31	4.79	0.31
Pastries, buns, and cakes	4.61	0.35	4.26	0.71	4.29	0.31	4.59	0.44
Industrial French fries	2.49	0.24	1.94	0.38	3.57 ^f	0.23	3.59 ^f	0.28
Soft drinks and sweetened fruit drink	2.44	0.24	2.11	0.27	2.89	0.20	3.25	0.27
Milk-based beverages	3.29	0.22	4.59	0.92	4.10 ^f	0.26	3.45	0.29
Packaged salty snacks	2.68	0.25	3.79 ^f	0.54	3.48 ^f	0.21	3.73 ^f	0.22
Industrial pizza	2.15	0.28	1.51	0.47	2.55	0.31	3.10	0.36
Margarine and other spreads	2.22	0.16	2.46	0.37	2.36	0.16	2.55	0.19
Sauces, dressing, and gravies	1.28	0.11	1.02	0.15	1.28	0.11	1.31	0.11
Industrial desserts	1.18	0.15	2.29	0.69	1.11	0.13	1.03	0.13
Other ultraprocessed foods ^e	1.87	0.19	2.09	0.38	2.32	0.19	2.72 ^f	0.22

Note. Adjusted for sex, age (years), ethnicity (white, no white), region (England North, England Central/Midlands, England South (incl. London), Scotland, Wales and Northern Ireland), and equalized household income.

Abbreviation: SE, standard error.

^aMain meals were evaluated based on 4 days of food records, using eight occasions for the combined analysis of lunch and dinner.

^bWatching television during main meals was not been reported at any occasion.

^cWatching television during main meals was reported on at least one occasion.

^dCategories reference to watching television during main meals: no (it was not reported at any occasion) and yes (it was reported on at least one occasion).

^eIncluding baked beans, meat alternatives, soy and others beverages as milk substitutes, and infant formula.

^f $p \leq .01$ for differences in relation to the first category—Never watching TV whilst eating.

foods and their subgroups according to the behaviour of watching TV whilst eating meals. Total daily consumption of ultraprocessed foods was higher amongst children who watched TV whilst having both meals (lunch and dinner; 1,062.7 kcal and 69.37% of total calories) compared with those who did not (965.83 kcal and 62.49% of total calories). The same trend was observed for children who watched TV only at dinner (1,028 kcal and 66.65% of total calories) compared with those who did not.

Regarding ultraprocessed food subgroups, we observed that children who watched TV whilst having both meals (lunch and dinner) consumed more packaged ready meals, confectionary, industrial French fries, and packaged salty snacks than those who did not watch

TV during meals. No significant differences in total energy intake were found for other ultraprocessed food subgroups (Table 2).

Table 3 shows the coefficients of the associations between watching TV during meals and consumption of ultraprocessed foods. In both crude and adjusted models, children who watched TV during their meals consumed more ultraprocessed foods on average than those who did not watch TV whilst eating. Specifically, children who watched TV whilst having both meals (lunch and dinner) consumed on average 85.5 kcal/day and 6.1% more energy from ultraprocessed foods than those who did not. Children who watched TV only during dinner consumed on average 37.1 kcal/day and 3.4% more energy from ultraprocessed foods than those who did not.

TABLE 3 Associations between watching television during meals and ultraprocessed foods consumption amongst children 4–10 years of age. UK National Diet and Nutrition Survey, 2008–2012 ($n = 1,277$)

Ultraprocessed food consumption	Watching TV during the main meals ^{a-d}			Watching TV at lunch and dinner		
	Never watching TV whilst eating	Watching TV at lunch	Watching TV at dinner			
Coefficient (CI 95%)						
Absolute (kcal)						
Crude	1.00	-6.40 (-102.73; 89.92)	65.34 ^f (14.91; 115.77)	87.18 ^f (34.81; 139.55)		
Adjusted ^e	1.00	14.64 (-73.94; 103.21)	37.06 (-10.72; 84.83)	85.45 ^f (33.77; 137.14)		
Relative (% of energy)						
Crude	1.00	1.71 (-2.78; 6.19)	3.88 ^f (1.76; 6.01)	6.18 ^f (3.86; 8.49)		
Adjusted ^e	1.00	3.17 (-1.14; 7.48)	3.36 ^f (1.26; 5.46)	6.09 ^f (3.84; 8.35)		

Abbreviation: CI, confidence interval.

^aMain meals were evaluated based on 4 days of food records, using eight occasions for the combined analysis of lunch and dinner.

^bWatching television during main meals was not been reported at any occasion.

^cWatching television during main meals was reported on at least one occasion.

^dCategories reference to watching television during main meals: no (it was not reported in any occasion) and yes (it was reported at least one occasion).

^eAdjusted for sex, age (years), ethnicity (white, no white), region (England North, England Central/Midlands, England South (incl. London), Scotland, Wales and Northern Ireland), and equalized household income.

^f $p \leq .01$ (in relation to the reference category—Never watching TV whilst eating) analysed by linear regression models.

Table 4 shows the differences in the total daily consumption of ultraprocessed foods (% of total energy) according to children's behaviour of watching TV during meals and socioeconomic characteristics. Despite the differences in the contribution of ultraprocessed foods amongst the categories of age, ethnicity, and income, we observed that the consumption of these foods was also higher amongst children who watched TV during their meals than those who did not watch TV whilst eating in the stratified analyses. The only exceptions were the first quintile of income and the first category of region that did not show a significant difference between the categories of "watching TV during meals."

Additional analysis was done to examine the association between the frequency of the behaviour of watching TV during meals and the consumption of ultraprocessed foods (Table S2). The frequency of watching TV whilst eating meals was positively associated with the consumption of ultraprocessed foods; and a dose-response effect became clear. The same relationship was maintained for analyses stratified by sociodemographic variables (Table S2).

4 | DISCUSSION

The results of this study reveals that ultraprocessed foods represent more than half of all calories in this population's diet (60%), and more than 70% of children watched TV during their meals. This behaviour of watching TV during meals was associated with higher shares of ultraprocessed foods in children's diets.

Few studies have assessed the energy contribution of ultraprocessed foods in children's diets, which is recognized as an important determinant of the nutritional quality of diets (Food and

Agriculture Organization, 2015). Studies carried out with Brazilian children under 10 years old showed that about 40% (variation between 36.1% and 48.6%) of total dietary energy intake came from ultraprocessed foods (Barcelos, Rauber, & Vitolo, 2014; Bielemann, Santos, dos Santos Costa, Matijasevich, & Santos, 2018; Leite et al., 2016; Karnopp et al., 2016; Sparrenberger, Friedrich, Schiffner, Schuch, & Wagner, 2015; Rauber et al., 2015), whereas amongst Colombian children aged 5 to 12 years old, the contribution was 34.4% (Cornwell et al., 2018). Then, the share of ultraprocessed foods in children's diets in the United Kingdom as observed in this study was almost 1.6 times higher than those observed in the Latin American countries (Barcelos et al., 2014; Bielemann et al., 2018; Cornwell et al., 2018; Karnopp et al., 2016; Leite et al., 2016; Rauber et al., 2015; Sparrenberger et al., 2015), nations in which dietary patterns are based on unprocessed and minimally processed foods.

High consumption of ultraprocessed foods is associated with nutritionally unbalanced diets. High energy density and higher total fat, saturated fat, and free sugars, along with lower protein and fibre content are common constituents of dietary patterns based on ultraprocessed foods (da Costa Louzada et al., 2018^b; Moubarac et al., 2017; Steele et al., 2017; Rauber et al., 2018). In addition, increasing evidence suggests that these foods are harmful to health. Cross-sectional studies have found associations between consumption of ultraprocessed foods and obesity (da Costa Louzada et al., 2015^a), metabolic syndrome (Tavares et al., 2012), and presence of asthma and wheezing (Melo, Rezende, Machado, Gouveia, & Levy, 2018). Prospective cohort studies have shown that high consumption of these foods is associated with obesity (Mendonça et al., 2016^a), hypertension (Mendonça et al., 2017^b), and cancer (Fiolet et al., 2018) in adults and dyslipidemia in children (Rauber et al., 2015). As the development of long-standing

TABLE 4 Mean daily relative energy contribution from ultraprocessed foods and its subgroups based on children's behaviour of watching television during meals according to sociodemographic characteristics. UK National Diet and Nutrition Survey, 2008–2012 ($n = 1,277$)

Characteristics	Watching TV during the main meals ^{a-d}				Watching TV at lunch and dinner			
	Never watching TV whilst eating		Watching TV at lunch		Watching TV at dinner			
	% of ultraprocessed foods, mean (SE)							
Sex								
Female	62.21	1.07	63.06	3.14	67.02 ^e	0.88	70.88 ^e	1.17
Male	62.82	1.17	64.72	2.61	66.28	0.95	67.80 ^e	1.29
Age								
4–6 years	60.81	1.18	60.60	3.03	64.60 ^e	1.19	69.48 ^e	1.03
7–10 years	64.19	1.07	67.90	2.32	67.68 ^e	0.82	69.28 ^e	1.31
Ethnicity								
White	63.27	0.87	65.54	2.32	68.16 ^e	0.71	70.77 ^e	0.80
Non-White	57.77	1.91	58.02	4.58	58.64	2.00	63.00	3.04
Region								
England North	63.03	2.15	65.27	5.40	67.84	1.51	68.17	1.74
England Central/Midlands	62.86	2.48	70.25 ^e	1.55	66.11	1.55	69.85 ^e	2.15
England South (including London)	61.66	1.11	60.92	2.90	65.03	1.08	69.64 ^e	1.45
Scotland	63.90	1.43	66.28	2.07	69.48 ^e	1.17	70.65 ^e	1.04
Wales	64.25	1.47	61.52	2.37	70.02 ^e	1.70	67.67	2.44
Northern Ireland	63.49	1.76	72.34	3.37	67.93	1.45	72.29 ^e	1.65
Monthly household income								
1° quintile	67.27	2.04	59.08	4.32	67.08	1.32	67.33	1.98
2° quintile	65.18	1.99	82.65 ^e	2.11	68.18	1.79	72.25 ^e	1.77
3° quintile	62.76	1.44	65.97	5.95	67.78 ^e	1.11	72.26 ^e	1.28
4° quintile	59.81	1.70	58.93	2.99	66.79 ^e	1.17	67.85 ^e	1.84
5° quintile	59.48	1.52	57.29	2.40	63.29 ^e	1.71	66.52 ^e	2.02

^aMain meals were evaluated based on 4 days of food records, using eight occasions for the combined analysis of lunch and dinner.

^bWatching television during main meals was not been reported at any occasion.

^cWatching television during main meals was reported on at least one occasion.

^dCategories reference to watching television during main meals: no (it was not reported in any occasion) and yes (it was reported at least one occasion).

Adjusted for the other socioeconomic characteristics: sex, age, ethnicity, region, and equivalized household income.

^e $p \leq .01$ for differences in relation to the first category—Never watching TV whilst eating.

preferences is built on familiarity (Birch, 1999), early and frequent exposures to highly palatable ultraprocessed foods raises serious concerns.

Moreover, we observed that more than 70% of the children watched TV during meals, and such behaviour was more common during dinnertime. These results corroborate studies conducted with Canadian (Liang et al., 2009) and Mexican (Batis, Rodríguez-Ramírez, Ariza, & Rivera, 2016) children and can be explained by the fact that children usually consume dinner at home (Matheson, Killen, Wang, Varady, & Robinson, 2004) and therefore would be more exposed to having this behaviour.

Ultraprocessed foods are increasingly available in the global food market; they are convenient and need little or no preparation and thus replace homemade culinary preparations (Monteiro et al., 2018^e). Our results showed that children who watched TV during

meals consumed an average of 6% more energy from ultraprocessed foods than those who did not. These findings suggest that the circumstances in which eating takes place may play an important role in children's eating patterns. Hare-Bruun et al. (2011) evaluated the eating preferences of a cohort of Danish children and found that children who watched TV during their meals had less healthy preferences, including higher consumption of French fries, carbonated drinks, and sweets/chocolate. A recent systematic review showed that watching TV whilst eating is associated with lower quality of children's diets through higher consumption of sugary drinks and foods (Avery et al., 2017). Therefore, limiting consumption of food in front of the TV may reduce preference and consumption of ultraprocessed foods and thus improve the quality of the diet and reduce the risk of overweight, obesity, and other related NCDs in

children (Buijzen, Schuurman, & Bomhof, 2008; Ghobadi et al., 2018; Liang et al., 2009).

Some social–environmental characteristics may be pointed out to explain the association found in this study. First, food advertising, which contributes to the purchase and increased consumption of food items advertised (Buijzen et al., 2008)—which are mostly ultraprocessed foods (Pan American Health Organization, 2012^a; Maia et al., 2017). There is evidence that even a brief exposure to advertising is enough for children to choose the food advertised (Borzekowski & Robinson, 2001; Buijzen et al., 2008), reinforcing such desire as long as the advertisement is repeated (Maia et al., 2017). The choice for those foods may also be influenced by its perception as more convenient for consumption in front of the TV (Avery et al., 2017; Fiates, Amboni, & Teixeira, 2008). Besides, there is the role played by replacing meals at the family table with meals eaten in front of the TV. The family table meal is associated with higher consumption of fruits and vegetables as well as lower intake of sugary beverages by children (Christian, Evans, Hancock, Nykjaer, & Cade, 2013; Fink, Racine, Mueffelmann, Dean, & Herman-Smith, 2014), whereas eating in front of a TV is associated with lower overall quality of children's diet (Trofholz, Tate, Miner, & Berge, 2017).

In the analyses stratified by the socioeconomic characteristics, the consumption of ultraprocessed foods was also higher amongst children who watched TV during meals compared with those who did not. Specifically in relation to income, the sampling fluctuations observed in the second quintile of income could be explained by the low number of children in this category ($n = 10$), which could have led to the unexpected result of a higher TV-watching effect at lunch than at both meals (lunch and dinner). The same sampling fluctuations were observed in the categories England Central/Midlands (watching TV at lunch $n = 9$) and Wales ($n = 4$).

To our knowledge, this is the first study looking at the association between watching TV during meals and dietary contribution of ultraprocessed foods in children. However, potential limitations should be considered. The possibility of reverse causality in the association between watching TV and consumption of ultraprocessed foods could not be lessened due to the cross-sectional study design. Dietary intake data was estimated from food diaries reported by parents, and lack of knowledge of all foods eaten by children and underreporting of some foods, particularly unhealthy ones, are potential issues. These biases could have led to underestimation of both the overall intakes and the dietary contribution of ultraprocessed foods, and could also have decreased the effect of the association between exposure and outcome. Although NDNS collects limited information indicating food processing (i.e., places of meals and product brands), these data are not consistently determined for all food items, which can lead to misclassification of foods. However, the standardized methods of NDNS minimize potential error and bias. NDNS uses a high-quality dietary assessment method that provides detailed analysis of different foods consumed, several days of assessment, and takes into account each individual's day-to-day variability. In addition, the methodology allows a more comprehensive assessment of eating habits by considering certain behaviours such as watching TV whilst eating.

In conclusion, high frequency of watching TV whilst eating meals was significantly associated with higher consumption of ultraprocessed foods by children in the United Kingdom, which suggest a negative impact on their dietary quality. Increasing the consumption of unprocessed or minimally processed foods, whilst decreasing the ultraprocessed counterpart, and offering guidance on eating together regularly without distractions could be effective ways of promoting healthful eating, family bonding, and local food culture.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

CONTRIBUTIONS

RBL and FR designed the research and took care of data management and analyses. RMM, FR, and RBL interpreted the data. The initial draft of the paper was prepared by RMM following extensive discussions with PPM, DAN, RBL, and FR. All authors read, edited, and approved the final manuscript.

ORCID

Daniela Almeida Neri  <https://orcid.org/0000-0003-1397-9126>

Fernanda Rauber  <https://orcid.org/0000-0001-9693-7954>

REFERENCES

- Avery, A., Anderson, C., & McCullough, F. (2017). Associations between children's diet quality and watching television during meal or snack consumption: A systematic review. *Maternal & Child Nutrition*, 13, e12428. <https://doi.org/10.1111/mcn.12428>
- Barcelos, G. T., Rauber, F., & Vitolo, M. R. (2014). Produtos processados e ultraprocessados e ingestão de nutrientes em crianças. *Revista Ciência & Saúde*, 7(3), 155–161. <https://doi.org/10.15448/1983-652X.2014.3.19755>
- Bates, B., Lennox, A., Prentice, A., Bates, C., Page, P., Nicholson, S., & Swan, G. (2014). *National Diet and Nutrition Survey results from years 1, 2, 3 and 4 (combined) of the Rolling Programme (2008/2009–2011/2012)*. London: Public Health England. Food Standards Agency.
- Batis, C., Rodríguez-Ramírez, S., Ariza, A. C., & Rivera, J. A. (2016). Intakes of energy and discretionary food in Mexico are associated with the context of eating: Mealtime, activity, and place–3. *The Journal of Nutrition*, 146(9), 1907S–1915S. <https://doi.org/10.3945/jn.115.219857>
- Bielemann, R. M., Santos, L. P., dos Santos Costa, C., Matijasevich, A., & Santos, I. S. (2018). Early feeding practices and consumption of ultraprocessed foods at 6 y of age: Findings from the 2004 Pelotas (Brazil) Birth Cohort Study. *Nutrition*, 47, 27–32. <https://doi.org/10.1016/j.nut.2017.09.012>
- Birch, L. L. (1999). Development of food preferences. *Annual Review of Nutrition*, 19(1), 41–62. <https://doi.org/10.1146/annurev.nutr.19.1.41>
- Borzekowski, D. L., & Robinson, T. N. (2001). The 30-second effect: An experiment revealing the impact of television commercials on food preferences of preschoolers. *Journal of the American Dietetic Association*, 101(1), 42–46. [https://doi.org/10.1016/S0002-8223\(01\)00012-8](https://doi.org/10.1016/S0002-8223(01)00012-8)
- Braithwaite, I., Stewart, A. W., Hancox, R. J., Beasley, R., Murphy, R., Mitchell, E. A., & ISAAC Phase Three Study Group (2013). The worldwide association between television viewing and obesity in children and adolescents: Cross sectional study. *PLoS ONE*, 8(9), e74263. <https://doi.org/10.1371/journal.pone.0074263>

- Buijzen, M., Schuurman, J., & Bomhof, E. (2008). Associations between children's television advertising exposure and their food consumption patterns: A household diary-survey study. *Appetite*, 50(2-3), 231-239. <https://doi.org/10.1016/j.appet.2007.07.006>
- Christian, M. S., Evans, C. E., Hancock, N., Nykjaer, C., & Cade, J. E. (2013). Family meals can help children reach their 5 A Day: A cross-sectional survey of children's dietary intake from London primary schools. *Journal of Epidemiology and Community Health*, 67(4), 332-338. <https://doi.org/10.1136/jech-2012-201604>
- Cornwell, B., Villamor, E., Mora-Plazas, M., Marin, C., Monteiro, C. A., & Baylin, A. (2018). Processed and ultra-processed foods are associated with lower-quality nutrient profiles in children from Colombia. *Public Health Nutrition*, 21(1), 142-147.
- ^ada Costa Louzada, M. L., Baraldi, L. G., Steele, E. M., Martins, A. P. B., Canella, D. S., Moubarac, J. C., ... Mozaffarian, D. (2015). Consumption of ultra-processed foods and obesity in Brazilian adolescents and adults. *Preventive Medicine*, 81, 9-15.
- ^bda Costa Louzada, M. L., Ricardo, C. Z., Steele, E. M., Levy, R. B., Cannon, G., & Monteiro, C. A. (2018). The share of ultra-processed foods determines the overall nutritional quality of diets in Brazil. *Public Health Nutrition*, 21(1), 94-102.
- Dietz, W. H. (2001). The obesity epidemic in young children: Reduce television viewing and promote playing. *British Medical Journal*, 322, 313-314. <https://doi.org/10.1136/bmj.322.7282.313>
- Fiates, G. M. R., Amboni, R. D. D. M. C., & Teixeira, E. (2008). Consumer behavior, eating habits and television viewing in students from Florianópolis, Brazil. *Revista de Nutrição*, 21(1), 105-114. <https://doi.org/10.1590/S1415-52732008000100011>
- Fink, S. K., Racine, E. F., Mueffelmann, R. E., Dean, M. N., & Herman-Smith, R. (2014). Family meals and diet quality among children and adolescents in North Carolina. *Journal of Nutrition Education and Behavior*, 46(5), 418-422. <https://doi.org/10.1016/j.jneb.2014.05.004>
- Fiolet, T., Srour, B., Sellem, L., Kesse-Guyot, E., Allès, B., Méjean, C., ... Hercberg, S. (2018). Consumption of ultra-processed foods and cancer risk: Results from NutriNet-Santé prospective cohort. *BMJ*, 360, k322.
- Fitt, E., Cole, D., Ziauddeen, N., Pell, D., Stickley, E., Harvey, A., & Stephen, A. M. (2015). DINO (Diet In Nutrients Out)—An integrated dietary assessment system. *Public Health Nutrition*, 18(2), 234-241. <https://doi.org/10.1017/S1368980014000342>
- Food and Agriculture Organization of the United Nations (2015). *Guidelines on the collection of information on food processing through food consumption surveys*. Rome: FAO.
- Food Standard Agency (2014). *McCance and Widdowson's the composition of foods*. Cambridge, UK: Royal Society of Chemistry.
- Ghobadi, S., Hassanzadeh-Rostami, Z., Salehi-Marzijarani, M., Bellissimo, N., Brett, N. R., Totosy de Zepetnek, J. O., & Faghiih, S. (2018). Association of eating while television viewing and overweight/obesity among children and adolescents: A systematic review and meta-analysis of observational studies. *Obesity Reviews*, 19(3), 313-320. <https://doi.org/10.1111/obr.12637>
- Hare-Bruun, H., Nielsen, B. M., Kristensen, P. L., Møller, N. C., Togo, P., & Heitmann, B. L. (2011). Television viewing, food preferences, and food habits among children: A prospective epidemiological study. *BMC Public Health*, 11(1), 311. <https://doi.org/10.1186/1471-2458-11-311>
- Karnopp, E. V. N., Vaz, J. D. S., Schafer, A. A., Muniz, L. C., Souza, R. D. L. V. D., Santos, I. D., ... Assunção, M. C. F. (2016). Food consumption of children younger than 6 years according to the degree of food processing. *Jornal de Pediatria*, 93(1), 70-78.
- Leech, R. M., Worsley, A., Timperio, A., & McNaughton, S. A. (2015). Understanding meal patterns: definitions, methodology and impact on nutrient intake and diet quality. *Nutrition Research Reviews*, 28(1), 1-21. <https://doi.org/10.1017/S0954422414000262>
- Leite, F. H. M., de Carvalho Cremm, E., de Abreu, D. S. C., de Oliveira, M. A., Budd, N., & Martins, P. A. (2016). Association of neighbourhood food availability with the consumption of processed and ultra-processed food products by children in a city of Brazil: A multilevel analysis. *Public Health Nutrition*, 21(1), 189-200.
- Liang, T., Kuhle, S., & Veugelers, P. J. (2009). Nutrition and body weights of Canadian children watching television and eating while watching television. *Public Health Nutrition*, 12(12), 2457-2463. <https://doi.org/10.1017/S1368980009005564>
- Ludwig, D. S. (2011). Technology, diet, and the burden of chronic disease. *JAMA*, 305(13), 1352-1353. <https://doi.org/10.1001/jama.2011.380>
- Maia, E. G., Costa, B. V. L., Coelho, F. S., Guimarães, J. S., Fortaleza, R. G., & Claro, R. M. (2017). Análise da publicidade televisiva de alimentos no contexto das recomendações do Guia Alimentar para a População Brasileira. *Cadernos de Saúde Pública*, 33(4), e00209115.
- Matheson, D. M., Killen, J. D., Wang, Y., Varady, A., & Robinson, T. N. (2004). Children's food consumption during television viewing. *The American Journal of Clinical Nutrition*, 79(6), 1088-1094. <https://doi.org/10.1093/ajcn/79.6.1088>
- Melo, B., Rezende, L., Machado, P., Gouveia, N., & Levy, R. (2018). Associations of ultra-processed food and drink products with asthma and wheezing among Brazilian adolescents. *Pediatric Allergy and Immunology*, 29(5), 467-468.
- ^bMendonça, R. D. D., Lopes, A. C. S., Pimenta, A. M., Gea, A., Martinez-Gonzalez, M. A., & Bes-Rastrollo, M. (2017). Ultra-processed food consumption and the incidence of hypertension in a Mediterranean cohort: The Seguimiento Universidad de Navarra Project. *American Journal of Hypertension*, 30(4), 358-366.
- ^aMendonça, R. D. D., Pimenta, A. M., Gea, A., de la Fuente-Arillaga, C., Martinez-Gonzalez, M. A., Lopes, A. C. S., & Bes-Rastrollo, M. (2016). Ultraprocessed food consumption and risk of overweight and obesity: The University Of Navarra follow-up (SUN) cohort study, 2. *The American Journal of Clinical Nutrition*, 104(5), 1433-1440.
- ^cMonteiro, C. A., Cannon, G., Moubarac, J. C., Levy, R. B., Louzada, M. L. C., & Jaime, P. C. (2018). The UN Decade of Nutrition, the NOVA food classification and the trouble with ultra-processing. *Public Health Nutrition*, 21(1), 5-17.
- ^aMonteiro, C. A., Levy, R. B., Claro, R. M., de Castro, I. R. R., & Cannon, G. (2010). Increasing consumption of ultra-processed foods and likely impact on human health: Evidence from Brazil. *Public Health Nutrition*, 14(1), 5-13.
- ^bMonteiro, C. A., Moubarac, J. C., Cannon, G., Ng, S. W., & Popkin, B. (2013). Ultra-processed products are becoming dominant in the global food system. *Obesity Reviews*, 14(S2), 21-28. <https://doi.org/10.1111/obr.12107>
- ^dMonteiro, C. A., Moubarac, J. C., Levy, R. B., Canella, D. S., da Costa Louzada, M. L., & Cannon, G. (2018). Household availability of ultra-processed foods and obesity in nineteen European countries. *Public Health Nutrition*, 21(1), 18-26. <https://doi.org/10.1017/S1368980017001379>
- Moodie, R., Stuckler, D., Monteiro, C., Sheron, N., Neal, B., Thamarangsi, T., ... Lancet NCD Action Group (2013). Profits and pandemics: Prevention of harmful effects of tobacco, alcohol, and ultra-processed food and drink industries. *The Lancet*, 381(9867), 670-679.
- Moubarac, J. C., Batal, M., Louzada, M. L., Steele, E. M., & Monteiro, C. A. (2017). Consumption of ultra-processed foods predicts diet quality in Canada. *Appetite*, 108, 512-520. <https://doi.org/10.1016/j.appet.2016.11.006>

- Nexo Jornal [Internet] (2017). O horário das refeições no Brasil e no mundo, segundo o Twitter. São Paulo: Nexo Jornal. Retrieved 03 March 2017 https://www.nexojornal.com.br/grafico/2017/06/04/O-hor%C3%A1rio-das-refei%C3%A7%C3%B5es-no-Brasil-e-no-mundo-segundo-o-Twitter?utm_campaign=selecao_da_semana_-_10062017&utm_medium=email&utm_source=RD+Station
- Ng, M., Fleming, T., Robinson, M., Thomson, B., Graetz, N., Margono, C., ... Abraham, J. P. (2014). Global, regional, and national prevalence of overweight and obesity in children and adults during 1980–2013: A systematic analysis for the Global Burden of Disease Study 2013. *The Lancet*, 384(9945), 766–781. [https://doi.org/10.1016/S0140-6736\(14\)60460-8](https://doi.org/10.1016/S0140-6736(14)60460-8)
- ^aPan American Health Organization (2012). *Recomendações da consulta de especialistas da Organização Pan-Americana da Saúde sobre a promoção e a publicidade de alimentos e bebidas não alcoólicas para crianças nas Américas*. Washington: PAHO.
- ^bPan American Health Organization (2015). *Ultra-processed food and drink products in Latin America: Trends, impact on obesity, policy implications* (pp. 1–58). Washington: PAHO.
- Public Health England (2014). *National Diet and Nutrition Survey results from years 1, 2, 3 and 4 (combined) of the Rolling Programme (2008/2009–2011/2012)*. London, UK: Public Health England.
- Rauber, F., Campagnolo, P. D. B., Hoffman, D. J., & Vitolo, M. R. (2015). Consumption of ultra-processed food products and its effects on children's lipid profiles: A longitudinal study. *Nutrition, Metabolism, and Cardiovascular Diseases*, 25(1), 116–122. <https://doi.org/10.1016/j.numecd.2014.08.001>
- Rauber, F., Louzada, M. L. C., Steele, E. M., Millett, C., Monteiro, C. A., & Levy, R. B. (2018). Ultra-processed food consumption and chronic non-communicable diseases-related dietary nutrient profile in the UK (2008–2014). *Nutrients*, 10(5), pii, E587.
- Reilly, J. J., & Kelly, J. (2011). Long-term impact of overweight and obesity in childhood and adolescence on morbidity and premature mortality in adulthood: Systematic review. *International Journal of Obesity*, 35(7), 891–898. <https://doi.org/10.1038/ijo.2010.222>
- Sparrenberger, K., Friedrich, R. R., Schiffner, M. D., Schuch, I., & Wagner, M. B. (2015). Ultra-processed food consumption in children from a basic health unit. *Jornal de Pediatria*, 91(6), 535–542. <https://doi.org/10.1016/j.jped.2015.01.007>
- Steele, E. M., Popkin, B. M., Swinburn, B., & Monteiro, C. A. (2017). The share of ultra-processed foods and the overall nutritional quality of diets in the US: Evidence from a nationally representative cross-sectional study. *Population Health Metrics*, 15(1), 6. <https://doi.org/10.1186/s12963-017-0119-3>
- Stuckler, D., McKee, M., Ebrahim, S., & Basu, S. (2012). Manufacturing epidemics: The role of global producers in increased consumption of unhealthy commodities including processed foods, alcohol, and tobacco. *PLoS Medicine*, 9(6), e1001235. <https://doi.org/10.1371/journal.pmed.1001235>
- Tavares, L. F., Fonseca, S. C., Rosa, M. L. G., & Yokoo, E. M. (2012). Relationship between ultra-processed foods and metabolic syndrome in adolescents from a Brazilian Family Doctor Program. *Public Health Nutrition*, 15(1), 82–87. <https://doi.org/10.1017/S1368980011001571>
- Trofholtz, A. C., Tate, A. D., Miner, M. H., & Berge, J. M. (2017). Associations between TV viewing at family meals and the emotional atmosphere of the meal, meal healthfulness, child dietary intake, and child weight status. *Appetite*, 108, 361–366. <https://doi.org/10.1016/j.appet.2016.10.018>
- ^aWorld Health Organization (2003). Diet, nutrition and the prevention of chronic diseases. WHO technical report series, 916, 77.
- ^bWorld Health Organization (2016). Global health observatory data repository. Retrieved 27 May 2017 <http://apps.who.int/gho/data/node.home>.

SUPPORTING INFORMATION

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

How to cite this article: Martines RM, Machado PP, Neri DA, Levy RB, Rauber F. Association between watching TV whilst eating and children's consumption of ultraprocessed foods in United Kingdom. *Matern Child Nutr.* 2019:e12819. <https://doi.org/10.1111/mcn.12819>