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Association of sedentary behaviours with food and beverages consumption and total diet quality in children from a Spanish region. The Calina study

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\textbf{ABSTRACT}

\textbf{Introduction:} The time spent in different types of sedentary behaviours has been associated with a poor intake in children, which contributes to childhood obesity. The aims of this study were: to examine the association between sedentary behaviours and the adherence to the total screen time (TST) recommendations, food and beverage consumption and the total diet quality index (DQI), in a sample of Spanish children.

\textbf{Methods:} The study included a cohort of 420 children (53.6\% boys) aged 7 years from Zaragoza (Spain), belonging the Growth and Feeding during Infancy and Early Childhood in Aragon (CALINA) longitudinal study. Data on dietary habits and TST (watching TV/DVD/videos and playing/using personal computers (PC)/video games) were parental-reported. TST was categorized based on the recommendations (≤2 h/day and >2 h/day). The DQI was computed from a validated semi-quantitative food-frequency questionnaire. Generalized linear mixed models, adjusted by maternal education, ethnicity and body mass index of the children, were analysed.

\textbf{Results:} Both in boys and girls, using a PC for ≤2 h per day was associated with a lower consumption of sugar and artificially sweetened beverages. In boys, using PC for ≤2 h per day was associated with a lower consumption of sweets, desserts and salty snacks and in girls, were associated with a lower consumption of juices and a higher consumption of fruits and vegetables. Only in boys, a low TST per day was associated with a lower consumption of sugar-sweetened beverages, whereas in girls, it was associated with a lower consumption of artificially sweetened beverages. Regarding DQI, both, boys and girls, showed
inverse associations between watching TV and total ST and the DQI; boys and girls meeting the TST recommendations (<2 h/day) had a better diet quality. **Discussion:** Sedentary behaviours were associated with unhealthy food and beverage consumption and a low total diet quality.

**Introduction**

Childhood is a vulnerable period of lifespan in relation to the sedentary time spent (Pate et al. 2011) and this is even more remarkable when increasing age (Janz et al. 2005; Te Velde et al. 2007). Sedentary time in front of a screen has been associated with obesity development (Biddle et al. 2018). In children, a sedentary lifestyle along with the low quality of the diet and a high consumption of fizzy drinks (sugar and artificially sweetened beverages) has been implicated in the steady rise of the obesity epidemic (Lumeng et al. 2006; Malik et al. 2013). Although the American Academy of Pediatrics recommends that total screen time (TST) should be limited to less than 2 h per day in children aged 2 years and older (American Academy of Pediatrics 2001), studies show that the majority of children spend more than 2 h per day in activities based on screens (Anderson et al. 2008; Santaliestra-Pasias et al. 2014; LeBlanc et al. 2015).

Numerous studies have examined the associations between sedentary behaviours like time spend in front of screens with food consumption, finding a positive association between children not meeting the TST recommendations with a higher consumption of foods considered unhealthy (Pearson and Biddle 2011; Pearson et al. 2014; Niven et al. 2015; Miguel-Berges et al. 2016; Costa et al. 2018).

Existing literature shows the positive relationship between high TST with high consumption of sugar and artificially sweetened beverages in preschool children (Miguel-Berges et al. 2016), school children and adolescents (Rey-Lopez et al. 2010; Santaliestra-Pasías et al. 2012). This association between TST and consumption of fizzy drinks may be in part the reason for the increased prevalence of overweight and obesity in children. Socioeconomic status, specifically maternal education and occupational status as well as the ethnicity have been associated with a worse lifestyle including an unhealthy diet and high time spend on sedentary behaviours (Fernández-Alvira et al. 2017; Iguacel et al. 2017).

TST also has been shown to influence children’s diet quality (Leech et al. 2014). A poor diet quality includes more frequent consumption of sugar-sweetened beverages, high consumption of fat/high sugar foods and low...
consumption of vegetables and fruits. The combination of high time spent in front of a screen and low levels of physical activity (PA) has been associated with a low-quality diet in children (Miguel-Berges et al. 2019). However, research assessing the relationship between combinations of both PA and TST and food and beverage consumption is very scarce.

To the authors’ knowledge, there are no studies that have investigated the effects of different sedentary behaviours and total screen time in relation to food consumption and the dietary quality index in Spanish children. For this reason, the aim of this study was to examine the association of sedentary behaviours and the adherence to the TST recommendations, with different food and beverage consumption and the dietary quality index (DQI), in a sample of Spanish children.

Methods

Design and study population

The CALINA study (Growth and Feeding in Infants from Aragon, Spain) is a longitudinal study in a representative cohort of infants from Aragon (Spain), since birth up to 7 years (Oves Suárez Lem et al. 2013). The main objective of the CALINA study was to assess growth patterns, body composition and feeding aspects in this population and to examine prenatal, postnatal and sociocultural factors which may influence them. The initially recruited sample was 1,602 individuals born in 2009–2010. In total, 1,540 had basic information on sex, birth weight, length at birth and date and place of birth. Those 1,540 were examined at birth and periodically re-examined in Primary Care Centres. For the present analysis, only children from the city of Zaragoza were invited to participate. In total, 420 children were included, as they met the inclusion criteria for participation in the 2016/2017 survey: age of 7 years and to have filled-in the information in the questionnaires regarding sedentary time at follow-up. Information on maternal education was obtained from a self-administered questionnaire including the number of years the mother studied. Mother’s education level was divided into four categories such as “No studies”, “Basic education”, “Mid-level education” and “Higher education” according to International Standard Classification of Education (ISCED 1997). Parents or legal guardians gave written informed consent for examinations of their children (both at birth and again for this follow-up). Ethical approval was obtained from Aragon’s Committee of Ethics in Clinical Research (CEICA).

Anthropometric measurements

Body weight was measured in kilograms (kg) with an electronic balance with precision close to 100 g (SECA 861 electronic balance, Hamburg, Germany).
Height was measured in meters (m) with a portable stadiometer with a precision of 1 mm (SECA 225 stadiometer, Hamburg, Germany). The body mass index (BMI) for age was calculated based on the International Obesity Task Force (IOTF) cut-off references.

**Sedentary behaviours**

Data on children’s sedentary behaviours were collected via questionnaire and reported by parents. Behaviours assessed included watching TV and/or DVDs and playing computer (PC). Parents reported frequency both for weekdays and weekend days. The frequency categories included: “not at all”, “less than 30 min/day”, “less than 1 h”, “1–2 h/day”, “2–3 h/day”, “more than 3 h/day”. These answers were further aggregated into two categories based on the World Health Organization recommendations for school children including ≤2 h per day and >2 h per day (WHO 2010). Average hours per day of TV/video viewing and PC use separately for weekdays and weekend days were summed up to obtain the TST. To obtain the weekly TV, PC or screen time per day, the average minutes per day, both for week and weekend days, were summed up and divided by 7 d.

**Food and beverage consumption and diet quality**

Food and beverage consumption was assessed using a 37-item semi-quantitative food-frequency questionnaire (FFQ) previously used and validated (Mouratidou et al. 2019) in the “Multifactorial evidence based approach using behavioural models in understanding and promoting fun, healthy food, play and policy for the prevention of obesity in early childhood (Toy-box)” study, a European multicentre study whose aim was to develop an obesity prevention programme specifically for pre-school children. Low-moderate relative validity was observed, which varied by food and beverage group (0.52–0.79) (Mouratidou et al. 2019). The selected groups of food and beverage consumption were chosen based on their association with obesity development (Commission of the European Communities 2005); (Pate et al. 2011) water, (Janz et al. 2005) sugar-sweetened beverages, (Te Velde et al. 2007) artificially sweetened beverages, (Biddle et al. 2018) fresh fruit juices and packed juices, (Lumeng et al. 2006) dried, canned and fresh fruits, raw and cooked vegetables, (Malik et al. 2013) dairy, (American Academy of Pediatrics 2001) sweets and desserts and (LeBlanc et al. 2015) salty snacks.

Parents reported the food consumption of their children and it was expressed as the number of portions per day. After collecting the food consumption data from the FFQ, the Diet Quality Index (DQI) was calculated. The DQI is an index largely used in studies with similar characteristics to assess the overall quality of the diet (Huybrechts et al. 2010; Vyncke et al. 2015).
This index consists of three components: dietary quality, dietary diversity and dietary equilibrium. Dietary quality expressed whether the children made the optimal food quality choices within a food group. Dietary diversity expressed the degree of variation in the diet. This diversity component was obtained by giving points ranging from 0 to 9 when at least one serving of food of a recommended food group was consumed. Dietary equilibrium was calculated from the difference between the adequacy of the diet and the excess of the intake in the diet.

To compute the overall DQI, the scores of the categories were summed and divided by 3, resulting in scores ranging from −33% to 100%.

**Statistical analyses**

Food and beverage consumption by respective sedentary behaviours was analysed by one-way analysis of covariance (ANCOVA), adjusted for maternal education, ethnicity and children’s BMI. Bonferroni corrections were used for post hoc multiple comparison tests. Additionally, mixed linear regression models were used to examine the relationship between sedentary behaviours and food and beverage consumption. Maternal education, BMI and ethnicity of the children were included as covariates. Values are presented as adjusted β values (estimated unstandardized regression coefficients) and 95% confidence intervals (CI). All statistical tests were stratified by sex and corresponding p values lower than 0.05 were considered statistically significant. The Predictive Analytics Software (IBM SPSS Statistics for Windows) version 20 was used to analyse the data.

**Results**

Table 1 presents descriptive information about the mean and standard error of age, body mass index, maternal education and sedentary behaviours. Only significant differences were shown between sexes with the PC use.

Table 2 presents the results of the ANCOVA (means and SD) for food and beverage consumption and DQI by sedentary behaviour categories, both for girls and boys, respectively. Boys spending ≤2 h per day watching TV had a lower consumption of sugar-sweetened beverages and salty snacks and higher consumption of water than those spending >2 h per day. Girls spending ≤2 h per day watching TV had a lower consumption of artificially sweetened beverages and salty snacks than those spending >2 h per day. In the case of boys spending ≤2 h per day using PC, they had a lower consumption of artificially sweetened beverages and salty snacks than those spending >2 h per day. In girls, the consumption of sugar-sweetened beverages, artificially sweetened beverages, juices, fruits and vegetables, sweets and dessert than those spending >2 h per day. In girls, the consumption of sugar-sweetened beverages, juices, fruits and vegetables, sweets and dessert than those spending >2 h per day and girls had a higher consumption of fruit and
vegetable consumption. Regarding the screen time, boys spending ≤2 h per day had a lower consumption of sugar-sweetened beverages, dairy, sweets, desserts and salty snacks and higher consumption of fruits, vegetables and water than those spending >2 h per day. Girls spending ≤2 h per day had a lower consumption of artificially sweetened beverages, sweets, desserts and salty snacks and higher consumption of fruits, vegetables and water than those spending >2 h per day.

Furthermore, the results also showed a significantly lower score of DQI, when children (boys and girls) spent >2 h of TV or total screen time per day.

Table 3 shows the results of the mixed linear regression models. In girls, watching TV for ≤2 h per day was associated with a lower consumption of salty snacks. In boys, using PC for ≤2 h per day was associated with a lower consumption of sugar-sweetened beverages, artificially sweetened beverages, sweets, desserts and salty snacks. Similar results were found in girls so that using PC for ≤2 h per day was associated with a lower consumption of sugar-sweetened beverages, artificially sweetened beverages, juices and higher consumption of fruits and vegetables. Only in boys, a low TST per day was associated with a lower consumption of sugar-sweetened beverages, whereas in girls, it was associated with a lower consumption of artificially sweetened beverages.
Table 2. a) Analysis of covariance for different foods and beverages by sedentary behaviour categories in boys participating in the CALINA study. Analysis was adjusted by maternal education, ethnicity of the child and body mass index. b) Analysis of covariance for different food and beverage portions by sedentary behaviour categories in girls participating in the CALINA study. Analysis was adjusted by maternal education, ethnicity of the child and body mass index.

| Portions/day<sup>a</sup> | Water Mean (standard error) | Sugar sweetened beverages Mean (standard error) | Artificially sweetened beverages Mean (standard error) | Juices Mean (standard error) | Fruits and Vegetables Mean (standard error) | Dairy Mean (standard error) | Sweets and desserts Mean (standard error) | Salty snacks Mean (standard error) | Diet Quality Index Mean (standard error) |
|--------------------------|----------------------------|-----------------------------------------------|--------------------------------------------------------|----------------------------|---------------------------------------------|---------------------------|------------------------------------------|--------------------------------------|-----------------------------------------|
| Weekly TV per day        |                            |                                               |                                                        |                            |                                             |                           |                                          |                                      |                                         |
| ≤2 h/day                 | 3.65 (0.09)*               | 0.16 (0.04)*                                  | 0.06 (0.01)                                            | 0.66 (0.06)                | 2.02 (0.09)                                 | 2.86 (0.10)               | 2.96 (0.15)                              | 0.18 (0.02)*                          | 82.33 (1.09)*                            |
| >2 h/day                 | 3.59 (0.14)*               | 0.22 (0.05)*                                  | 0.09 (0.02)                                            | 0.60 (0.08)                | 1.82 (0.12)                                 | 3.07 (0.14)               | 3.56 (0.21)                              | 0.25 (0.02)*                          | 73.49 (1.53)*                            |
| Weekly PC per day        |                            |                                               |                                                        |                            |                                             |                           |                                          |                                      |                                         |
| ≤2 h/day                 | 3.62 (0.08)                | 0.16 (0.03)*                                  | 0.04 (0.04)                                            | 0.62 (0.05)*               | 1.92 (0.07)*                               | 2.93 (0.08)               | 2.96 (0.12)*                             | 0.20 (0.01)                           | 81.58 (0.84)                             |
| >2 h/day                 | 4.02 (0.36)                | 0.40 (0.11)*                                  | 0.13 (0.06)                                            | 0.96 (0.19)*               | 2.24 (0.46)*                               | 2.84 (0.33)               | 4.59 (0.49)*                             | 0.25 (0.06)                           | 86.89 (3.64)                             |

TV, Television; PC, personal computer.
* Significant differences between ≤2 h and >2 h (p < 0.05).
<sup>a</sup>Portions per day.
Table 3. General linear model of beverage consumption by sedentary behaviour categories in both males and females participating in the CALINA study. Analysis was adjusted by maternal education, ethnicity of the child and body mass index.

|                          | Water | Sugar sweetened beverages | Artificially sweetened beverages | Juices | Fruits and Vegetables | Dairy | Sweets and desserts | Salty snacks | Diet Quality Index |
|--------------------------|-------|----------------------------|----------------------------------|--------|-----------------------|-------|--------------------|-------------|-------------------|
|                          | β (95% CI) | β (95% CI)                  | β (95% CI)                        | β (95% CI) | β (95% CI)            | β (95% CI) | β (95% CI)         | β (95% CI) | β (95% CI)        |
| Weekly TV per day        |       |                             |                                  |        |                       |       |                    |             |                  |
| Boys                     | 0.10  | −0.11                       | 0.01                             | 0.08   | 0.16                  | −0.20 | −0.52              | −0.05       | 2.12              |
|                          | (−0.26;0.46) | (−0.25;0.03)               | (−0.05;0.05)                     | (−0.13;0.29) | (−0.13;0.47)        | (−0.55;0.14) | (−1.06;0.02) | (−0.11;0.01) | (1.63;6.35)      |
| Girls                    | 0.09  | −0.10                       | −0.04                            | −0.04  | 0.14                  | −0.25 | −0.47              | −0.07       | 2.76              |
|                          | (−0.26;0.46) | (−0.22;0.10)               | (−0.11;0.00)                     | (−0.26;0.18) | (−0.15;0.43)        | (−0.69;0.18) | (−1.04;0.09) | (−0.13;0.03) | (1.62;17.15)     |
| Weekly PC per day        |       |                             |                                  |        |                       |       |                    |             |                  |
| Boys                     | 7.44  | −0.51                       | −0.09                            | −0.35  | −0.40                 | 0.14  | −1.96              | −0.13       | −4.37             |
|                          | (−0.78;0.78) | (−0.77;0.25)               | (−0.19;0.00)                     | (−0.76;0.06) | (−0.99;0.19)        | (−0.54;0.82) | (−3.00;0.92) | (−0.24;0.07) | (−12.06;3.31)    |
| Girls                    | 0.69  | −1.07                       | −0.22                            | −0.64  | 0.93                  | −0.08 | 0.34               | 0.13        | 4.74              |
|                          | (−0.47;1.85) | (−1.35;0.79)               | (−0.42;0.02)                     | (−1.27;0.02) | (0.08;1.77)        | (−1.32;1.17) | (−1.28;1.96) | (−0.03;0.30) | (−7.71;17.19)    |
| Weekly screen time per day|       |                             |                                  |        |                       |       |                    |             |                  |
| Boys                     | 0.15  | −0.13                       | −0.19                            | 0.01   | 0.30                  | −0.11 | −0.51              | −0.07       | 5.91              |
|                          | (−0.18;0.49) | (−0.26;0.00)               | (−0.06;0.29)                     | (−0.18;0.20) | (0.02;0.58)        | (−0.44;0.21) | (−1.03;0.01) | (−0.12;0.01) | (2.56;9.25)      |
| Girls                    | 0.27  | −0.11                       | −0.66                            | 0.05   | 0.35                  | −0.09 | −0.38              | −0.08       | 3.96              |
|                          | (−0.65;0.61) | (−0.20;0.00)               | (−0.73;0.00)                     | (−0.15;0.25) | (0.07;0.62)        | (−0.49;0.31) | (−0.89;0.14) | (−0.13;0.02) | (0.10;8.03)       |

TV, television; PC, personal computer.
Reference group: ≤2 h per day.
beverages. In both (boys and girls), a low total screen time per day was associated with a higher consumption of fruits and vegetables and lower consumption of salty snacks.

Regarding DQI, both, boys and girls, showed inverse associations between watching TV and total ST and the DQI; boys and girls meeting the TST recommendations (<2 h/day) had a better diet quality.

Discussion

In this study, associations between sedentary behaviours with food and beverage consumption and total diet quality index in Spanish children were investigated. The main finding of our study suggests that TV watching and total screen time were associated with a low consumption of foods considered healthy (F & V and water) and a higher consumption of energy-dense products (juices, sugar-sweetened beverages, sweets, desserts and salty snacks).

Results from this study are in the same line with those included in a systematic review (Avery et al. 2017). They found evidence that watching TV does lead to a reduced quality of the diet consumed and that there is an association between watching TV and a greater intake of energy-dense high-fat and high-sugar foods. On the contrary, this association was different in the case of the PC use. Previous studies have also found that energy intake is greater during TV watching than during the use of computers for homework or leisure (Lyons et al. 2013; Marsh et al. 2014).

The importance of the study of energy-dense foods and fizzy drinks is growing given its relationship with the increase in obesity in children and adolescents. Evidence from observational studies previously showed that a diet rich in energy-dense foods and fizzy drinks is associated with poorer diet quality (Martinez Steele et al. 2017), hypertension (Mendonca et al. 2017), metabolic syndrome and obesity (Monteiro et al. 2011). A recent systematic review revealed that the association between consumption of ultra-processed foods and body fat levels showed positive directions (i.e. increased consumption ends up with increasing body fat levels) (Costa et al. 2018).

TST has also been associated with obesity development (Robinson et al. 2017). A number of possible mechanisms are suggested to explain the effects of total screen time on obesity. These include, for example, displacing physical activity, increasing energy intake from eating while viewing TV and/or the effects of advertising, and reducing sleep (Robinson et al. 2017). Previous studies reveal that children who spend more time in front of screens also consume fewer fruits and vegetables and more energy-dense snacks and energy-dense drinks (Pearson and Biddle 2011; Ford et al. 2012). Our findings are consistent with previously reported literature in European preschool children (Miguel-
Berges et al. 2016), school-aged children (Borghese et al. 2014) and adolescents (Santaliestra-Pasías et al. 2012; Costa et al. 2018). In the cross-sectional study ALADINO conducted also in Spain in 2011–2013, they found similar associations. High levels of screen time were associated with a greater frequency of consumption of energy-dense, micronutrient-poor products and a lower frequency of consumption of fruits and vegetables (Perez-Farinos et al. 2017).

The Parents influence may improve sedentary behaviours and dietary intake. A literature review identified that parental practice of physical activity and doing physical activities with parents were positively correlated with physical activity and negatively with sedentary behaviours (Verloigne et al. 2012). Parental limits and rules about TV or total screen time are other important mechanisms to decrease sedentary behaviours. In some European studies consistent associations between parental limits and rules and less TV/video/DVDs viewing in children were found (Veldhuis et al. 2014; Bjelland et al. 2015; Miguel-Berges et al. 2020).

The importance of having a low total screen time has been observed in our study as well as in other studies. Our results support specific screen time recommendations for children, as we observed elevated energy-dense food and beverage consumption in those who spend more time using screens. In order to reduce the time in front of screens, several strategies have been suggested such as removing TV sets out of children’s bedrooms, enhancing alternatives for entertainment for children such as reading, sports, creative games and promoting activities for improving their neurodevelopment (American Academy of Pediatrics 2001).

The benefits of fruit and vegetable consumption are well known and exposure at an early age is important to prevent selective eating in later years. However, their consumption is very low in young populations. Our findings have a clinical relevance because it has been observed an increase in fruit and vegetable consumption in children who had decreased the time spent in front of screens (Pearson et al. 2018). Moreover, the study confirms the important role of parents and the relevance of setting family rules in order to reduce screen time in children (Birken et al. 2011).

Some limitations of this study have to be acknowledged. This is a cross-sectional study not allowing to establish causal relationships. The results can not be extrapolated to the whole population of Spain, but at the origin were representative of the region of Aragón. Dietary and behavioural information was collected via parental self-reported questionnaires, which are prone to over- or under-reporting. Time spent using new technologies as tablets was not assessed in the current study.

The main strength of our study is the fact that includes essential information on energy balance-related behaviours for a population group that is within a critical period in lifestyle habit acquisition. Moreover, parents and
caregivers must continually be reminded of their substantial influence in setting on positive habits such as physical activity and healthy diet.

**Conclusion**

This study provides evidence on the associations between different sedentary behaviours and food and beverage consumption and diet quality index in a Spanish school-age sample. From a public health point of view, it is important to identify screen time alternatives and supply healthy foods in order to provide an appropriate environment for obesity prevention in children. Our results support evidence calling for limiting children’s exposure to screen-based activities associated with energy-dense food consumption. The role of parents is crucial, not only in establishing clear messages about media use by their children but also improving the screen-related behaviours of their adult relatives.

**Disclosure statement**

No potential conflict of interest was reported by the authors.

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**References**

Anderson SE, Economos CD, Must A. 2008. Active play and screen time in US children aged 4 to 11 years in relation to sociodemographic and weight status characteristics: a nationally representative cross-sectional analysis. BMC Public Health. 8(1):366. doi:10.1186/1471-2458-8-366.

Avery a, Anderson C, McCullough F. 2017. Associations between children’s diet quality and watching television during meal or snack consumption: a systematic review. Matern Child Nutr. 13(4). doi:10.1111/mcn.12428.

Biddle SJH, Pearson N, Salmon J. 2018. Sedentary behaviors and adiposity in young people: causality and conceptual model. Exerc Sport Sci Rev. 46(1):18–25. doi:10.1249/JES.0000000000000135.
Birken CS, Maguire J, Mekky M, Manlhiot C, Beck CE, Jacobson S, Peer M, Taylor C, McCrindle BW, Parkin PC, et al. 2011. Parental factors associated with screen time in pre-school children in primary-care practice: a target kids! study. Public Health Nutr. 14(12):2134–2138. doi: 10.1017/S1368980011000516.

Bjelland M, Soenens B, Bere E, Kovacs E, Lien N, Maes L, Manios Y, Moschonis G, Te Velde SJ. 2015. Associations between parental rules, style of communication and children’s screen time. BMC Public Health. 15(1):1002. doi: 10.1186/s12889-015-2337-6.

Borghese MM, Tremblay MS, Leduc G, Boyer C, Belanger P, LeBlanc AG, Francis C, Chaput JP. 2014. Independent and combined associations of total sedentary time and television viewing time with food intake patterns of 9- to 11-year-old Canadian children. Appl Physiol Nutr Metab. 39(8):937–943. doi: 10.1139/apnm-2013-0551.

Commission of the European Communities (2005) Green paper: promoting healthy diets and physical activity: a European dimension for the prevention of overweight, obesity, and chronic disease. Published 2005. 2005.

Costa CDS, Flores TR, Wendt a, Neves RG, Assuncao MCF, Santos IS. 2018. Sedentary behavior and consumption of ultra-processed foods by Brazilian adolescents: brazilian National School Health Survey (PeNSE), 2015. Cad Saude Publica. 34(3):e00021017.

Fernández-Alvira JM, Mouratidou T, Bammann K, Hebestreit a, Barba G, Sieri S, Reisch L, Eiben G, Hadjigeorgiou C, Kovacs E, et al. 2017. Parental education and frequency of food consumption in European children: the IDEFICS study. Public Health Nutr. 16(3):487–498. doi: 10.1017/S136898001200290X.

Ford C, Ward D, White M. 2012. Television Viewing Associated With Adverse Dietary Outcomes in Children Ages 2–6. Obesity Rev. 13(12):1139–1147. doi: 10.1111/j.1467-789X.2012.01028.x.

Huybrechts I, Vereecken C, De Bacquier D, Vandevijvere S, Van Oyen H, Maes L, Vanhauwaert E, Temme L, De Backer G, De Henauw S, et al. 2010. Reproducibility and validity of a diet quality index for children assessed using a FFQ. Br J Nutr. 104 (1):135–144. doi: 10.1017/S0007114510000231.

Iguacel I, Fernandez-Alvira JM, Labayen I, Moreno LA, Samper MP, Rodriguez G. 2017. Social vulnerabilities as determinants of overweight in 2-, 4- and 6-year-old Spanish children. Eur J Public Health 28(2):289-295.

Janz KF, Burns TL, Levy SM. 2005. Tracking of activity and sedentary behaviors in childhood: the iowa bone development study. Am J Prev Med. 29(3):171–178. doi:10.1016/j.amepre.2005.06.001.

LeBlanc AG, Katzmarzyk PT, Barreira TV, Broyles ST, Chaput JP, Church TS, Fogelholm M, Harrington DM, Hu G, Kuriyan R, et al. 2015. Correlates of total sedentary time and screen time in 9–11 year-old children around the world: the international study of childhood obesity, lifestyle and the environment. PLoS One. 10(6):e0129622. doi: 10.1371/journal.pone.0129622.

Leech RM, McNaughton SA, Timperio a. 2014. The clustering of diet, physical activity and sedentary behavior in children and adolescents: a review. Int J Behav Nutr Phys Act. 11(1):4. doi:10.1186/1479-5868-11-4.

Lumeng JC, Rahnama S, Appugliese D, Kaciroti N, Bradley RH. 2006. Television exposure and overweight risk in preschoolers. Arch Pediatr Adolesc Med. 160 (4):417–422. doi: 10.1001/archpedi.160.4.417.

Lyons EJ, Tate DF, Ward DS. 2013. The better the story, the bigger the serving: narrative transportation increases snacking during screen time in a randomized trial. Int J Behav Nutr Phys Act. 10(1):60. doi:10.1186/1479-5868-10-60.
Malik VS, Pan a, Willett WC, Hu FB. 2013. Sugar-sweetened beverages and weight gain in children and adults: a systematic review and meta-analysis. Am J Clin Nutr. 98(4):1084–1102. doi:10.3945/ajcn.113.058362.

Marsh S, Ni Mhurchu C, Jiang Y, Maddison R. 2014. Comparative effects of TV watching, recreational computer use, and sedentary video game play on spontaneous energy intake in male children. a randomised crossover trial. Appetite. 77:13–18. doi:10.1016/j.appet.2014.02.008.

Martinez Steele E, Popkin BM, Swinburn B, Monteiro CA. 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. Popul Health Metr. 15(1):6. doi:10.1186/s12963-017-0119-3.

Mendonca RD, Lopes AC, Pimenta AM, Gea a, Martinez-Gonzalez MA, Bes-Rastrollo M. 2017. Ultra-processed food consumption and the incidence of hypertension in a mediterranean cohort: the seguimiento universidad de navarra project. Am J Hypertens. 30(4):358–366. doi:10.1093/ajh/hpw137.

Miguel-Berges ML S-PA, Mouratidou T, Androutsos O, de Craemer M, Pinket AS, Birnbaum J, Koletzko B IV, Usheva N, Kulaga Z, Gozdz M, Manios Y and Moreno LA 2016. Associations between food and beverage consumption and different types of sedentary behaviours in European preschoolers: the ToyBox-study. Eur J Nutr 56(5).

Miguel-Berges ML, Santaliestra-Pasias AM, Mouratidou T, De Miguel-Etayo P, Androutsos O, De Craemer M, Galcheva S, Koletzko B, Kulaga Z, Manios Y, et al. 2019. Combined longitudinal effect of physical activity and screen time on food and beverage consumption in European preschool children: the toybox-study. Nutrients. 11(5):1048. doi:10.3390/nu11051048.

Miguel-Berges ML, Santaliestra-Pasias AM, Mouratidou T, Flores-Barrantes P, Androutsos O, De Craemer M, Galcheva S, Koletzko B, Kulaga Z, Manios Y, et al. 2020. Parental perceptions, attitudes and knowledge on European preschool children’s total screen time: the ToyBox-study. Eur J Public Health. 30(1):105–111. doi:10.1093/eurpub/ckz151.

Monteiro CA, Levy RB, Claro RM, de Castro IR, Cannon G. 2011. Increasing consumption of ultra-processed foods and likely impact on human health: evidence from Brazil. Public Health Nutr. 14(1):5–13. doi:10.1017/S1368980010003241.

Mouratidou T, Mesana Graffe MI, Huybrechts I, De Decker E, De Craemer M, Androutsos O, Manios Y, Galcheva S, Lateva M, Gurzowska B, et al. 2019. Reproducibility and relative validity of a semiquantitative food frequency questionnaire in European preschoolers: the ToyBox study. Nutrition. 65:60–67. doi:10.1016/j.nut.2019.03.003.

Niven P, Scully M, Morley B, Baur L, Crawford D, Pratt IS, Wakefield M. 2015. What factors are associated with frequent unhealthy snack-food consumption among Australian secondary-school students? Public Health Nutr. 18(12):2153–2160. doi:10.1017/S1368980014002675.

Oves Suárez Lem B, Samper Villagrasa MP, Cuadrón Andrés I, Álvarez Sauras ML, Lasarte Velillas JJ, Moreno Aznar LA, Rodriguez Martinez G. 2013. Immigration and factors associated with breastfeeding. CALINA Study | Anales De Pediatrã-a (English Edition).

Pate RR, Mitchell JA, Byun W, Dowda M. 2011. Sedentary behaviour in youth. Br J Sports Med. 45(11):906–913. doi:10.1136/bjsports-2011-090192.

Pearson N, Biddle SJ. 2011. Sedentary behavior and dietary intake in children, adolescents, and adults. a systematic review. Am J Prev Med. 41(2):178–188. doi:10.1016/j.amepre.2011.05.002.
Pearson N, Biddle SJ, Williams L, Worsley a, Crawford D, Ball K. 2014. Adolescent television viewing and unhealthy snack food consumption: the mediating role of home availability of unhealthy snack foods. Public Health Nutr. 17(2):317–323. doi: 10.1017/S1368980012005204.

Pearson N, Biddle SJH, Griffiths P, Johnston JP, Haycraft E. 2018. Clustering and correlates of screen-time and eating behaviours among young children. BMC Public Health. 18(1):753. doi: 10.1186/s12889-018-5698-9.

Perez-Farinos N, Villar-Villalba C, Lopez Sobaler AM, Dal Re Saavedra MA, Aparicio a, Santos Sanz S, Robledo de Dios T, Castrodeza-Sanz JJ, Ortega Anta RM. 2017. The relationship between hours of sleep, screen time and frequency of food and drink consumption in Spain in the 2011 and 2013 ALADINO: a cross-sectional study. BMC Public Health. 17(1):33. doi: 10.1186/s12889-016-3962-4.

Rey-Lopez JP, Vicente-Rodriguez G, Ortega FB, Ruiz JR, Martinez-Gomez D, De Henauw S, Manios Y, Molnar D, Polito a, Verloigne M, et al. 2010. Sedentary patterns and media availability in European adolescents: the HELENA study. Prev Med. 51(1):50–55. doi: 10.1016/j.ypmed.2010.03.013.

Robinson TN, Banda JA, Hale L, Lu AS, Fleming-Milici F, Calvert SL, Wartella E. 2017. Screen media exposure and obesity in children and adolescents. Pediatrics. 140(Suppl 2):S97–s101. doi: 10.1542/peds.2016-1758K.

Santaliestra-Pasías AM, Mouratidou T, Verbestel V, Bammann K, Molnar D, Sieri S, Siani a, Veidebaum T, Mårild S, Ler L, et al. 2014. Physical activity and sedentary behaviour in European children: the IDEFICS study. Public Health Nutr. 17(10):2295–2306. doi: 10.1017/S1368980013002486.

Santaliestra-Pasías A MT, Verbestel V, Huybrechts I, Gottrand F, Le Donne C, Cuenca-Garcia M, Diaz LE, Kafatos A, Manios Y, Molnar D, Sjöström M, Widhalm K, De Bourdeaudhuij I, Moreno LA. 2012. Food Consumption and Screen-Based Sedentary Behaviors in European Adolescents: The HELENA Study. Archives of pediatrics & adolescent medicine 166(11):1010–1020. doi: 10.1001/archpediatrics.2012.646.

te Velde SJ DBI, Thorsdottir I, Rasmussen M, Hagströmer M, Klepp KI, Brug J. 2007. Patterns in sedentary and exercise behaviors and associations with overweight in 9–14-year-old boys and girls—a cross-sectional study. BMC Public Health. 7(1):16. doi: 10.1186/1471-2458-7-16.

Veldhuis L, van Grieken a, Renders CM, Hirasing RA, Raat H. 2014. Parenting style, the home environment, and screen time of 5-year-old children; the 'be active, eat right' study. PLoS One. 9(2):e88486. doi: 10.1371/journal.pone.0088486.

Verloigne M, Van Lippevelde W, Maes L, Brug J, De Bourdeaudhuij I. 2012. Family- and school-based correlates of energy balance-related behaviours in 10–12-year-old children: a systematic review within the ENERGY (European energy balance research to prevent excessive weight gain among youth) project. Public Health Nutr. 15(8):1380–1395. doi: 10.1017/S1368980011003168.

Vyncke K, Cruz Fernandez E, Fajo-Pascual M, Cuenca-Garcia M, De Keyzer W, Gonzalez-Gross M, Moreno LA, Beghin L, Breidenass C, Kersting M, et al. 2013. Validation of the diet quality index for adolescents by comparison with biomarkers, nutrient and food intakes: the HELENA study. Br J Nutr. 109(11):2067–2078. doi: 10.1017/S000711451200414X.

WHO. 2010. Global recommendations on physical activity for health. Geneva: World Health Organization.

American Academy of Pediatrics. 2001. Children, adolescents, and television. Pediatrics. 107(2):423–426. doi: 10.1542/peds.107.2.423.