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Screen time behaviours and caffeine intake in US children: findings from the cross-sectional National Health and Nutrition Examination Survey (NHANES)

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ABSTRACT

Background Screen time (ST) behaviours, for example, television (TV) watching and computer use, among youth are associated with unhealthy eating, and these patterns track over time. A positive association between ST and TV watching with consumption of caffeinated foods and beverages has been described in national samples of children in a few European countries. The association of ST behaviours with caffeine intake has not been previously reported. We examined whether ST behaviours were associated with caffeine intake on a given day (% consumers and amount consumed) in a nationally representative sample of US children.

Methods Data on 3421 children (ages 6–11 years) from the cross-sectional National Health and Nutrition Examination Survey 2007–2012 were used. Time spent on TV watching and computer use was determined using questionnaires. Dietary intake was assessed using a 24-hour recall by trained interviewers. Caffeine intake (mg) was estimated by using updated food and nutrient databases. Caffeine consumption was examined in relation to time spent (≥2 vs<2 hours/day) on ST behaviours.

Results Children who watched TV ≥2 hours/day had significantly higher (~45% more) caffeine intake. Total ST or computer use was not associated with caffeine consumption in school-aged children.

Conclusion TV watching was positively associated with caffeine intake in school-aged children, suggesting the need for continued monitoring of ST and caffeine intake behaviours in children and adolescents as well as examining the correlates of these behaviours to inform nutrition and health policies.

What is already known on this topic?

- There are suggestions that ST and eating habits form in childhood and track into later ages.
- ST behaviours (TV and computer use) are associated with adverse health outcomes and unhealthy eating.
- Few national-level studies have examined the association of ST with consumption of caffeinated foods (eg, soda and chocolate) in European children.

What this study hopes to add?

- This study relates ST behaviours with quantitatively estimated caffeine intake in a nationally representative sample of 6–11-year-old US children.
- TV watching was associated with higher caffeine intake on a given day among all children and among those consuming caffeine.
- ST and caffeine intake in youth need to be monitored.

INTRODUCTION

Excessive screen time (ST) and use of caffeinated products among youth are subjects of public health concern. ST behaviours include watching television (TV) and using computers or other electronic media.[1] ST behaviours have been related to increased cardiometabolic risk, shorter sleep and unhealthy eating habits in youth.[2–6] Positive associations between ST and consumption of caffeinated foods and beverages have been described in national samples of school-aged children primarily in a few European countries.[2] To our knowledge, the association of ST behaviours with quantitative estimates of caffeine intake has not been previously examined. Furthermore, eating habits form early in childhood, and both eating patterns and ST can track into adolescence and later ages, impacting long-term health.[1–3 7 8] Thus, the purpose of this study was to examine the association of ST behaviours with caffeine intake in a nationally representative sample of US school-aged children. We tested the hypothesis that there was no association between ST behaviours and caffeine consumption (ie, proportion of children who consumed caffeine and amount of caffeine consumed on a given day).

METHODS

Data

National Health and Nutrition Examination Survey (NHANES) is a series of large, complex, stratified, multistage probability surveys of the US population, conducted by the National Center for Health Statistics (NCHS) of the Centers for Disease Control and Prevention (CDC).[9] NHANES is designed to assess the health and nutritional status of adults and children in the USA and has been collecting these comprehensive data continuously since 1999. Briefly, participants are administered an in-home interview, followed by a visit to a mobile examination centre (MEC) that includes a physical examination and dietary interviews. The NHANES protocol is approved by the NCHS Research Ethics Review board. Cross-sectional data were also collected on ST behaviours on 6–11-year-old survey participants (SPs) in certain NHANES cycles (2007–2008, 2009–2010 and 2010–2012). These data, along with detailed methods of collection and questionnaires used, are publically available on the NHANES website (https://www.cdc.gov/nchs/nhanes/index.htm).

Written parental informed consent and child assent were obtained for all children ages 6–11 years. Unweighted exam response rate (%) for NHANES 2007–2012 was 74.1 (range: 69.5–75.4). The analytic sample consisted of NHANES participants aged 6–11 years (n=3421) with data on ST behaviours and dietary intake, and whose dietary recall data were considered 'reliable' in terms of the quality and completeness of the recall (https://wwwn.cdc.gov/Nchs/Nhanes/2011-2012/DR1TOT_G.htm).

ST behaviours

Data on ST behaviours, including TV watching and computer use, were collected by asking: 'Over the past 30 days, on average how many hours per day did SP sit and watch TV or videos' and 'Over the past 30 days, on average how many hours per day did SP use a computer or play computer games outside of work or school'. These questions are similar to those used in other validated surveys such as the CDC's Youth Risk Behaviours Surveillance System and other studies.[10–12] Proxies (generally a parent) provided responses ranging from none, <1, 1, 2, 3, 4 or ≥5 hours. Total ST was computed by summing TV watching and computer use time (<1 was coded as 0.5); these questions are designed to be mutually exclusive, but there are possible limitations when summing the responses (rounding up or down). All ST variables were dichotomised to <2 or ≥2 hours, considering recommendations to limit ST to <1 to 2 hours per day,[6 13] as used in other studies examining eating habits and ST behaviours in children.[2 14 15]

Caffeine intake

The type and quantity of all foods and beverages consumed in the 24-hour period preceding the MEC visit were collected by trained interviewers using a standardised computer-assisted dietary interview system, that is, Automated Multiple-Pass Method (AMPM) of the United States Department of Agriculture (USDA).[9 16] The methodology used for determination of caffeine intake has been described in detail in previous NHANES analyses.[17–19] Briefly, the AMPM includes a multiple pass format interview, standardised probes, and memory cues to help respondents remember and describe food and beverage consumption.[16] For beverages that may be caffeinated (eg, soda, coffee, tea and energy drinks), additional questions were asked to determine caffeine content.[18] Proxies, generally parents, assisted with the dietary interviews. NHANES caffeine intake data are computed using the USDA's Food and Nutrient Database for Dietary Studies, which is updated for each survey cycle to reflect current market supply.[9 17]

Statistical analysis

Statistical analyses were conducted with STATA V.13. Caffeine intake displayed a skewed distribution; thus, these data were logarithmically transformed to test hypotheses.[18]

Day 1 dietary sample weights that account for differential selection probability, non-response, non-coverage and complex sample design were applied. Weighted, untransformed estimates of the 25th, 50th (median), 75th, 90th and 95th percentiles for caffeine intake and proportions of caffeine consumers on a given day were estimated.[18] Hypotheses concerning caffeine intake (mg) in relation to ST variables were tested using weighted means of the log-transformed variable (α=0.05).[18]

RESULTS

Overall, 73.7, 63.4 and 19.2% children spent ≥2 hours/day on total ST, TV watching and computer use, respectively. Seventy-four per cent reported consuming caffeine on a given day. A trend of a greater proportion of children who watched ≥2 hours TV/day consuming caffeine (75.2%) versus those who watched less TV (70.3%) was noted that approached significance (p=0.05). The proportion of caffeine consumption by computer use and total ST did not differ significantly (data not shown).

Caffeine intake in relation to ST behaviours is presented for all children and for caffeine consumers only in tables 1 and 2, respectively. The median caffeine intake of children who watched TV ≥2 hours/day was 44% higher versus those who watched TV <2 hours/day (p<0.05); medians (95% CI) on a given day were 4.9 (0–93.6) and 3.4 (0–81.3) mg, respectively (table 1). Although caffeine intake was higher among children with ≥2 hours/day of computer use or total ST, these differences were not statistically significant (table 1). When analyses were restricted to caffeine consumers only (table 2), children who watched TV ≥2 hours/day had 46% higher median caffeine intake than those who watched less TV (p<0.05); medians (95% CI) were 12.1 (0–115.9) and 8.3 (0–96.9) mg, respectively. As for all

Table 1 Caffeine intake (mg) on a given day for all children (ages 6–11 years) overall and by screen time variables*

	n†	Median	25th percentile	75th percentile	90th percentile	95 percentile	P values‡
All	3421	4.4	0.0	24.6	58.6	85.8	
Total screen time							NS
<2 hours	807	3.7	0.0	16.0	42.5	69.1	
≥2 hours	2474	4.7	0.0	28.2	62.0	94.9	
Television watching							0.02
<2 hours	1138	3.4	0	15.5	43.7	81.3	
≥2 hours	2143	4.9	1.0	30.2	62.3	93.6	
Computer use							NS
<2 hours	2605	4.3	0.0	23.2	55.5	82.5	
≥2 hours	678	4.8	0.0	31.1	84.6	119.0	

*Medians and percentiles were calculated from untransformed weighted data; 5th and 10th percentiles are not presented and were essentially equal to zero because of a high proportion of children who did not consume any caffeine.
†Unweighted n.
‡All statistical tests were performed on log-transformed means.

children, caffeine intake among caffeine consumers was higher for those with ≥2 hours/day of computer use or total ST but was not statistically significant (table 2).

DISCUSSION

A positive association between ST behaviours and consumption of caffeinated foods (including sodas, candy and chocolate) has been reported in nationally representative samples of children in few European countries and in Iran and in small cross-sectional studies.[2 3 14] To our knowledge, the association of ST behaviours with quantitatively estimated caffeine intake in a nationally representative sample of US children has not been previously examined. Thus, the findings of this study add to the limited literature on caffeine consumption and ST behaviours in children.

Total ST (≥2 hours/day) and caffeine consumption were reported by proxies (generally a parent) for 73.7% and 73.5% children, respectively; this is consistent with previous limited literature in nationally representative samples of US children.[1 17] Although in the current study the median caffeine intake on a given day among 6–11-year-old US children was small, some children consumed large and potentially detrimental amounts.[17 18] Furthermore, caffeine intake increases with age,[17–19] and eating habits formed in childhood can continue into adolescence and adulthood,[8] suggesting the need to monitor this behaviour into adolescence and later years.

Table 2 Caffeine intake (mg) on a given day for caffeine consumers (ages 6–11 years) overall and by screen time variables*

	n†	Median	25th percentile	75th percentile	90th percentile	95 percentile	P values‡
All	2425	10.2	3.1	38.2	73.2	112.1	
Total screen time							NS
<2 hours	559	8.2	2.8	30.4	56.7	84.4	
≥2 hours	1760	11.6	3.3	41.3	79.7	116.0	
Television watching							0.04
<2 hours	781	8.3	2.8	31.1	64.6	96.9	
≥2 hours	1538	12.1	3.3	42.3	76.0	115.9	
Computer use							NS
<2 hours	1866	9.9	3.0	36.6	66.9	96.6	
≥2 hours	454	12.3	3.9	45.1	98.2	128.2	

*Medians and percentiles were calculated from untransformed weighted data; 5th and 10th percentiles are not presented and were essentially equal to zero because of a high proportion of children who did not consume any caffeine.
†Unweighted n.
‡All statistical tests were performed on log-transformed means.

In the current study, children who watched TV ≥2 hours/day had significantly greater caffeine intake than those who watched less TV. These findings are consistent with increased odds of soda ('soft drinks') consumption by 6–9-year olds who watched TV ≥2 hours/day in five European countries.[2] Eating patterns and ST behaviours can differ across countries; our findings of a positive association between TV watching and caffeine intake corroborate the findings noted in European countries[2] and extend them to US. children. Children who watch more TV may have shorter sleep, experience fatigue and higher exposure to food-related advertising and may have unhealthy eating habits[2 3 6]; these factors could motivate higher intake of caffeinated foods and/or beverages. Alternatively, it is also possible that caffeine consumption increases wakefulness and decreases time spent asleep, which could in turn be spent as watching TV.[5 20] Interestingly, in a study in Belgium, soda consumption in early adolescence predicted ST (TV and computer use) in early adulthood among girls.[7]

Our findings have limitations. They are based on cross-sectional data relying on reports of time spent on ST behaviours and dietary intake based on a 24-hour recall that could be subjected to recall bias. However, these techniques used in large-scale surveys and epidemiological studies are considered adequate to describe large-group level means and examine group level associations.[9 21] The cross-sectional nature of NHANES data does not allow determination of the directionality of the association noted between TV watching and caffeine intake or to draw any causal inferences. Future research could examine the association of ST behaviours with caffeine intake using more objective measures of total ST as well, on adjusting for demographic and lifestyle covariates, and describe usual caffeine intakes and sources among youth.

In conclusion, this study describes for the first time a positive association of ST behaviours, notably TV watching, with caffeine intake among a nationally representative sample of 6–11-year-old US children. The findings highlight the need for continued monitoring of ST and caffeine intake behaviours in youth and for examining their correlates to inform nutrition and health policies.

Contributors NA conceptualised the study design with input from SMF and SFQ and wrote the first draft of the manuscript. SMF carried out the data analysis. All authors were involved in the interpretation of the findings; provided critical input; drafted, revised and reviewed the manuscript and approved the final manuscript.

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Competing interests None declared.

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Data sharing statement NHANES data are publically available to download from its homepage.

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