

Young children's screen habits are associated with consumption of sweetened beverages independently of parental norms

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Abstract

Objectives This study investigated the associations between children's screen habits and their consumption of sweetened beverages. Because parents might be disposed to regulate their child's screen and dietary habits in a similar direction, our specific aim was to examine whether these associations were independent of parental norms.

Methods In the Swedish sample of the European Identification and prevention of dietary and lifestyle-induced health effects in children and infants (IDEFICS) study, parents filled in questionnaires about their 2 to 9-year-old children's ($n = 1,733$) lifestyle and diets.

Results Associations between screen habits and sweetened beverage consumption were found independent of parental norms regarding sweetened beverages. A longitudinal analysis revealed that sweetened beverage consumption at 2-year follow-up was predicted by exposure to commercial TV at baseline (OR 1.4, 95 % CI 1.1–1.9). Cross-sectional analysis showed that the likelihood of consuming sweetened

beverages at least 1–3 times per week increased for each hour/day watching television (OR 1.5, 95 % CI 1.2–1.9), and for being exposed to commercials (OR 1.6, 95 % CI 1.3–2.1). TV viewing time and commercial exposure contributed to the associations independently of each other.

Conclusions The results strengthen the assumption that it is possible to influence children's dietary habits through their TV habits.

Keywords Children · Television · Advertisements · Soft drinks · Parents · Family · Food habits

Introduction

TV viewing has been linked to increased BMI (Giammattei et al. 2003; Hancox et al. 2004) and childhood obesity (Epstein et al. 2008; Ludwig and Gortmaker 2004). Previous studies have indicated that the influence of TV on

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weight is through dietary intake rather than physical inactivity (Cleland et al. 2008). According to reviews, the relationship between TV viewing and food behaviour could be explained by greater exposure to marketing of energy dense foods (Cairns et al. 2009) as well as eating in front of the TV (Jordan and Robinson 2008; Swinburn and Shelly 2008).

Several studies have found a relationship between time spent viewing TV and dietary habits, such as a higher intake of sugary and fast foods as well as a lower intake of fruits and vegetables (Boynton-Jarrett et al. 2003; Giammattei et al. 2003; Lissner et al. 2012; McGowan et al. 2012; Miller et al. 2008). Longitudinal associations between television viewing and poor eating habits have also been observed (Barr-Anderson et al. 2009; Hare-Bruun et al. 2011; Pearson et al. 2011).

Although studies have demonstrated that TV viewing predicts overweight and poor eating habits, this does not prove causality. There might be a confounding factor in the association, namely social norms in the family regarding dietary consumption. To illustrate: parents, who tend to limit TV time might also be disposed to limit consumption of certain foods. In other words, dietary intake might be a result of parental norms on dietary consumption, rather than a consequence of TV exposure. Parental norms on dietary consumption can be described as parents influencing by acting as role models (descriptive norms) as well as approving or disapproving of certain consumption (injunctive norms), according to Cialdini and Trost 1998 definition (pp. 155–157).

To be able to take parental norms into consideration, it is preferable to focus on a specific food group instead of foods in general. Children's increased consumption of sugar-sweetened beverages is an issue that needs to be addressed from a public health perspective as the drinks can entail positive energy balance with their low satiety value (Mourao et al. 2007; Popkin 2010), and considerable contribution to sugar and energy intake in children (Swedish National Food Administration 2007). Intake of sugar-sweetened beverages has been reported to be associated with an increased risk of childhood obesity (Ludwig et al. 2001; Moreno and Rodríguez 2007), dental caries (Lee and Messer 2010) and type 2 diabetes (Vartanian et al. 2007). Moreover, sweetened beverages are a food group that is largely promoted in TV commercials (Kelly et al. 2010). Studies on the association between TV viewing and soft drink consumption are however contradictory. Some have found a positive association (Boynton-Jarrett et al. 2003; Feldman et al. 2007; Giammattei et al. 2003; McGowan et al. 2012; Miller et al. 2008; Péneau et al. 2009; Van Strien et al. 2009), others no or negative association (Dubois et al. 2008; Laurson et al. 2008; Matheson

et al. 2004). To our knowledge, none have taken social norms into consideration.

Therefore, the aim of this study is to examine the association between young children's TV, computer and commercial exposure and their consumption of sweetened beverages, taking into consideration descriptive and injunctive parental norms regarding their child's sweetened beverage consumption. Further, we aim to examine the influence of exposure to commercial TV on subsequent changes in sweetened beverage consumption after 2 years.

Materials and methods

Study population and study design

The data used in this study is the Swedish part of Identification and prevention of dietary and lifestyle-induced health effects in children and infants (IDEFICS), a large-scale European study investigating diet, social determinants and lifestyle factors of 2 to 9-year-olds where the material for the baseline survey was collected during September 2007–May 2008 and a first follow-up survey during 2009–2010. The design of the IDEFICS study has been described previously (Ahrens et al. 2011). In brief, a cohort from eight European countries was recruited into a population-based baseline survey, which was the starting point of a prospective cohort study with an embedded community intervention (2008–2009) where two out of six lifestyle messages were to enhance daily consumption of water and reduce TV viewing. Parents filled in questionnaires on their children's lifestyles and diets, including a food frequency questionnaire (FFQ). At the same time, the children's height and weight was measured. Four questions about children's exposure to commercial TV and parents' attempts to limit this exposure, as well as questions to capture parents' descriptive and injunctive norms on sweetened beverage consumption were added only in the Swedish questionnaire, with a special focus in this study. The approval by the appropriate ethics committees was obtained and all applicable international ethics regulations were followed during this research.

In Sweden, 2,759 children were contacted via their day care centres or schools in three municipalities in the Gothenburg region in western Sweden. The municipalities were chosen with the primary aim to select intervention and control regions that were comparable considering infrastructural, socio-demographic and socioeconomic characteristics (Ahrens et al. 2011). 1,809 children were included in the Swedish study and 1,733 participants had valid data on beverage consumption. The mean age was 5.7 years, and 51.3 % were boys, see Table 1 for all rele-

Table 1 Descriptive data of TV, computer and commercial exposure, sweetened beverage consumption and parental norms

Variable	Girls					Boys					Total
	2–2.9 n = 84	3–4.9 n = 240	5–6.9 n = 225	7–9.5 n = 295	p for trend (age)	2–2.9 n = 111	3–4.9 n = 248	5–6.9 n = 230	7–9.5 n = 300	p for trend (age)	
Sweetened beverages											
At least 1–3 times/week, child %	42	53	55	59	.01	51	59	61	65	.01	57
At least 1–3 times/week, parent ^a %	45	47	46	40	0.2	48	49	48	46	0.5	46
Parent's approval of consumption ^b %	17	26	28	36	<.001	23	28	31	30	0.2	29
Favouring parental norms ^c %	11	18	17	16	0.6	14	19	20	18	0.5	17
TV, computer and commercial exposure											
TV >1 h/day, child %	34	49	57	57	<.001	28	54	60	58	<.001	53
Total screen time >1 h/day,	37	63	81	92	<.001	32	76	92	98	<.001	79
Exposure to commercial TV, child %	46	55	69	87	<.001	41	63	78	92	<.001	72
Parent not or partly limiting exposure ^d %	74	82	82	93	<.001	73	83	90	94	<.001	86

(IDEFICS study, Gothenburg centre, 2007–2010)

^a Descriptive norm^b Injunctive norm^c Combined variable of descriptive and injunctive parental norms^d Parent not or partly limiting child's exposure to TV commercials

vant variables at baseline described by sex and age group. We were able to use data from the Swedish follow-up survey 2009–2010 to analyse the influence of exposure to commercial TV on sweetened beverage consumption prospectively. 1,333 participants also had valid data on beverage consumption for analysis in the follow-up survey. The mean age was 7.7 years and 49.7 % were boys, respectively.

Measures

Children's sweetened beverage consumption

The following question and items from the FFQ measured the frequency of consuming sweetened beverages: In the last month, how many times did your child eat or drink the following food items? Please refer to the last 4 weeks and exclude all pre-school or school meals.

- Sugar-sweetened drinks including sports drinks, for example syrup-based drinks [local examples]
- Sugar-free drinks [local examples].

The parents could choose between seven categories when answering, ranging from “never/less than once per week” to “4 or more times per day” or “don't know”. A previous study investigated the reproducibility of the food consumption frequencies derived from the FFQ and found that it gave reproducible estimates of the consumption frequency of food items measured (Lanfer et al. 2011).

A variable for the combined consumption of beverages with added sugar or artificial sweeteners, carbonated or not, was then created to account for the consumption of what hereafter is called sweetened beverages. Finally, a dichotomised variant of this variable was created: at least one to three times per week versus less than once per week.

TV, computer and commercial exposure

The children's TV, computer and commercial exposure was measured with several questions and resulted in four variables (a–d):

- Hours per day spent watching TV, videos or DVD* were measured by the question “How long does your child usually watch TV/video/DVD per day?” Answers were separated by weekdays and weekends and categorised in six categories from “not at all” to “more than 3 h per day”. An hours-per-day variable was created by approximating the intervals given for each category in the answers to a decided number. For example “less than 30 min per day” was given the label 0.5 and “more than 3 h per day” was given the label 3.5. The TV/video/DVD hours during weekdays were then multiplied by 5 and the weekend hours by 2. Finally, this was divided by 7, to get the continuous variable of hours-per-day spent watching TV/video/DVD. This question has been tested for reproducibility and the results suggest agreement between repeat measures (Lissner et al. 2012).

- (b) *Total screen time* (hours per day spent watching TV, videos, DVD, sitting at the computer or playing computer games) was measured by adding hours a day watching TV/video/DVD with hours a day at a computer screen (measured by the question “How long does your child usually sit at a computer/game console per day?” with the same procedure as accounted for in a), creating a continuous variable of hours-per-day in front of a TV or a computer screen.
- (c) *Exposure to commercial TV* was measured by the question “Which TV channels has your child watched the past month?” (a question only added in the Swedish questionnaire for the purpose of this study). Multiple responses of eight channels were possible, whereof two channels are public and not allowed to broadcast commercials according to Swedish legislation. The six additional channels were chosen on the basis of coverage and viewing time (MMS 2006) in the younger age groups (3–12 years) and by being financed by commercials and not distribution revenues (The Swedish Broadcasting Authority 2007). If one or more of the other six commercial channels were filled in, exposure to commercial TV was registered, and thus a dichotomised variable was created: exposed versus not.
- (d) *Parents’ limitations of children’s exposure to TV commercials* were measured by the question “Do you deliberately attempt to limit your child’s exposure to TV commercials?” (a question only added in the Swedish questionnaire) with three possible answers: “Yes, completely”, “yes, partly”, “no, not at all”. A dichotomised variable was created: Completely versus partly or not at all.

Possible confounders

Parental norms regarding sweetened beverages were measured by two questions only added in the Swedish questionnaire and applied to the parent who filled in the questionnaire (mothers in over 80 % of the cases). The frequency of parents’ consumption of sweetened beverages (descriptive norm) was measured with the same procedure as the children’s consumption. The parents’ injunctive norm was measured by the question: “How do you feel about your child drinking soft drinks?” with five possible answers: “OK”, “quite OK”, “neither nor”, “quite bad”, “bad”. Parents who reported approval (injunctive norm) of their child’s consumption of sweetened beverages (OK or neither nor) and consumed sweetened beverages themselves at least one to three times per week (descriptive norm), were categorised as having norms favouring consumption of sweetened beverages in a combined norm variable.

Other Having older siblings has been significantly associated with a frequent intake of sugar-rich foods (Brekke et al. 2007). Therefore, having older siblings was taken into account in the present study and measured with a dichotomised variable: living with one or more older siblings versus not living with older siblings.

An indicator for socioeconomic status was assessed by the education of the parent who filled in the questionnaire, as well as the household’s total monthly income, measured in nine categories ranging from below 1,000 € to exceeding € 5,500. The variable for education was dichotomised as above or equal to 2 years of undergraduate studies versus less than 2 years of undergraduate studies.

Body mass index (BMI) was calculated based on measured height and weight, and children were classified as overweight (including obese) versus not overweight, using age-specific cut points defined by Cole (Cole et al. 2000). The reason for adjusting for weight status was that overweight might affect the reporting of sweetened beverage consumption as well as being associated with TV viewing.

Analysis

Logistic regression was used to analyse the association between the children’s TV, computer and commercial exposure and their consumption of sweetened beverages, where the beverage consumption was the dependent variable. Logistic regression was chosen as an analysis method, as the frequencies turned out to be naturally dichotomised to less than once per week versus at least one to three times per week, both at baseline and follow-up. All four variables for TV, computer and commercial exposure were analysed in separate models. In each of these models, adjustments were made for age, sex, having older siblings, child’s weight status, parental education, income, and parental norms on sweetened beverages. The combined variable for favouring parental norms on sweetened beverages was used for adjusting in all models, due to collinearity when using two separate norm variables in the same model. The analyses were also stratified by sex and age groups.

Logistic regression was performed for testing the hypothesis that exposure to commercial TV at baseline predicts consumption of sweetened beverages at follow-up, with adjustments for consumption of sweetened beverages at baseline, TV viewing time, as well as age, sex and intervention. Furthermore, possible mediating effects of parental norms on sweetened beverages were tested. No intervention effects on beverage intake were detected and therefore data from both intervention and control groups were analysed in the same model. All adjusted models were tested for goodness of fit by the Hosmer and Lemeshow test.

Table 2 Associations between parental norms and consumption of sweetened beverages at least once/week

Parental norms	Prevalence % sweetened beverages at least 1–3 times/week		OR (95 % CI) ^a		
	Favouring norm	Not favouring norm	Crude	Adjusted for age and sex	Multiple adjustments ^b
Descriptive norm (I)	75	42	4.1 (3.3–5.1)	4.2 (3.4–5.2)	4.5 (3.6–5.6)
Injunctive norm (II)	70	52	2.1 (1.7–2.7)	2.1 (1.7–2.6)	2.1 (1.6–2.6)
Combined (I+II)	80	53	3.6 (2.6–4.8)	3.5 (2.6–4.8)	3.6 (2.6–5.0)

(IDEFICS study, Gothenburg centre, 2007–2010)

(I) Parents as role models for consumption

(II) Parent's approval of consumption

^a Increased risk calculated by *OR* odds ratio (95 % confidence intervals), in different logistic regression models. All *OR*s were significant on the 0.1 % significance level ($p < 0.001$)

^b Additionally adjusted for siblings and socioeconomic variables

All statistical calculations were performed with the PASW Statistics program version 18.0. A probability value of less than 5 % was considered as statistically significant.

Results

Descriptive statistics

The distribution of the frequency of consuming sweetened beverages at follow-up was very similar to baseline, i.e. 56 % consumed those at least one to three times per week, even though the children were 2 years older. See main descriptive results for all the relevant variables in Table 1.

Of all the children, 53 % watched TV for more than 1 h a day, while only 6 % watched more than 2 h. After the age of 3 years, the results of this parent-reported data indicate an increase by age group in the consumption of sweetened beverages, TV viewing time and exposure to commercial TV (Table 1). Some significant gender differences were also found ($p < 0.05$): More boys than girls consumed sweetened beverages at least one to three times per week, and the boys also had longer total screen time and more exposure to commercial TV than the girls.

Approximately half of the sample had one or more older siblings (53 %). The percentage of parents whose education extended 2 years on undergraduate level was 59 %. Fifty percent had a household's income in the category 3,000–4,000 € a month after tax, whereas 25 % had lower income and 25 % had higher income. Approximately, 10 % of the children were overweight or obese.

Parental norms regarding sweetened beverages

Before adjusting for the measured confounders (parental norms), we tested their association with the dependent variable of consuming sweetened beverages. The prevalence of

drinking sweetened beverages at least weekly was significantly associated with exposure to parental norms favouring sweetened beverage consumption (Table 2).

The children whose parents consumed sweetened beverages (descriptive norm) at least one to three times per week were 4.5 (95 % CI 3.6–5.6) times more likely to do so as well, when adjusting for age, sex, older siblings and socio-economic variables. The children whose parents approved of the child's sweetened beverage consumption (injunctive norm) were at double the risk (OR 2.1, 95 % CI 1.6–2.6) of consuming sweetened beverages at least one to three times per week. When descriptive and injunctive norms were combined to one variable of parental norms regarding sweetened beverages, logistic regression analysis resulted in an odds ratio of 3.6 (95 % CI 2.6–5.0) of drinking sweetened beverages at least one to three times per week for the children whose parents had favouring norms on sweetened beverages. Thus, the association with the combined parental norm was somewhat weaker than with the variable for descriptive norm only. However, due to collinearity, the combined variable was used in further analyses examining associations between sweetened beverage consumption and different variables on TV viewing. The results presented in Table 2 show that the measurements for parental norms regarding sweetened beverages have a strong association with children's intake of sweetened beverages, and were therefore adjusted for in further logistic regression models.

Cross-sectional associations

Figure 1 describes the unadjusted association between watching TV and consuming sweetened beverages. The results suggest that as the time spent viewing TV increases, so does the frequency of drinking sweetened beverages, in a dose–response fashion. The likelihood of drinking sweetened beverages at least weekly increased by 70 % for

each hour a day watching television (Table 3). When adjusting for parental norms as well as age, sex, socioeconomic variables, older siblings and child's overweight, odds ratio (95 % CI) of weekly consumption was 1.5 (1.2–1.9) for each hour a day watching TV. A similar association was observed for screen time.

The association between exposure to commercial TV and sweetened beverage consumption was also significant (Table 3). Further analyses revealed that the association between being exposed to commercial TV and drinking sweetened beverages at least one to three times per week was significant (OR 1.6, 95 % CI 1.3–2.1) with multiple adjustments including TV viewing time, indicating that watching TV commercials was associated with drinking sweetened beverages more frequently, independent of time spent watching TV. The likelihood of drinking sweetened beverages at least weekly was more than double when parents did not or only partly attempt to limit exposure to

TV commercials, as compared to limiting the exposure completely.

Longitudinal association

A longitudinal analysis revealed that consuming sweetened beverages at least one to three times per week at follow-up was predicted by exposure to commercial TV at baseline (OR 1.4, 95 % CI 1.1–1.9) with adjustments for sweetened beverage consumption at baseline, as well as age, sex, intervention and TV viewing time. Sweetened beverage consumption at follow-up was also associated with favouring parental norms on sweetened beverages (baseline). A possible mediation by parental norms on sweetened beverages was, however, ruled out, as the association between exposure to commercial TV and parental norms on sweetened beverages was not significant. Consequently, the odds ratio was the same and remained significant when adjusting for parental norms on sweetened beverages.

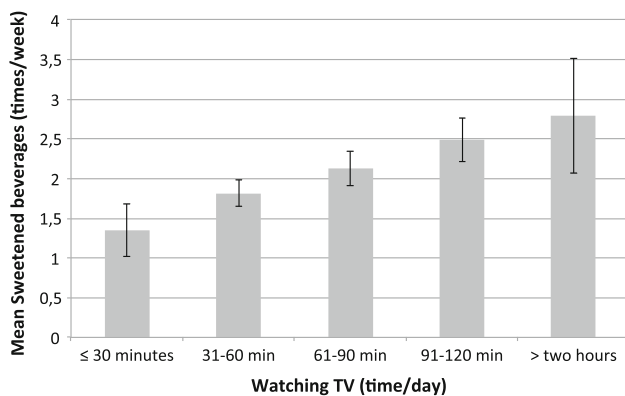


Fig. 1 The association between consumption of sweetened beverages and watching TV (95 % CI) (IDEFICS study, Gothenburg centre, 2007–2010)

Sensitivity analysis

The presented results are similar to the results with adjustment for each variable for parental norms regarding sweetened beverages in ordinal scale in separate models, indicating that our findings are not a result of using a combined variable for adjustment. The results when analysing the children's consumption of sugar-sweetened beverages separately, instead of combined with the consumption of artificially sweetened beverages as the above analyses, were similar in all aspects (data not shown). The trends in all the associations were, moreover, similar when stratified by sex, age groups or intervention versus control groups.

Table 3 Associations between TV, computer and commercial exposure and consumption of sweetened beverages at least 1–3 times/week

Exposure variable	OR (95 % CI) ^a		
	Crude	Adjusted for age, sex and parental norms on SB	Multiple adjustments ^b
TV and computer time (h/day)			
TV viewing	1.7 (1.4–2.0)	1.5 (1.2–1.9)	1.5 (1.2–1.9)
Total screen time	1.5 (1.3–1.7)	1.4 (1.2–1.7)	1.4 (1.2–1.6)
Commercial TV versus not			
Exposure to commercial TV	1.8 (1.5–2.3)	1.8 (1.4–2.2)	1.6 (1.3–2.1)
Parent not or partly limiting exposure	2.3 (1.7–3.0)	2.0 (1.5–2.7)	1.9 (1.4–2.6)

(IDEFICS study, Gothenburg centre, 2007–2010)

SB sweetened beverages

^a Increased risk calculated by OR odds ratio (95 % confidence intervals), in different logistic regression models. All ORs were significant on the 0.1 % significance level ($p < 0.001$)

^b Additionally adjusted for siblings, socioeconomic variables, child's overweight, and for the two TV use variables on commercial TV also adjusted for TV viewing (h/day)

Discussion

The main findings of this study are that exposure to commercial TV was significantly associated with consuming sweetened beverages, independently of parental norms, in both cross-sectional and longitudinal analyses. Adjusted cross-sectional analyses show that the likelihood of consuming sweetened beverages at least one to three times per week increased by 50 % for each hour a day watching television, by 40 % for each hour a day of total screen time, and by 60 % for having been exposed to commercial TV versus not. Parents' attempts to limit their child's exposure to TV commercials were also found to be of importance as children of parents who did not or only partly limit their children's exposure to commercials were at nearly double the risk to consume sweetened beverages at least one to three times per week, compared to children of parents who attempted to limit the exposure completely. The analyses performed show that both TV viewing time and exposure to commercial TV are associated with sweetened beverage consumption, independent of each other. This could indicate that TV viewing influences sweetened beverage consumption through TV commercials, and also in other ways, for example drinking sweetened beverages while watching TV or by program content influence.

By analysing total screen time as one variable in this study, we have taken into consideration that the computer might be used to watch TV, but also the time children spend playing computer games. The association between total screen time and sweetened beverage consumption was slightly weaker than between TV time and sweetened beverage consumption. This is not surprising because playing electronic games has been related to increased energy intake (Swinburn and Shelly 2008) and body composition (Rey-López et al. 2008) to a lesser extent than TV viewing. The nature of watching TV or playing a computer game is different, as TV viewing does not require active hands and thus promotes snacking while watching. TV still dominates in food marketing (Cairns et al. 2009), although emerging new media may become an additional venue for advertisements for unhealthy foods. Increased marketing of energy dense foods aimed at children is a recognised public health problem and our findings add to the research evidence for the negative effects of marketing aimed at children.

The conclusion of the analyses was the same when using the variable for the frequency of consuming sugar-sweetened beverages separately, or combined with the consumption of beverages with artificial sweeteners. We find this strengthening the results as it limits the risk of bias based on the answers falling in the wrong category. Moreover, not only sugar-sweetened beverages, but also artificially sweetened beverages have been associated with

weight gain according to a recent systematic review (Brown et al. 2010).

A limitation of this study is that the questionnaire only measured one parent's norms, i.e. how often the parent who filled in the questionnaire consumed sweetened beverages (descriptive norm), and his or her approval of the child's sweetened beverage consumption (injunctive norm). In most cases, it was the mother who filled in the questionnaire. Another limitation is that the sample was not representative for Sweden. The participating municipalities were chosen with the primary aim to select comparable regions for a community intervention and dropout may have entailed self-selection bias. The aim of this study is, however, not to estimate prevalence and it is not probable that the demonstrated associations are a result of selection bias. The fact that the exposure to both screens and sweetened beverages was low in our sample in comparison to representative data for Sweden (Swedish Media Council 2010; Swedish National Food Administration 2007) could be a result of sampling bias and/or social desirability bias. It can furthermore be difficult for parents to estimate their children's food and screen habits. This might have been the case when exposure to commercial TV was measured, as parents reporting no exposure to commercial TV might not have been aware of their children switching channels from public service channels. Even so, we observed a significant association between TV exposure and sweetened beverage consumption in our sample, despite reports of low frequency of sweetened beverage intake and TV viewing. Thus, it is possible that we underestimate rather than overestimate the strength in associations.

According to Marmot et al. (2008), early childhood is an important life stage to promote health equity, as early child development affects subsequent life changes and for example the risk of obesity. This study has focused on young children and among our results are that parental norms on sweetened beverage consumption do not affect the association between TV viewing and sweetened beverage consumption. Thus, we argue that the responsibility for children's food habits is not solely their parents' but that community action is needed, which is in line with Marmot et al. (2008) who states that action on the social determinants of health must involve all sectors of society.

Conclusion

These findings support previous studies, which have shown that TV viewing is associated with unhealthy food habits. We were able to demonstrate that the associations between sweetened beverage consumption and all the measures of TV and computer use were independent of parental norms regarding sweetened beverages, even though parental norms regarding sweetened beverages were strongly

associated with the consumption of sweetened beverages. Furthermore that exposure to commercial TV predicted the consumption of sweetened beverages 2 years later. Our results also indicate that to decrease children's sweetened beverage consumption, parents' attempts to limit children's exposure to TV commercials are important. This further strengthens the assumption that it is possible to affect children's food habits by influencing their TV habits.

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Conflict of interest The authors declare that they have no conflict of interests.

Ethical standard This study complies with Swedish legislation. Approval by the appropriate ethical committees has been obtained. Both the children and their parents gave their consent.

References

- Ahrens W, Bamman K, Siani A et al (2011) The IDEFICS cohort: design, characteristics and participation in the baseline survey. *Int J Obes* 35:S3–S15
- Barr-Anderson DJ, Larson NI, Nelson MC, Neumark-Sztainer D, Story M (2009) Does television viewing predict dietary intake five years later in high school students and young adults? *Int J Behav Nutr Phys* 6:1–8
- Boynton-Jarrett R, Thomas TN, Peterson KE, Wiecha J, Sobol AM, Gortmaker SL (2003) Impact of television viewing patterns on fruit and vegetable consumption among adolescents. *Pediatrics* 112(6):1321–1326
- Brekke HK, van Odijk J, Ludvigsson J (2007) Predictors and dietary consequences of frequent intake of high-sugar, low-nutrient foods in 1-year-old children participating in the ABIS study. *Br J Nutr* 97(1):176–181
- Brown RJ, De Banate MA, Rother KI (2010) Artificial Sweeteners: a systematic review of metabolic effects in youth. *Int J Pediatr Obes* 5:305–312
- Cairns G, Angus K, Hastings G (2009) The extent, nature and effects of food promotion to children: a review of the evidence to December 2008. World Health Organization
- Cialdini RB, Trost MR (1998) Social influence: Social norms, conformity, and compliance. In: Gilbert DT, Fiske ST, Lindzey G (eds) *The handbook of social psychology*, vol II, 4th edn. McGraw-Hill, New York, pp 151–160
- Cleland VJ, Schmidt MD, Dwyer T, Venn AJ (2008) Television viewing and abdominal obesity in young adults: is the association mediated by food and beverage consumption during viewing time or reduced leisure-time physical activity? *Am J Clin Nutr* 87:1148–1155
- Cole TJ, Bellizzi MC, Flegal KM, Dietz WH (2000) Establishing a standard definition for child overweight and obesity worldwide: international survey. *BMJ* 320:1–6
- Dubois L, Farmer A, Girard M, Peterson K (2008) Social factors and television use during meals and snacks is associated with higher BMI among pre-school children. *Public Health Nutr* 11(12):1267–1279
- Epstein LH, Roemmich JN, Robinson JL et al (2008) A randomized trial of the effects of reducing television viewing and computer use on body mass index in young children. *Arch Pediatr Adolesc Med* 162(3):239–245
- Feldman S, Eisenberg ME, Neumark-Sztainer D, Story M (2007) Associations between watching TV during family meals and dietary intake among adolescents. *J Nutr Educ Behav* 39:257–263
- Giammattei J, Blix G, Marshak HH, Wollitzer AO, Pettitt DJ (2003) Television watching and soft drink consumption. *Arch Pediatr Adolesc Med* 157:882–886
- Hancox RJ, Milne BJ, Poulton R (2004) Association between child and adolescent television viewing and adult health: a longitudinal birth cohort study. *Lancet* 364:257–262
- Hare-Bruun H, Nielsen BM, Kristensen PL, Møller NC, Togo P, Heitmann BL (2011) Television viewing, food preferences, and food habits among children: a prospective epidemiological study. *BMC Public Health* 11:1–10
- Jordan AB, Robinson TN (2008) Children, television viewing, and weight status: summary and recommendations from an expert panel meeting. *Ann Am Acad Polit Social Sci* 119:119–132
- Kelly B, Halford JCG, Boyland EJ et al (2010) Television food advertising to children: a global perspective. *Am J Public Health* 100(9):1730–1736
- Lanfer A, Hebestreit A, Ahrens W et al (2011) Reproducibility of food consumption frequencies derived from the children's eating habits questionnaire used in the IDEFICS study. *Int J Obes* 35:S61–S68
- Laurson K, Eisenmann JC, Moore S (2008) Lack of association between television viewing, soft drinks, physical activity and body mass index in children. *Acta Paediatr* 97:795–800
- Lee JG, Messer LB (2010) Intake of sweet drinks and sweet treats versus reported and observed caries experience. *Eur Arch Paediatr Dent* 11(1):5–17
- Lissner L, Lanfer A, Gwozdz W et al (2012) Television habits in relation to overweight, diet and taste preferences in European children: the IDEFICS study. *Eur J Epidemiol*. doi:10.1007/s10654-012-9718-2
- Ludwig DS, Gortmaker SL (2004) Programming obesity in childhood. *Lancet* 364:226–227
- Ludwig DS, Peterson KE, Gortmaker SL (2001) Relation between consumption of sugar-sweetened drinks and childhood obesity: a prospective, observational analysis. *Lancet* 357:505–508
- Marmot M, Friel S, Bell R, Houweling TAJ, Taylor S, on behalf of the Commission on Social Determinants of Health (2008) Closing the gap in a generation: health equity through action on the social determinants of health. *Lancet* 372:1661–1669
- Matheson DM, Killen JD, Wang Y, Varady A, Robinson TN (2004) Children's food consumption during television viewing. *Am J Clin Nutr* 79:1088–1094
- McGowan L, Croker H, Wardle J, Cooke L (2012) Environmental and individual determinants of core and non-core food and drink intake in preschool-aged children in the United Kingdom. *Eur J Clin Nutr* 66:322–328
- Miller SA, Taveras EM, Rifas-Shiman SL, Gillman MW (2008) Association between television viewing and poor diet quality in young children. *Int J Pediatr Obes* 3:168–176
- MMS, Media Audience Measurement in Scandinavia [Mediamätning i Skandinavien] (2006) TV-viewing 2006. Annual Report
- Moreno LA, Rodríguez G (2007) Dietary risk factors for development of childhood obesity. *Curr Opin Clin Nutr* 10:336–341
- Mourao D, Bressan J, Campbell W, Mattes R (2007) Effects of food form on appetite and energy intake in lean and obese young adults. *Int J Obes* 31:1688–1695

- Pearson N, Ball K, Crawford D (2011) Mediators of longitudinal associations between television viewing and eating behaviours in adolescents. *Int J Behav Nutr Phys* 8:1–9
- Péneau S, Mekhmoukh A, Chapelot D et al (2009) Influence of environmental factors on food intake and choice of beverage during meals in teenagers: a laboratory study. *Br J Nutr* 102: 1854–1859
- Popkin BM (2010) Patterns of beverage use across the lifecycle. *Physiol Behav* 100:4–9
- Rey-López JP, Vicente-Rodríguez G, Biosca M, Moreno LA (2008) Sedentary behaviour and obesity development in children and adolescents. *Nutr Metab Cardiovas* 18:242–251
- Swedish Media Council (2010) Young children and media [Småungar & Medier 2010]. Stockholm
- Swedish National Food Administration (2007) Dietary habits and nutrient intake in Swedish children 4 year old and school children in grade 2 and 5. Riksmaten—children 2003. <http://www.slv.se/Group1/Food-and-Nutrition/Dietary-surveys1/Riksmaten—Children-2003-Summary/>. Accessed January 2011
- Swinburn B, Shelly A (2008) Effects of TV time and other sedentary pursuits. *Int J Obes* 32:S132–S136
- The Swedish Broadcasting Authority (2007) Media Development [Medieutveckling]
- Van Strien T, van Niekerk R, Ouwens MA (2009) Perceived parental food controlling practices are related to obesogenic or leptogenic child life style behaviors. *Appetite* 53:151–154
- Vartanian LR, Schwartz MB, Brownell KD (2007) Effects of soft drink consumption on nutrition and health: a systematic review and meta-analysis. *Am J Public Health* 97(4):667–675