Title: Contribution of home availability, parental child-feeding practices and health beliefs on children's sweets and salty snacks consumption in Europe: Feel4Diabetes-Study.

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ABSTRACT

Adoption of healthy dietary and snacking habits could support optimum physical and mental development in children as they define health in adulthood. This study assessed parameters associated with children's snacking such as food home availability, parenting practices, and parents' health beliefs. In this cross-sectional study 12, 039 children, 49.4% boys 5-12 years old, participating in the European Feel4Diabetes-Study were included. Children's weekly consumption of sweets and salty snacks, home availability of snacks, food parenting practices, and health beliefs were assessed via questionnaires. Logistic regression was applied to explore associations of a) home availability of snacks, b) food parenting practices (permissiveness and rewarding with snacks) and c) parent's opinions on deterministic health beliefs with children's consumption of sweets and salty snacks. Results showed that home availability (sweets: OR_{adj} 4.76, 95%CI: 4.32, 5.23; salty snacks: OR_{adj}: 6.56, 95%CI: 5.64, 7.61), allowing to consume (sweets: OR_{adj}: 3.29, 95%CI: 2.95, 3.67; salty snacks: OR_{adj}: 3.41, 95%CI: 2.98, 3.90) and rewarding with sweets/salty snacks (sweets: OR_{adj}: 2.69, 95%CI: 2.23, 3.24; salty snacks: OR_{adj}: 4.34, 95%CI: 3.57, 5.28) 'sometimes/or less frequently' compared to 'always/or often' were associated with lower weekly consumption of sweets and snacks. Parents' disagreement compared to agreement with deterministic health beliefs and inattentive eating were associated with lower consumption of salty snacks and sweets in children. Overall, the findings of this study indicate that attempts to promote healthy snacking habits in children should aim to improve parental dietary habits, food parenting practices, health beliefs, and reducing home availability of unhealthy foods and snacks.

INTRODUCTION

During childhood, it is well-known that dietary habits are important for children's development [1]. Over the last few decades, global modernization has resulted in the abandonment of wholesome traditional dietary patterns to the adoption of a Westernized diet including overconsumption of energy-dense, nutrient-poor foods such as sweets, salty snacks, sugar-sweetened beverages and fast foods, characterized for being high in sugars, fats, processed meats and salt [2]. According to data derived from round 4 (2015-2017) of the WHO European Childhood Obesity Surveillance Initiative (COSI) that involved 132, 489 children from 23 European countries, showed that 10% of children consumed sweet snacks or soft drinks daily and less than 50% fruits and vegetables [3]. These findings signify the urgent need to create healthier food and beverage environments within the family circle. Furthermore, adherence to this type of dietary pattern promotes inflammation triggering the premature onset of adult chronic diseases such as cardiovascular disease, diabetes and obesity [1]. Contrastingly, a healthy diet rich in fruits, vegetables, wholegrain cereals, nuts and fish, diminishes inflammation and lowers the risk for future chronic diseases [1]. Therefore, to ensure optimum health it is crucial that children adopt good dietary and snacking habits early in life to track into adulthood.

The home is the most widely studied setting for influences on children's dietary habits [4]. Parents play a primary role in influencing children's dietary habits [4]. Types of foods purchased, made available and accessible in the home including during family meals as well as their own dietary practices, health attitudes and beliefs are correlated with children's food intake [5; 6]. Parents' role as food-providers can impact children's intake of healthy foods such as fruits and vegetables or intake of unhealthy foods sweets and salty snacks through the foods they provide as well as the social environment they create [7; 8; 9; 10]. Furthermore, feeding practices employed by parents to influence children's food intake represent a large component of parental behaviours [4]. Child-feeding practice constructs including controlling and restricting/or forbidding sweets, snacks and junk foods can be counterproductive and inadvertently enhance children's intake of these foods, cause dysregulation of food intake and increase adiposity [11; 12; 13; 14]. Alternatively, fewer family rules concerning the type of foods eaten and rewarding using poor quality foods can contribute to a higher intake of fat and sugars, snacks along with fewer fruits and vegetables [10; 14]. Given that school-aged children consume two-thirds of their meals at home, environmental exposures external to the home, namely the

school setting, via availability of foods served in canteens, and peers, appear to play a minor role. Understanding the factors that shape food preferences in childhood are critical in identifying aspects that promote dietary habits beneficial to health and deter unhealthy ones. Furthermore, the impact of family on children's fruit and vegetable intake have been extensively studied [15; 16], however, less attention has been given to food parenting practices that are associated with snacking in European children [10]. Currently, there are no universal definitions for snacks, snacking or quantitative recommendations for weekly intake [17]. Most nutritional guidelines define snacking as calorie-dense foods high in sugar and fat with minimal nutritional content consumed in between habitual meals, providing fewer calories than in typical meals [17] and recommend 'limiting' intake of sweet and savoury snacks [17]. On the other hand, foods such as fruit, vegetables, nuts, milk and yogurt can be considered healthy snacks.

Therefore, the scope of this study was to explore parameters associated with children's intake of sweets and salty snacks, such as food home availability, food parenting practices and beliefs. We hypothesized that home availability of snacks and certain parental practices, such as permissiveness and the use of food as reward, and beliefs are positively associated with sweets and salty snacks intake in European school children. In terms of public health significance, this research suggests parenting practices and beliefs which could be discouraged when targeting to improve children's dietary behaviours as well as provide direction for health professionals working with families.

METHODS

Study design

The current study is a cross-sectional analysis of baseline data of all families (parents-children dyads) participating in the Feel4Diabetes study. This multi-national population study was a 2-year school and community–based intervention designed to prevent type 2 diabetes and promote healthy eating and physical activity in vulnerable families across six European countries: Bulgaria, Hungary, Belgium, Finland, Greece and Spain. In short, the Feel4Diabetes intervention promoted healthy eating and exercise by creating a supportive environment at three levels that included the home/family, school and municipalities. Recruitment was based on a standardized multi-sampling procedure and was undertaken in selected provinces of the

six European countries. Elementary schools were randomly selected and recruited within each area. The population of interest was 5-12-year-old children attending the first three grades of elementary school in the selected municipalities of each country. The participating families were either randomised to active intervention or control group. Details of the screening procedure and study methodology have been previously described [18]. For the purpose of the current study only baseline data involving all families have been analysed. The study protocol was approved by the Institutional Ethics committees in each of the six European countries and informed consent was obtained from all participating families. The work described has been conducted in accordance with the Declaration of Helsinki guidelines for experiments involving humans.

Study sample

In the Feel4Diabetes study, 12, 041 families (parent-dyads) were enrolled at baseline and data was assessed for 12, 039 children (age range 5-12 years old). Two children (4 and 16 years old) were excluded because their ages were not within the specified limits. Given that some families consisted of more than one child and to avoid duplication of parental information, one child per family was randomly selected. Data on children's sweets intake was complete for 11, 356 children and on salty snacks for 9, 928 children.

In the present study, we postulated that parenting is one of the main influential components of the home food and social environment that defines children's snacking patterns. Based on previous literature [19], we defined snacking as ready-to-eat, energy-dense, nutrient-poor foods consumed in between meals and less than four times per week as the recommended intake given the health benefits of reduced snacking in the prevention of obesity and dental caries in children [17]. According to food composition tables, snack foods were categorized as 'sweets' (such as chocolate bars, cookies or ice-cream) or 'salty snacks' (hamburgers, chips and pizza) based on raw materials used in their production (high content of sugars, fat, sodium) [20] and manufacturing process (frying, drying, baking, roasting) [21].

Demographic information

Demographic information that included country of residence, children's sex and age along with maternal educational level as an indicator of socio-economic status (SES) [22] was collected via a printed version of a standardized self-administered questionnaire that was distributed to children during school hours and completed by one parent at home. Parents were instructed to seal completed questionnaires in an envelope which was returned by children to the school and

collected by researchers on a weekly basis. Parents were provided with the contact details of researchers in order to clarify any queries that they might have during the study period.

Children's snacking habits

Children's snacking was evaluated using a self-administered validated Food Frequency Questionnaire developed for the Feel4Diabetes Study [23]. Data regarding children's snack intake was collected from one parent per family. Respondents were instructed to report children's usual frequency of sweets and salty snacks in terms of specified serving size. Conventional household measures were used to represent one standard portion size for each food item (1 cup, ½ cup) as well as commercial units (1 small hamburger, 1 small bag of chips, 1 slice of pizza, 1 small chocolate bar, ½ cup of ice-cream, cookies or sweets). Frequency of sweets and salty snacks intake was recorded as weekly or daily consumption of food items which were categorized as less than 1 time per week, 1 or 2 times per week, 3 or 4 times per week, 5 or 6 times per week, 1 or 2 times per day, 3 or 4 times per day, 5 or 6 times per day and more than 6 times per day. Parents' intake of snacks were evaluated using the same FFQ.

Home availability of salty snacks/and sweets, food parenting practices and health beliefs

Home availability of snacks, parental practices and beliefs were evaluated by the following questions.

Q1a) On a weekly basis, how often are sweets available at your home?

Q1b) On a weekly basis, how often are salty snacks available at your home?

Q2a) On a weekly basis, how often do you allow your child to eat sweets and/or salty snacks?

Q2b) On a weekly basis, how often do you reward your child with sweets or salty snacks?

Q3a) I believe that my health and well-being are determined by my destiny.

Q3b) I believe that people have little power on preventing disease

Q3c) I choose to eat the food that I like without thinking too much about it.

For Q1, response options were "always, often, sometimes, rarely and never", for Q2 options were "very often, often, sometimes, rarely and never, and for Q3 options were "strongly disagree, disagree, agree or strongly agree". Parents were instructed to tick one of the

responses. To maintain comparability across countries, all questionnaires were translated into six languages.

Anthropometry

During school hours, basic anthropometric measurements were conducted on a weekly basis in children by trained personnel. Bodyweight was recorded to the nearest 0.1 kg using digital scales (SECA, 813) with children standing without shoes in minimal clothing. Height was measured to the nearest 0.1 cm using a stadiometer (SECA 217) with children standing without shoes, their shoulders relaxed, arms hanging freely and head aligned in the Frankfort horizontal plane. Then, body mass index (BMI) was calculated using Quetelet's equation [weight (kg)/ height^2 (m^2)] and z-scores estimated as defined by the International Obesity Task Force (IOTF) sex and age-specific BMI cut-offs [24].

Sample size calculation/randomization

Screen time is one of the most important energy balance related behaviours (EBRBs) in children [25] and also one of the main objectives of the Feel4Diabetes Study was to reduce sedentary behaviour in school children [18]. In this context, a power calculation was performed using G*Power analysis [26] and estimated based on reducing sedentary behaviour in school children. It was estimated that a minimum sample of 600 families per treatment arm (i.e 1200 families in total) was required to achieve statistical power greater than 80% at a two-sided 5% significance level for reducing screen time by 0.2 hours/day in children within 8 months [18]. After including an attrition rate of 20%, a total sample of 9000 families would be required to be recruited in order to detect a statistically significant difference between the arms. Schools and families were randomized to the intervention and control arms within each municipality with a 1:1 allocation ratio after the completion of baseline assessments.

Statistical Analysis

Continuous variables were assessed for normality by applying the Kolmogorov-Smirnov test and the histogram plot. Demographic data are presented as means and standard deviations (SD) or as frequencies (n) and percentages (%) in the case of skewness. Response options for frequencies of sweets and salty snacks were dichotomized to ≤ and > 4 times per week [19]. Home availability responses were also recoded into two categories 'always/often' and 'sometimes/rarely/never'. Similarly, food parenting practices were merged to 'very often/often' and 'sometimes/rarely/never', and health beliefs 'strongly agree/agree' and

'strongly disagree/disagree'. In the univariate analysis, group differences were examined using Mann-Whitney or Pearson's Chi-Square test. Spearman's rank correlation coefficient rho (r) was used to determine correlations between parents and children's intake of sweets and salty snacks, where values of rho ranging from 0.10 to 0.39 indicate weak correlations and 0.40 to 0.69 moderate [27]. The association between home availability, parental practices/beliefs and children's intake of sweets and salty snacks were explored applying multivariate logistic regression. In analyses, children's sweets intake and salty snacks were defined as the dependent variables and food parenting practices and health beliefs as the independent. Given that children's age, sex, BMI z-score, country and maternal education are factors influencing children's food choice, these were entered as covariates in the adjusted regression model. How well the theoretical model fitted the data was measured using the Nagelkerke coefficient R^2. The degree of association is expressed as odds ratio (OR) and 95% confidence interval (CI). Exploratory to this study, we repeated the regression analysis stratified by age group (5.0-9.0 years vs 10.0-12.5 years) according to the WHO definition for teenagers (10-19 years old) [28], given that this can be an influencing factor in children's eating habits [29]. All p-values reported are two-tailed and statistical significance was set at alpha < 0.05. SPSS version 20 (IBM, Chicago, IL) was employed for all statistical analyses.

RESULTS

Demographic details of the population are presented in Table 1. From the initial sample at baseline, mean age of children was 8.20 (S.D 0.99) years with 49.35% (5942/12,039) boys; 85.20% (10,255/12,039) of respondents were mothers and 10.17% fathers (1224/12039) with 66.56% (8014/12,039) of mothers completing tertiary education and 52.30% (6295/12039) of fathers.

Regarding intake of sweets and salty snacks, frequency (%) of children and parents consuming these foods ≤ 4 times per week is presented in Table 2. Sex differences in sweets intake were observed in children, with more girls consuming sweets ≤ 4 times per week than boys (girls vs boys: 56.41% vs 53.85%; $P = 0.01$). Comparison of parents' versus children's sweets and salty snacks intake showed moderate correlations (sweets: $r = 0.451$, $P < 0.001$; salty snacks $r = 0.531$, $P < 0.001$).

The relationship between home availability, food parenting practices and health beliefs, and children's intake of sweets and salty snacks less/equal to or more than 4 times/week is shown in Table 3. The univariate analysis revealed that for children consuming sweets and salty snacks

≤ 4 times/week there were substantial differences in home availability (P < 0.001), food parental practices (P < 0.001) and beliefs (P < 0.001). It appears that when sweets and salty snacks were available in the home 'sometimes/rarely', children were more likely to consume these foods ≤ 4 times/week as compared to these foods being available 'always/often'. The same trend was observed for food parenting practices such as 'allowing to eat these foods' and 'rewarding with sweets and salty snacks. With respect to health beliefs, parents who 'strongly disagree/disagree' that 'health was determined by destiny', 'I have little control on preventing disease' and 'I choose to eat food I like without thinking', more children consumed sweets and salty snacks ≤ 4 times/week as compared to those whose parents 'strongly agree/agree' to these questions.

Applying logistic regression to explore the association between home availability, food parenting practices and health beliefs, and children's intake of sweets and salty snacks yielded statistical significance for all factors (Table 4). In the crude analysis, a positive association was observed between home availability of sweets (OR: 5.82, 95%CI: 5.33, 6.35), allowing to eat sweets (OR: 3.73, 95%CI: 3.38, 4.11) and being rewarded with sweets (OR: 3.30, 95%CI: 2.78, 3.92) 'sometimes/rarely' and children's intake of sweets ≤ 4 times/week, as compared to 'always/often'. After adjusting for children's age, sex, BMI, country of residence and maternal education level, home availability of sweets at a frequency of 'sometimes/rarely' was associated with children being 4.76 times more likely to consume sweets ≤ 4 times/week than those when sweets were available 'always/often' (OR_{adj} 4.76, 95%CI: 4.32, 5.23); whereas 3.29 times more likely when allowing to eat sweets 'sometimes/rarely' (OR_{adj}: 3.29, 95%CI: 2.95, 3.67) and 2.69 times more likely when rewarding with sweets at the same frequency (OR_{adj}: 2.69, 95%CI: 2.23, 3.24). The degree of association as reflected by the Nagelkerke coefficient R^2 indicated substantial influence of home availability, food parenting practices including allowing to consume and rewarding with sweets (29.4%, 23.1%, and 19.1% respectively). Regarding parental health beliefs, in the adjusted analysis, no significant associations were observed for parents who 'strongly disagree/disagree' that their 'health is determined by destiny', 'I have little power preventing disease' and children's sweets intake compared to parents who 'strongly agree/agree' to these statements. In contrast, for parents who 'strongly disagree/disagree' with 'I choose to eat food I like without thinking', children were 1.61 times more likely to consume sweets ≤ 4 times/week than those parents who 'strongly agree/agree' (OR_{adj}: 1.61, 95%CI: 1.45, 1.80). Comparable findings were observed in the crude and adjusted regression analysis for children's intake of salty snacks, although to a greater extent than sweets intake as reflected by the size of the odds ratio. Home availability of salty snacks, allowing to

consume and rewarding with salty snacks 'sometimes/rarely' was associated with children consuming these foods ≤ 4 times/week compared to 'always/often' [(OR_{adj}: 6.56, 95%CI: 5.64, 7.61); (OR_{adj}: 3.41, 95%CI: 2.98, 3.90); (OR_{adj}: 4.34, 95%CI: 3.57, 5.28) respectively]. With respect to parental health beliefs, children from parents who 'strongly disagree/disagree' that 'my health depends on destiny', 'I have little power preventing disease' and 'I choose to eat food I like without thinking', were twice as likely to consume salty snacks ≤ 4 times/week compared to children whose parents 'strongly agree/agree' with the above statements [(OR_{adj}: 2.08, 95%CI: 1.74, 2.49); (OR_{adj}: 1.86, 95%CI: 1.58, 2.20); (OR_{adj}: 2.65, 95%CI: 2.26, 3.11), respectively].

Furthermore, the same trend was observed for children's sweet and salty snacks intake vs home availability and parenting practices in the regression analysis stratified by age group (5.0-9.0 years vs 10.0-12.5 years) (Supplemental Table S1). However, regarding health belief 'parents disagreeing with my health is determined by destiny' which was borderline significant in the original adjusted analysis ($P_{adj} = 0.05$), became significant for sweet intake < 4 times/week in the 5.0-9.0 year olds ($P_{adj} = 0.03$) and non-significant for salty snack intake < 4 times/week in 10.0-12.5 year olds ($P_{adj} = 0.35$). Likewise, for 'I have little power preventing disease' was non-significant in the original analysis for sweet intake ($P_{adj} = 0.80$) but significant in the 10-12.5 years age group $P_{adj} = 0.01$). On the other hand, results remained significant in both age groups for "I choose to eat food I like without thinking' which is consistent with the original analysis.

DISCUSSION

The present study aimed to determine factors of the home environment, food parenting practices and health beliefs that associate with sweets and salty snack intake in children. Understanding how children's food consumption choices are developed will aid in the adoption of good dietary habits in children which have potential lifetime health benefits. The findings of this study highlight that home availability of sweets and salty snacks 'sometimes or less frequently' compared to 'always or often', was associated with lower weekly intake of these foods in children. The same trend was observed when parents 'allowed' children to consume sweets and salty snacks 'sometimes or rarely' and 'rewarded' them with these foods at the same frequency as compared to 'very often'. Interestingly, stratification of data according to age group did not alter associations between parenting practices, home availability and children's weekly intake of sweets and salty snacks. In reference to health beliefs, parents who 'disagree'

that 'my health is determined by destiny', 'I have little power preventing disease' and 'I choose to eat the food I like without thinking' were related to lower intake of sweets and salty snacks in children as compared to those whose parents 'agree' to the above statements. Notably, differences were observed in associations between health beliefs and snacking in the 10-12.5 year age group. This data supports our primary hypothesis and is promising because it suggests that by modifying parental behaviour and rectifying false health beliefs it is possible to discourage snacking in children. Therefore, our study is important and useful as a practical guide for health professionals on strategies that could hinder unhealthy snacking in European children and closes the gaps in the literature [7; 30; 31; 32].

Various factors might explain children's reduced intake of sweets and salty snacks when snacks were available in the home 'sometimes/rarely' as compared to always/often. Aspects of the home environment can contribute to children's dietary behaviour especially in children within the 5-12 years age group. The family is the major provider of food and therefore parents influence availability, accessibility, foods purchased and served during family mealtimes and function as important role models [6]. Furthermore, parents provide experiences with food and children imitate parental dietary behaviours, food-related attitudes including preferences. In addition, we found moderate correlations between parents' and children's intake of sweets and salty snacks which reflect a significant modelling effect via direct observation of parental behaviour and through increased taste exposure [33]. This is in line with prior studies documenting resemblance between parents' and children's intake of sweets, salty snacks and fat across Europe [7; 31; 32; 34]. Therefore, in the home setting, early repeated exposure of children to foods high in energy, sugar and fat might enhance children's liking and prioritize preference and selection for them. [11; 33; 35]. In this context, it is plausible that by decreasing frequency of exposure to poor quality foods in the home would inevitably result in decreased consumption by children, as was demonstrated in our study. Overall, our observations highlight the need for improving parents' food preferences to enhance positive changes in children.

Another intriguing observation we noted was that parents 'disagreeing' that 'my health is related to destiny', 'I have little power over disease' and 'I choose to eat food I like without thinking', was associated with children consuming fewer sweets and salty snacks. It appears

that parents' health-related beliefs were transferred to offspring. Previous research has demonstrated that a positive, health-conscious family environment can establish and enhance adoption of beneficial health behaviours through role modelling, provision of healthy foods, along with encouragement and support for practising healthy dietary behaviours by children [4]. Hoffman et al., in a study of 7-11-year-old schoolchildren found that apart from parental feeding practices, parents' health-related attitudes, goals and motivations influenced their children's food intake [36]. In children whose mothers emphasized health-related goals, children consumed more healthy foods and less unhealthy [36]. Similarly, low levels of nutrition knowledge and food-related health attitudes in mothers along with less knowledge regarding snack recommendations were related to poor diet quality and increased snacking in pre-schoolers [5; 32]. On the other hand, intriguingly, we noted age differences in associations between health beliefs and children's snacking, predominately in the 10-12.5 year age group, most likely related to cognitive development, health and nutrition literacy in adolescents [37].

These observations posit that educating parents the importance of diet in relation to health and addressing unhealthy parental beliefs might be a cost-effective, feasible and practical means of improving dietary habits of the entire family and ultimately overall health of the population. Nutrition education would provide parents with the skills to make informed choices about foods that their family consume and support autonomy because such information would provide direction for dietary behaviours.

With regards to food parenting practices such as 'permissiveness' and rewarding with snacks, we showed that rewarding or allowing children to snack sometimes or rarely resulted in lower weekly intake of sweets and salty snacks which is supported by the literature [38; 39; 40]. Wang et al., demonstrated that using food as a reward was associated with higher odds of children snacking more than once daily (OR, 1.43; 95%CI 1.01 to 2.04) [40]. Sleddens et al., reported that instrumental feeding (or rewarding) practised by parents' increased snacking behaviour in 6-7-year-old children [39]. On the same note, Hennessy et al., showed that a permissive feeding style (lack of control and indulging to children's requests) was associated with increased intake of low nutrient dense foods including sweets and salty snacks in 9-year-old children [38]. Although WHO dietary recommendations advocate reduction in intake of energy-dense high fat and sugary foods [41], using highly palatable foods (for example sweets) as a reward, this is common practice by parents which can promote children's overconsumption

of low-nutrient energy dense foods by diminishing the extent that children rely on their own hunger and satiety cues to initiate and terminate eating [13]. Collectively, the aforementioned studies reinforce our observations that allowing or rewarding children by sweets and salty snacks 'sometimes' by parents might decrease consumption of these foods. Thus, suggesting that health professionals should be aware of the different parental child-feeding practices and styles when evaluating children's diet quality and perhaps focus on interventions modifying parental behaviour that will encourage healthy eating habits in children and discourage unhealthy.

Strengths and limitations

The findings of the current study should be interpreted in light of several considerations. Novel to this study was the exploration of associations between health beliefs and snacking patterns in children. To our knowledge, most studies have focused on children's intake of healthy foods such as fruits and vegetables and more research is needed to determine factors that reduce intake of unhealthy foods and snacking [42]. Hence, the development of intervention strategies to improve children's dietary patterns is likely to be more successful if supported by an understanding not only of healthy but also unhealthy food intake. Furthermore, given the lack of a uniform definition for snacking as well as snack-specific dietary recommendations for children available in the WHO European region [17], our study could be useful in setting the foundations for guidelines on how parents should incorporate snacks into children's healthy diet, and parenting practices that could effectively modify intake of unhealthy snacks. Additional strong points of the present work are the standard methods and procedures used by all participating countries to record dietary intake, food parenting practices and home availability along with the large sample size and homogeneity among children with respect to age.

A possible limitation is the cross-sectional design which does not allow conclusions to be drawn about causal relationships. The use of parental reports to capture children's sweet and salty snacks intake may evoke a source of bias due to recall error [43]. Moreover, parents may not be aware of foods purchased and consumed by children outside of the home and during school hours [43]. Although the use of FFQs in collecting dietary data is common practice in nutritional epidemiology, they are subject to over-reporting of healthy foods and under-reporting of non-healthy due to social desirability [44]. Nevertheless, FFQs are cost-effective and appropriate for large epidemiological cohort studies to assess habitual intake of populations [44] and we

employed a concise, simple FFQ of low-respondent burden. Another drawback, questionnaire response options ‘always, often, sometimes, rarely and never’ were not defined to respondents which could lead to inaccuracy in results. One more domain worth further investigation, sex differences in parenting styles were not explored in the present study. Previous research has identified fathers as predictors of children’s unhealthy food intake [31; 45].

CONCLUSION

The family unit is an important social context where children learn and adopt dietary behaviours that persist throughout the lifespan. During childhood, parents play a prime role as health promoters, role models, and educators in the lives of their children, influencing food perceptions and choices including snacks. This study demonstrated that home availability of sweets and salty snacks, permissiveness and rewarding with these foods ‘sometimes or less frequently’ compared to ’always/or often’ were associated with lower weekly intake of snacks in children. These findings indicate that attempts to promote healthy snacking habits in school-aged children should target improving parental dietary habits, food parenting practices, health beliefs and reducing home availability of unhealthy foods such as sweets and salty snacks which could bring about adoption of healthy eating practices in children that track into adulthood.

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552

553

554 Table 1 Demographic characteristics of population per total sample of families and by children's sex

		Children's sex		
	Total (N= 12, 039)	**Boys (n = 5942)**	**Girls (n = 6097)**	
Characteristic	**% (n)**	**% (n)**	**% (n)**	**P**
Country				
Belgium	14.84% (1787/12, 039)	14.99% (891/5942)	14.66% (894/6097)	**0.02**[a]
Finland	12.49% (1504, 12,039)	12.72% (756/5942)	12.27% (748/6097)	
Greece	18.90% (2283/12, 039)	18.38% (1092/5942)	19.53% (1191/6097)	
Hungary	15.18% (1828/12, 039)	14.69% (873/5942)	15.66% (955/6097)	
Bulgaria	24.68% (2972/12, 039)	24.40% (1450/5942)	24.96% (1522/6097)	
Spain	13.84% (1667/12, 039)	14.81% (880/5942)	12.91% (787/6097)	
Children details				
Age*	8.20 (0.99)	8.22 (1.00)	8.19 (0.99)	0.05[b]
SES status				
Maternal education level >12 years	66.56% (8014/12,039)	71.97% (3975/5523)	70.95% (4039/5693)	0.23[a]

555 In bold statistically significant P-values

556 *Data are presented as mean (SD)

557 [a] P-value estimated using Chi-Square test; [b] Mann-Whitney test

558 P-value significant at 5%.

559 ** Data for mothers and fathers are not shown but described in text.

560

561 Table 2 Percentage of children and parents consuming sweets and salty snacks ≤ 4 times per week

		Children		
Food group	**Total % (n)**	**Boys % (n)**	**Girls % (n)**	**P[a]**
Children				
Sweet intake (%) ≤4x/week	55.16% (6264/11,356)	53.87% (3009/5586)	56.41% (3255/5770)	**0.01**
Salty snacks ≤4x/week	87.11% (8649/9928)	86.74% (4206/4849)	87.48% (4443/5079)	0.27
Parents				
Sweets ≤4x/week	66.13% (7474/11,302)	65.29% (3633/5564)	66.94% (3841/5738)	0.06
Salty snacks ≤4x/week	92.53% (10281/11,111)	92.54% (5062/5470)	92.52% (5219/5641)	0.96

562 Data shown for frequency of sweets and salty snacks intake ≤ 4x/week only

563 In bold statistically significant P-values

564 Key: ≤ 4x/week – less than or equal to 4 times per week.

565 [a] P-value derived from Chi Square test comparing differences in children's frequency of snacks and
566 sweets intake ≤ 4x/week and > 4x/week.

567

568

569 Table 3 Relationship between home availability, food parenting practices and health beliefs, and
570 children's intake of sweets and salty snacks ≤ 4 times per week

		Children's intake			
		Sweets		**Salty snacks**	
		≤ 4x/week		**≤ 4x/week**	
Question from questionnaire	**Response**	% (n)	P[a]	% (n)	P[a]
Home Availability					
Sweets and salty snacks	Always/often	43.42% (2675/6161)	**< 0.001**	27.38% (2337/8536)	**< 0.001**
	Sometimes/rarely/never	56.58% (3486/6161)		72.62% (6199/8536)	
Parental Practices					
Allow child to eat sweets and/ or salty snacks	Very often/often	11.40% (702/6160)	**< 0.001**	18.09% (1541/8520)	**< 0.001**
	Sometimes/rarely/never	88.60% (5458/6160)		81.91% (6979/8520)	
Reward child with sweets or salty snacks	Very often/often	3.11% (192/6166)	**< 0.001**	4.12% (351/8524)	**< 0.001**
	Sometimes/rarely/never	96.89% (5974/6166)		95.88% (8173/8524)	
Health Beliefs					
Health is determined by destiny	Strongly agree/agree	9.43% (573/6079)	**< 0.001**	9.89% (834/8430)	**< 0.001**
	Strongly disagree/disagree	68.81% (4183/6079)		67.44% (5685/8430)	
I have little power preventing disease	Strongly agree/agree	13.60% (830/6101)	**< 0.001**	13.96% (1178/8436)	**< 0.001**
	Strongly disagree/disagree	72.09% (4398/6101)		70.40% (5939/8436)	
I choose to eat foods I like without thinking	Strongly agree/agree	16.40% (1000/ 6097)	**< 0.001**	18.59% (1568/8435)	**< 0.001**
	Strongly disagree/disagree	63.98% (3901/6097)		62.17% (5244/8435)	

571 Data shown for frequency of sweets and snack intake ≤ 4x/week only
572 In bold statistically significant P-values
573 Key: ≤ 4x/week – less than or equal to 4 times per week
574 [a] P-value derived from Chi-Square test comparing differences in children's frequency of snacks and
575 sweets intake ≤ 4x/week and > 4x/week.
576
577

578 Table 4 Association between home availability, food parenting practices, beliefs and children's intake
579 of sweets and salty snacks ≤ 4 times per week from the crude and adjusted logistic regression model

	Children's sweets intake ≤ 4 times per week					
	Crude			Adjusted		
Question/Response	**R^2**	**OR (95%CI)**	**P**	**R^2**	**OR (95%CI)**	**P_{adj}**
Home availability of sweets						
Always/often	Ref*					
Sometimes/rarely/never	19.7%	5.82(5.33, 6.35)	< **0.001**	29.4%	4.76(4.32, 5.23)	< **0.001**
Allow to eat sweets						
Very often/often	Ref					
Sometimes/rarely/never	8.6%	3.73(3.38, 4.11)	< **0.001**	23.1%	3.29(2.95, 3.67)	< **0.001**
Reward with sweets						
Very often/often	Ref					
Sometimes/rarely/never	2.5%	3.30(2.78, 3.92)	< **0.001**	19.1%	2.69(2.23, 3.24)	< **0.001**
Health is determined by destiny						
Strongly agree/agree	Ref					
Strongly disagree /disagree	0.9%	1.55(1.37, 1.75)	< **0.001**	18.2%	1.14(0.99, 1.30)	0.054
Little power preventing disease						
Strongly agree/agree	Ref					
Strongly disagree /disagree	0.4%	1.25(1.12, 1.39)	< **0.001**	18.1%	1.01(0.90,1.14)	0.804
Choose to eat food I like without thinking						
Strongly agree/agree	Ref					
Strongly disagree /disagree	1.2%	1.64(1.49, 1.81)	< **0.001**	18.9%	1.61(1.45, 1.80)	< **0.001**
	Children's salty snacks intake ≤ 4 times per week					
	Crude			**Adjusted**		
	R^2	**OR (95%CI)**	**P**	**R^2**	**OR (95%CI)**	**P_{adj}**
Home availability of salty snacks						
Always/often	Ref					
Sometimes/rarely/never	13.9%	5.58(4.91, 6.35)	< **0.001**	29.5%	6.56(5.64, 7.61)	< **0.001**
Allow to eat salty snacks						
Very often/often	Ref					
Sometimes/rarely/never	12.7%	5.34(4.71, 6.05)	< **0.001**	23.7%	3.41(2.98, 3.90)	< **0.001**
Reward with salty snacks						
Very often/often	RRef					
Sometimes/rarely/never	7.7%	6.58(5.54, 7.81)	< **0.001**	21.8%	4.34(3.57, 5.28)	< **0.001**
Health is determined by destiny						
Strongly agree/agree	Ref					
Strongly disagree/disagree	4.0%	3.07(2.61, 3.61)	< **0.001**	19.3%	2.08(1.74, 2.49)	< **0.001**
Little power preventing disease						

Strongly agree/agree	Ref					
Strongly disagree/disagree	3.9%	2.66(2.29, 3.09)	< **0.001**	19.3%	1.86(1.58, 2.20)	< **0.001**
Choose to eat food I like without thinking						
Strongly agree/agree	Ref					
Strongly disagree/disagree	4.4%	2.83(2.45, 3.26)	< **0.001**	20.8%	2.65(2.26, 3.11)	< **0.001**

580 OR- Odds Ratio; 95%CI- 95% Confidence Interval; R^2 - Nagelkerke coefficient R^2

581 In bold statistically significant P-values

582 Dependent variables children's frequency of intake of sweets and salty snacks as the dichotomous

583 variables (0 = > 4 times/week, 1= ≤ 4 times/week).

584 P- P-value derived from the crude logistic regression analysis

585 P_{adj}- P-value from the regression model adjusted for children's age, sex, BMI (z-score), country and

586 maternal education.

587 *Reference category

588