Parental practices and children's lifestyle correlates of childhood overweight/ obesity in Europe: the Feel4Diabetes Study

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Abstract

Background: Parental influences on children's eating and physical activity (PA) and consequently on their weight are fundamental. The purpose of this paper is to identify the predominant correlates of childhood overweight/obesity among a variety of parental practices and children's lifestyle indices, in a large sample of children in Europe.

Methodology: High risk low SES families were recruited through schools, located in 6 European countries (Belgium, Finland, Greece, Spain, Bulgaria, Hungary). 7397 children 4-12 years old and their parents were selected using the FINDRISC-questionnaire. Parental practices assessed: parental role modeling, permissiveness, reward. Children's dietary intake and lifestyle behaviors were assessed through parent-reported questionnaires.

Results: Regarding parental practices it was revealed that being sometimes (OR, 95%C.I.1.26(1.10-1.43)) or rarely (OR, 95%C.I.1.43(1.21-1.69)) physically active with the child was associated with greater overweight/obesity risk, while rare permission of computer/mobile/tablet (OR, 95%C.I.0.81(0.67-0.98)) and sometimes

(OR, 95%C.I.0.77(0.68-0.88)) or rare (OR, 95%C.I.0.77(0.66-0.91)) reward with PA were associated with lower risk. Regarding children's lifestyle factors, consuming >3 cups/week fresh fruit juices (OR, 95%C.I.1.28(1.13-1.45)), skipping breakfast (OR, 95%C.I.1.37(1.17-1.61)), absence of 1h daily PA (OR, 95%C.I.1.40(1.24-1.58)) and increased daily screen time (ST) (OR, 95%C.I.1.23(1.09-1.39)) were associated with greater overweight/obesity risk. All the variables were adjusted for maternal education, child's sex and age.

Principal conclusions: These results underline the importance of parents' inclusion as an integral component of any health promotion and obesity prevention program in children as parental positive influence and support on children's eating, PA and ST behaviors could have a considerable impact on their weight status.

Keypoints/ highlights of the manuscript:

- Being physically active with the child is associated with reduced obesity risk
- Omission of breakfast and high fresh fruit juices consumption may increase childhood obesity risk
- Parental control on children's screen time is linked with lower childhood obesity risk

Introduction

Obesity is one of the most pressing public health challenges globally[(1)]. It is described as an excess of adipose tissue or body fat and is caused by a lasting positive energy imbalance[(1)]. In 2010 the number of obese children was 15 million while in 2016 this number had increased to over 340 million[(2)]. The prevalence of obesity in children and adolescents aged 2-19 years in 2017-2020 was 19.7% and affected about 14.7 million. The prevalence of obesity was 12.7% among 2-5 year olds, 20.7% among 6-11 year olds and 22.2% among 12-19 year olds[(3)]. Unmonitored childhood obesity, is associated with a greater risk of adult obesity and an earlier onset of chronic disorders, such as metabolic syndrome, cardiovascular disease, diabetes mellitus and hypertension[(1,4)]. In addition to the physical consequences of childhood obesity, psychological issues have been also documented, including high levels of depression,

anxiety and low level of self-esteem[5]. Obese children experience weight-related stigmatization, discrimination and social isolation that impact negatively on their psychological well-being and their quality of life[6].

Childhood obesity is incredibly complex and reflects numerous systems that impact a child's health, such as genetics and embryonic development, environmental/societal risk factors (including SES, access to facilities/ food, school policies, neighborhood safety, food insecurity) and behavioral risk factors. Childhood obesity is even more alarming, in vulnerable subpopulations (e.g. families with a low socio-economic status (SES)) where unhealthy dietary patterns, higher levels of physical inactivity and sedentary behavior have been reported and consequently there is a higher overweight/obesity prevalence compared to the general population[7-12]. Except from the living environment, home environment and family feeding behaviors play important role in child's eating behaviors and weight status especially during first years of life. Family is the first and most important social context where children adopt and gradually develop eating behaviors[13] and subsequently they shape their food choices, lifestyle quality and weight status[14]. Several studies have evaluated the predictive role of parental practices (restriction, reward, role modeling)[15-18] on children's' lifestyle behaviors [19-21] and on their weight status[22-24]. Nevertheless, the current available data about the associations of parental practices with children's lifestyle behaviors are not fully consistent as it is clearly stated in a recent systematic review[25]. In order to develop preventative measures, a source of childhood overweight/obesity in parental practices needs to be identified, as the majority of previous research is inconsistent, with no direct correlation between parent influence and childhood obesity[25]. Moreover previous studies have mainly focused on the general population, as there are no data available for families at high risk for chronic

diseases, such as Type 2 Diabetes (T2D)[25]. More specifically, studies among families with higher SES outnumber those among lower SES and most high-quality studies among parents with lower SES have investigated feeding styles instead of general parental practices, so direct comparisons are difficult to make[9,10].

To our knowledge, this study is the first to assess the interaction of parental practices and children's lifestyle indices and their association with childhood overweight/obesity risk in families at high risk for T2D. We aim to address the above literature gaps and identify the most dominant parental practices and children's lifestyle behaviors of overweight and obesity in a large sample of children 4-12 years old from the Feel4Diabetes study conducted in low SES families in Europe.

Methods

Study design and sampling procedure

The current study considered the baseline data of the Feel4Diabetes-study, (National Clinical Trial number, NCT 02393872) which was a large school and community-based intervention. The Feel4Diabetes study, which had a cluster-randomized design, aimed to promote a healthy lifestyle among school children and their parents including healthy eating and enhancing physical activities. It was intending to alleviate the negative outcomes of obesity and obesity-related metabolic risk factors in low SES families in Europe.

The recruitment of the population included families from "vulnerable" social groups from 6 European countries. "Vulnerable" groups are defined as the population from low/middle income countries (Bulgaria, Hungary), low socio-economic areas in high income countries (Belgium, Finland) and countries under austerity measures (Greece, Spain). In Bulgaria and Hungary, all areas within the selected provinces were considered "vulnerable" and therefore eligible to participate in the Feel4Diabetes-

program. In Greece, Spain, Finland and Belgium, the municipalities/school districts/other equivalent units in the selected provinces were grouped in tertiles according to socio-economic indices retrieved from official resources and authorities (e.g. in Greece information was retrieved from the Hellenic Statistical Authority) and consequently “vulnerable” areas were randomly selected only from the tertile with the lowest education level or the highest unemployment rate. Then, in all countries, after the necessary approvals were obtained from the local authorities (Ethics Committees, Ministries, Municipalities, etc.) lists were created based on the schools located in the selected "vulnerable" areas and primary schools were randomly selected and recruited from each area until the recruitment goal was achieved. This sample included children from the first three grades of compulsory education[26]. We focused or efforts on low SES areas as children of low SES families are at disproportionately higher risk of being obese compared to their more affluent peers[27]. There is a growing body of literature suggesting that the association between SES and development of childhood obesity is growing in strength with an ever widening gap in obesity rates between low and high SES groups[27,28]. In many developed countries, the rates of childhood obesity have stabilized or even been reduced in higher SES groups, whereas lower SES groups have generally seen a steady increase[1-3]. This clearly highlights the role of low SES as a critical risk factor and for this reason we wanted to emphasize our research on low SES families.

The identification of the “high-risk families” of developing T2D was made by using the FINDRISC questionnaire (Finnish Diabetes Risk Score (FINDRISC) a prediction tool that assesses the risk of developing T2D) [29]. FINDRISC requires no laboratory testing and has been validated in multiple populations. It uses age, BMI, physical activity, vegetable & fruit intake, medical treatment of hypertension, history of

hyperglycemia and family history to determine risk of developing diabetes[29]. A family was regarded as "high-risk" if at least one parent fulfilled the country specific cut-off point for FINDRISC that indicated increased T2D risk (that was set as a FINDRISC score ≥ 9). In the present study we included in the analysis children and parents only from the "high-risk families" group. The final sample was 7397 children and 14794 parents, as for every children information was collected by both parents. The design of the study started in 2015, the recruitment began in January 2016 and the initial measurements were carried out between April-June while in three countries (Finland, Hungary, Bulgaria) the measurements were carried out during August-September 2016[26].

Ethical approvals and consent forms

The Feel4Diabetes study complies with all the conditions set out in the Helsinki Declaration and the Council of Europe conventions on human rights and biomedicine. All countries participating in this study, before the program started, received approval from the relevant ethics committees and local authorities. Prior to entering the study, all parents/guardians independently completed and signed a specific consent form. More details regarding the approvals received by each country can be found elsewhere[26].

Measurements

Trained research assistants have conducted all the measurements using standardized procedures and calibrated portable equipment.

Anthropometry

All anthropometric measurements were taken twice by dyads of researchers. A third measurement was also taken, where the previous two measurements differed >100g for weight and >1cm for height. For the height measurement the participant had to

remove the shoes and any other clothing or object that could impede the procedure. The nearest tenth of a centimetre (i.e. 0.1 cm) was recorded using telescopic stadiometers: SECA 213, SECA 214, SECA 217 and SECA 225. For the weight measurement the participant had to wear light clothing and remove the shoes. The nearest 0.1 kg was recorded using electronic weight scales: SECA 813 and SECA 877. For children, the BMI reference values that are used for body weight categorization and the diagnosis of overweight and obesity are different from those of adults and vary according to age and biological sex[30].

Diet

Child's food and beverage intake was reported by the parent and measured using the question: "how often do you and your child usually consume the following foods and drinks?", which they could answer by choosing one of the following eight options: on a weekly (less than 1, 1–2, 3–4, or 5–6 times per week) or daily basis (1–2, 3–4, 5–6, and more than 6 times per day). Beverages assessed for children were water (one glass or one cup), fruit juices (freshly squeezed or prepacked without sugar), soft drinks and fruit juices containing sugar, and soft drinks without sugar. Foods assessed were fruits and berries (fresh or frozen), fruits and berries (canned), vegetables, sweets, and salty snacks and fast food (ICC = 0.633, (0.371–0.822)[31].

Physical activity and sedentary behavior

In the questionnaire for adults, physical activity (PA) questions were based on the short form of the International Physical Activity Questionnaire[32]. More detailed questions on sedentary behaviors were added, including time spending sitting, time spending on TV viewing, using a computer/laptop/smartphone on weekdays and

weekend days, questions regarding social support, perceptions and attitudes for PA, environmental determinants and knowledge about PA recommendations for adults. The PA questionnaire for children was initially based on a relevant questionnaire that was developed for the needs of a previous multi-component, kindergarten-based, family-involved intervention (Toy-box study)[33] with major modifications in order to be applicable in school-aged children. The same principles were used, as in the case of the adults' questionnaire.

Parenting Practices

The questionnaire on parenting practices contained a variety of factors, derived from previously validated questionnaires including the Parental Support for Physical Activity Scale (test-retest reliability: ICC = 0.81)[34] [child's PA index, parental PA, parental support etc), the Parenting Strategies for Eating and Activity Scale[35] (including 26 questions about restriction, responsibility, monitoring: I limit the amount of time my child plays video games or is on the computer; I limit the amount of time my child plays video games or is on the computer; How often do you allow your child to watch TV or DVD or allow the use of computer, mobile or tablet?; How often do you allow the consumption of sweets and/or salty snacks?; How often do you watch TV with your child?; How often are you physically active with your child?; How often do you consume fruit with your child? etc) and the Parental Feeding Style Questionnaire (test-retest reliability: ICC = 0.76–0.83)[36] (including questions about instrumental feeding, emotional feeding, control and encouragement: I reward my child with sweets, salty snacks or fast food when she/he is well behaved, I reward my child with PA when she/he is well behaved, I reward my child with TV when she/he is well behaved etc). In the present questionnaire, parenting practices were specifically related to fruit consumption, PA, ST and were therefore these variables

were used in the analyses. There were three question categories: 1. Parents role modeling of PA and healthy eating habits 2. Parents permission of sweet consumption, TV and DVD watching, use of computer, mobile or tablet 3. Parents reward with TV, PA or with sweets, salty snacks or fast food. All items were assessed on a five-point Likert scale: (1)Never, (2)Mostly Not, (3)Sometimes/Sometimes Not, (4)Mostly, (5)Always. For some questions, 'Not Applicable' was an alternative answer category, for which the results were set as missing values. For all variables, a higher mean value represents a higher form of the variable.

Statistical analysis

Continuous variables are presented as means ± standard deviations and categorical values as proportions (%). The normality of distribution of variables was determined by the Kolmogorov – Smirnov test and histograms.

Multinomial logistic regression was employed to examine the univariate associations between several parental practices and lifestyle indices (independent variables) and childhood overweight/ obesity (dependent variable). Multinomial logistic regression was also performed to assess the multivariate associations of those parental practices and lifestyle indices that were found to be associated with the dependent variables at the univariate level, with the risk of childhood overweight/ obesity, also adjusted for children's age and sex and for maternal education. Statistical analysis was performed using the Statistical Package for Social Sciences (SPSS Inc., Chicago, IL, USA), version 25.0. The level of statistical significance was set at $p < 0.05$.

Results

Table 1 displays the main characteristics of the 7397 children enrolled of whom 50.8% were girls. 10.8% were 4-7 years old, 65.6% were 7-9 years old and 23.5% were 9-12 years old. In total, the 17.2% of all children were overweight and the 7.1% were obese.

Table 2 presents the univariate associations of parental practices and children's lifestyle indices with the risk of overweight/obesity in childhood. The risk was greater if parents were sometimes (OR, 95% C.I.1.20(1.09-1.32)) or rarely/never (OR, 95% C.I.1.46(1.30-1.64)) physically active with the child in comparison with a higher frequency while watching TV sometimes (OR, 95% C.I. 0.86(0.78-0.94)) or rarely/never (OR, 95% C.I.0.88(0.78-0.99)) with the child was associated with lower overweight/obesity risk compared to a higher frequency. Likewise, limited TV/DVD, use of electronic devices, limited use of TV as a reward was associated with lower risk. Regarding diet, >3 cups/week of fresh fruit juices (OR, 95% C.I.1.24(1.13-1.37)) and diet soft drinks (OR, 95% C.I.1.28(1.08-1.51)) were associated with higher risk compared to ≤1 cups/week, respectively.

Table 3 presents the multivariate associations of those parental practices and children's lifestyle indices found to be associated with overweight/obesity in childhood at the univariate level, also adjusted for children's age and sex and for maternal education. Children who were physically active sometimes (OR, 95% C.I.1.26(1.10-1.43)) or rarely/ never (OR, 95% C.I.1.43(1.21-1.69)) with their parents had higher overweight/obesity risk compared to those that were often/very often. Accordingly, >3 cups/week of fresh fruit juices (OR, 95% C.I.1.28(1.13-1.45)) and skipping breakfast (OR, 95% C.I.1.37(1.17-1.61)) were associated with higher risk compared to ≤1 cup/week and daily breakfast consumption, respectively. Likewise, absence of daily PA (OR, 95% C.I.1.40(1.24-1.58)) and ≥2 hours/day ST (OR, 95%

C.I.1.23(1.09-1.39)) were associated with higher risk compared to daily PA and <2 hours/day ST, respectively. Conversely, children whose parents allowed them to use electronic devices rarely/never (OR, 95% C.I.0.81(0.67-0.98)) and reward them with PA (e.g. reward their children by being physically active together or by taking them to the playground or to the park) sometimes (OR, 95% C.I.0.77(0.68-0.88)) or rarely/never (OR, 95% C.I.0.77(0.66-0.91)) had lower overweight/ obesity risk compared to very often/often frequency, respectively.

Discussion

The present study aimed to identify the predominant correlates of childhood overweight/obesity, among a variety of parental practices and lifestyle indices, in a large sample of children from families from six European countries. Parents being rarely physically active with the child, children's high fresh fruit juices consumption, irregular breakfast consumption, absence of 1h PA/day and increased daily ST were associated with greater overweight/ obesity risk. On the contrary, rare permission of computer/mobile/tablet and rare reward with PA were associated with lower risk. Parents play a critical role for young children since they directly determine child's physical and social environment and indirectly influence behaviors and attitudes[(20)]. Our results show that parental influence is a key risk factor for childhood overweight/obesity as it can control the obesogenic environment by affecting children's food choices, dietary habits, PA and sedentary behavior. Since parents play a critical role, addressing this issue is of clinical and public health relevance as obesity is persistently and rapidly increasing.

First of all, our findings indicate that children who were rarely physically active with their parent had higher overweight/obesity risk. A growing body of research shows that children are more likely to be physically active when their parents encourage and

support them to be so and participate together in sport[22,37] and this could have a positive influence on their weight status. A study conducted in 1615 7 year-old German children revealed that those of active parents were less likely to be overweight or obese and that children with at least one active parent displayed a higher participation in organized sports[38]. Parental behavior through role-modeling and direct involvement may have a considerable influence on children's PA and BMI[39-41] thus it has been proposed that attempts to increase children's PA and therefore maintain a healthy weight status should target the whole family[42,43]. Another longitudinal study in 197 girls revealed that those from families in the obesogenic cluster (high levels of dietary intake and low levels of PA) had significantly higher BMI and skinfold thickness values at age 7 and showed significantly greater increases in BMI and skinfold thickness from ages 5 to 7 years than girls from non-obesogenic families (low levels of dietary intake and high levels of PA). Differences were reduced but not eliminated after controlling for parents' BMI[44].

Additionally, not being physically active everyday was associated with increased childhood overweight/obesity risk. In agreement with our results is a recent meta-analysis of 199 studies which revealed that children who do 1h of moderate- to vigorous-intensity PA/day have 30% lower childhood obesity risk[7]. Several large nationally representative longitudinal studies have reported significant protective associations between PA and BMI, and these results were consistent for both sexes and among different ethnic groups[6,45]. Regular engagement in PA during childhood is a well-documented contributor to health and quality of life and can provide health benefits including improvement in cardio-respiratory fitness, weight control, better self-esteem and psychological well-being[37,46]. Physical inactivity, on the other side,

can lead to energy imbalance, poor health and fitness, reduced muscle and bone health, sleep disorders, increased body weight combined with poor nutritional choices and consequently increase the risk of obesity[7].

Regarding ST activities, due to the rapid increase in screen use by children, promoted by the vast array of electronic media devices, ST has emerged as an important modifiable risk factor for childhood obesity. Results from a meta-analysis of 14 cross-sectional studies revealed a linear dose-response relationship between TV watching and obesity, while a 13% increase in obesity risk was observed for each hour/day of TV watching[47]. Another meta-analysis demonstrated that watching TV for >2 h/day can increase the risk of obesity by 42% while playing computer games >1-2 h/day can increase the risk by 8%[7]. Another meta-analysis in children (<18 years old) showed an increased overweight/obesity risk for ≥2 hr/day on ST activities compared to <2 hr/day[48] while a prospective European study in 3 year old children revealed that longer daily ST was associated with a higher BMI and waist-to-height ratio at 6 years of age[49]. Increased ST activities can promote obesity in several ways, including displacing time for PA, increasing calorie intake and promoting poor diet quality. More specifically, commercials increase children's desire/requests for the advertised food products[50,51] and contribute to unhealthful perceptions about food and nutrition, increasing the consumption of unhealthy snacks (high in fats, sugar, salt and fast food) and even interfering with sleep duration and quality[7,51].

Additionally, our results show that limited/monitored ST by parents was associated with lower childhood overweight/obesity risk. A recent longitudinal study on children 2-5 years old disclosed that the practice of limiting ST was associated with reductions in children's BMI z-score and waist circumference, while controlling practice of using ST as reward/control behavior was associated with increased child BMI z-score[52].

Our results are consistent with findings from other studies in the weight-related parenting literature demonstrating that effective media parenting practices can reduce the impact of TV viewing on child health outcomes[11,53,54]. Previous studies have revealed that, parental monitoring of children's ST is related to more sleep, healthier eating habits, better hunger and satiety regulation and therefore a lower BMI[55], while restriction of child's exposure to commercial ST or co-viewing and communication about advertisements' purposes are associated with lower energy-dense food consumption[56].

Furthermore, it was disclosed that rewarding their child by being physically active together or by taking him/her to the playground or to the park rarely was negative associated with childhood overweight/obesity risk. The vast majority of previous studies have investigated the method of using food or screen time as a reward. More specifically, using food or screen activities as a reward has been associated with higher levels of unhealthy eating among children and higher BMI values, as the foods chosen as rewards are often unhealthy and they may seem more attractive to children because they consider them valuable[57-60]. To the best of our knowledge, this is the first study that has evaluated the association of rewarding the child with PA with childhood overweight/ obesity. Nevertheless, the opinions about the effectiveness of the rewarding method are still mixed because, when something is presented as reward, its preference is enhanced, but over time a negative shift in this preference is observed[60-62]. According to the Self-Determination Theory rewards undermine children's natural interest in activities and the need for autonomy[63] and they induce them to engage in the activity not for their own enjoyment but to earn the rewards. As a result, they feel pressured, disinterested, or disaffected. Based on the above, it could

be explained why limited use of the rewarding method is associated with decreased childhood overweight/obesity risk.

Regarding fresh fruit juices consumption our results agree with a recent meta-analysis of 4657 studies in children 1-18 years old which showed that the consumption of 100% fruit juice is associated with a small amount of weight gain in children 1-6 years old but that was not clinically significant, and was not associated with weight gain in children 7-18 years old[64]. Other studies in preschoolers have shown that excessive fruit juice consumption (>340ml per day) is associated with increased energy intake and increased obesity risk[64,65]. Moreover, recent data suggest that excessive fructose consumption in children, either from the sucrose in 100% fruit juice or from sweetened beverages, could be associated with liver injury and the metabolic syndrome[65,66]. Hepatic metabolism of fructose promotes fat development and storage of intrahepatic lipids, inhibition of mitochondrial b-oxidation of long-chain fatty acids, triglyceride formation and steatosis, liver and skeletal muscle insulin resistance, and hyperglycemia[67]. Additionally, previous studies disclosed that liquid calories may fail to trigger physiological satiety mechanisms as solid foods do, also implicating 100% fruit juices in the obesity epidemic[68,69]. Conversely, although whole fruit also has fructose, the fiber that contains limits the insulin response and increases satiety[70], while fruit juice may alter nervous system energy signaling, resulting in dependence and habituation, that are associated with overconsumption and the metabolic syndrome[71].

Finally, regarding breakfast, numerous studies have shown that regular breakfast consumption, gradually decreases, and that its omission has a positive association with obesity[6,72]. A meta-analysis of 16 observational studies in children and adolescents disclosed that the risk of obesity in those that skipped breakfast was 43%

greater than those who ate breakfast regularly[73]. Accordingly, a more recent systematic review and meta-analysis among children and adolescents aged between 5-19 years indicated that eating breakfast everyday can reduce the risk of overweight/ obesity by 34%[7]. Proposed mechanisms that can justify this association is related to the effects of breakfast on better appetite control, satiety and greater total energy intake as well as greater thermogenesis[73,74].

An important strength of this study is its large sample as it was conducted in more than 12211 participants, including more than 2000 families at high risk for developing T2DM, from six European countries. Another important strength of our study is the inclusion of low SES families from different countries in Europe as until now the majority of previous studies were conducted on high SES families, and as a result they did not take into consideration the important influence of socioeconomic level on lifestyle and health indices. Socioeconomic status can encompass quality of life attributes as well as the opportunities and privileges afforded to people within society. Poverty, specifically, is not a single factor but rather is characterized by multiple physical and psychosocial stressors. Further, SES is a consistent and reliable predictor of a vast array of outcomes across the life span, including physical and psychological health and affects overall human functioning. Low SES and its correlates, such as lower educational achievement, poverty and poor health, ultimately affect the society. Inequities in health distribution, resource distribution, and quality of life are increasing in Europe and therefore it is of outmost importance to focus our attention on low SESS families. Additionally, the standardized protocols and procedures followed across all centers, and the objectively collected data regarding anthropometric indices, clinical and lifestyle data safeguard the more objective and reliable assessment and increase the generalizability of findings. On the other hand,

part of the collected data is self-reported. Although the validity and reliability of the relevant questionnaires were tested before the start of the intervention, this approach is prone to recall and social desirability bias. Moreover the main weakness with the cross-sectional design of the study is that we cannot make inferences about causality. More specifically, the present study is a cross-sectional secondary analysis of Feel4Diabetes community-based intervention using only data from the baseline part of the study. Thereby future prospective studies are needed in order to understand further how families succeed before the present findings can be used in an intervention.

Conclusion

Our results display that being rarely physically active with the child, children's high fresh fruit juices consumption, skipping breakfast as well as absence of 1h PA/day and increased daily ST are associated with greater overweight/ obesity risk, while rare ST permission and rare reward with PA are associated with lower risk. Based on these, future public health actions could be orchestrated aiming to counteract childhood overweight/ obesity. As families represent a crucial environmental influence in the development and maintenance of child's healthful eating and physical activity habits, obesity prevention programs could enhance the effectiveness of parenting practices related to diet and physical activity/inactivity behaviors.

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Table 1 Characteristics of the study sample.

		Total sample of children (n=7397)
		(%) of Total sample
Sex	Boy	49.2
	Girl	50.8
Age (years)	4-7	10.8
	7-9	65.6
	9-12	23.5
Region	High-income countries	36.4
	Under economic crisis countries	20.3
	Low-income countries	43.3
Weight status	Underweight/Normal weight	75.7
	Overweight	17.2
	Obese	7.1
		Total sample of parents (n=14794)
		(%) of Total sample
Mother's age (years)	< 45	90.6
	45-54	8.0
	> 54	0.1
Father's age (years)	< 45	67.4
	45-54	15.5
	> 54	1.4
Mother's education (years)	≤ 9	6.2
	10-14	36.6
	≥ 15	57.2
Father's education (years)	≤ 9	7.0
	10-14	41.3
	≥ 15	51.7
Who answer EBRB questionnaire	Mother	89.7
	Father	9.5
	Other (stepmother/father/caregiver/grandparent)	0.8

Table 2 Univariate associations of several parental practices and lifestyle correlates (independent variables) with children's overweight/ obesity (dependent variables). Total sample N=7397

Independent variables	% of total	Odds ratio (95% confidence interval) Overweight/Obesity
Parental practices		
Eating habits		
Consumption of fruit with child		
Very often/Often	60.6	1.00
Sometimes	28.4	1.08 (0.98-1.19)
Rarely/Never	11.0	1.14 (0.99-1.30)
Allow sweets and/or salty snacks		
Very often/Often	21.0	1.00
Sometimes	39.9	1.02 (0.91-1.15)
Rarely/Never	39.1	0.97 (0.87-1.09)
Reward with sweets, salty snacks or fast food		
Very often/Often	6.2	1.00
Sometimes	20.6	0.91 (0.75-1.11)
Rarely/Never	73.2	1.04 (0.87-1.24)
Physical activity		
Physically active with child		
Very often/Often	41.6	1.00
Sometimes	39.5	**1.20 (1.09-1.32)**
Rarely/Never	19.0	**1.46 (1.30-1.64)**
Reward with physical activity		
Very often/Often	37.8	1.00
Sometimes	39.8	**0.87 (0.79-0.95)**
Rarely/Never	22.4	**0.99 (0.88-1.10)**
Screen time		
TV watching with child		
Very often/Often	39.5	1.00
Sometimes	42.1	**0.86 (0.78-0.94)**
Rarely/Never	18.4	**0.88 (0.78-0.99)**
Allow TV or DVD watching		
Very often/Often	29.6	1.00
Sometimes	39.5	**0.87 (0.79-0.97)**
Rarely/Never	30.9	**0.89 (0.80-0.99)**
Allow use of computer, mobile or tablet		
Very often/Often	26.3	1.00
Sometimes	34.9	**0.84 (0.76-0.94)**
Rarely/Never	38.9	**0.84 (0.75-0.93)**
Reward with TV watching		
Very often/Often	11.8	1.00
Sometimes	25.2	**0.75 (0.65-0.87)**
Rarely/Never	63.0	**0.85 (0.75-0.97)**
Children's Lifestyle		
Fruits and vegetables		
≥5 portions[1]/day	60.6	1.00
<5 portions[1]/day	28.4	0.93 (0.82-1.06)
Fruit juices fresh consumption		
≤ 1 cups/week	36.2	1.00

> 1-3 cups/week	22.1	0.98 (0.87-1.10)
> 3 cups/week	41.7	**1.24 (1.13-1.37)**
Soft drinks/Sugar juices consumption		
≤1 cups/week	21.5	1.00
>1-3 cups/week	26.4	1.00 (0.90-1.12)
>3 cups/week	84.6	1.03 (0.93-1.14)
Soft drinks diet consumption		
≤ 1 cups/week	84.6	1.00
> 1-3 cups/week	7.6	**1.26 (1.06-1.48)**
> 3 cups/week	7.8	**1.28 (1.08-1.51)**
Sweets consumption		
≤ 1 portion[1]/week	7.6	1.00
> 1-3 portions[1]/week	22.9	0.87 (0.74-1.04)
> 3 portions[1]/week	69.5	**0.77 (0.66-0.90)**
Salty snacks consumption		
≤ 1 portion[2]/week	41.1	1.00
> 1-3 portions[2]/week	33.3	0.96 (0.87-1.07)
> 3 portions[2]/week	25.7	**1.18 (1.05-1.32)**
Breakfast consumption		
Everyday	88.6	1.00
Not everyday	11.4	**1.51 (1.33-1.71)**
Physical activity for 1hr		
Everyday	34.9	1.00
Not everyday	65.1	**1.47 (1.34-1.61)**
Screen-time activities		
< 2 hours/day	63.9	1.00
≥ 2 hours/day	36.1	**1.30 (1.19-1.42)**

[1] ½ cup

[2] 1 small hamburger, 1 small bag of chips, 1 slice of pizza

Bold font indicates statistically significant OR ($P < 0.05$).

Table 3 Multivariate associations of several parental practices and lifestyle correlates (independent variables) with children's overweight/ obesity (dependent variables). Total sample N=7397

Independent variables	**% of total**	**Odds ratio (95% confidence interval) Overweight/Obesity**
Parental practices		
Eating habits		
Consumption of fruit with child		
Very often/Often	60.6	1.00
Sometimes	28.4	0.97 (0.86-1.10)
Rarely/Never	11.0	1.04 (0.87-1.24)
Physical activity		
Physically active with child		
Very often/Often	41.6	1.00
Sometimes	39.5	**1.26 (1.10-1.43)**
Rarely/Never	19.0	**1.43 (1.21-1.69)**
Reward with physical activity		
Very often/Often	37.8	1.00
Sometimes	39.8	**0.77 (0.68-0.88)**
Rarely/Never	22.4	**0.77 (0.66-0.91)**
Screen time		
TV watching with child		
Very often/Often	39.5	1.00
Sometimes	42.1	0.91 (0.80-1.03)
Rarely/Never	18.4	0.93 (0.80-1.09)
Allow TV or DVD watching		
Very often/Often	29.6	1.00
Sometimes	39.5	1.00 (0.86-1.18)
Rarely/Never	30.9	1.15 (0.95-1.40)
Allow use of computer, mobile or tablet		
Very often/Often	26.3	1.00
Sometimes	34.9	0.94 (0.80-1.11)
Rarely/Never	38.9	**0.81 (0.67-0.98)**
Reward with TV watching		
Very often/Often	11.8	1.00
Sometimes	25.2	0.82 (0.67-1.00)
Rarely/Never	63.0	1.00 (0.83-1.20)
Children's Lifestyle		
Fruit juices fresh consumption		
≤ 1 cups/week	36.2	1.00
> 1-3 cups/week	22.1	0.97 (0.83-1.13)
> 3 cups/week	41.7	**1.28 (1.13-1.45)**
Soft drinks diet consumption		
≤ 1 cups/week	84.6	1.00
> 1-3 cups/week	7.6	1.16 (0.94-1.42)
> 3 cups/week	7.8	1.03 (0.83-1.27)
Sweets consumption		
≤ 1 portion[1]/week	7.6	1.00
> 1-3 portions[1]/week	22.9	0.93 (0.74-1.18)
> 3 portions[1]/week	69.5	**0.75 (0.60-0.93)**
Salty snacks consumption		
≤ 1 portion[2]/week	41.1	1.00

> 1-3 portions[2]/week	33.3	0.96 (0.84-1.09)
> 3 portions[2]/week	25.7	1.12 (0.96-1.30)
Breakfast consumption		
Everyday	88.6	1.00
Not everyday	11.4	**1.37 (1.17-1.61)**
Physical activity for 1hr		
Everyday	34.9	1.00
Not everyday	65.1	**1.40 (1.24-1.58)**
Screen-time activities		
< 2 hours/day	63.9	1.00
≥ 2 hours/day	36.1	**1.23 (1.09-1.39)**

*Adjusted for all statistically significant lifestyle factors and parental practices, and also for maternal education, child's sex and age.

[1] ½ cup

[2] 1 small hamburger, 1 small bag of chips, 1 slice of pizza

Bold font indicates statistically significant OR ($P < 0.05$).