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Fathers' daily intake of fruit and vegetables is positively associated with children's fruit and vegetable consumption patterns in Europe: The Feel4Diabetes Study

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Abstract

Background: Past research has focused on the relationship between mothers' and children's eating habits, although little is known about fathers as potential agents. The present study aimed to investigate the relationship between fathers' and children's fruit and vegetable (FV) intake in the context of fathers' education level and family income insecurity.

Methods: Cross-sectional analysis using baseline data from the multicentre Feel4Diabetes Study were collected in 2016. Participants were parent-dyads (fathers, $n = 10{,}038$) and school children ($n = 12{,}041$) from six European countries. Socio-demographic and dietary data were collected using questionnaires. Associations were assessed applying the multinomial logistic regression model.

Results: Overall, European children have low FV intake, especially in Southern European countries (Greece, Spain and Hungary). Children with fathers consuming FV daily were more likely to consume fresh fruit (odds ratio [OR] = 2.75; 95% confidence interval [CI] = 1.95–3.88) and vegetables (OR = 2.55; 95% CI = 1.80–3.60) 1–2 times per day. After adjusting for paternal educational level and family income insecurity significant associations remained for fresh fruit ($OR_{adj} = 2.59$; 95% CI = 1.82–3.69) and vegetables ($OR_{adj} = 1.98$; 95% CI = 1.38–2.86). Country differences showed that fathers' educational level and income insecurity might be important factors worth considering for FV intake in Greece.

Conclusions: The present study showed that fathers' FV intake was positively associated with children's daily intake of these foods. Implementation of future population-based strategies promoting FV intake not only in mothers, but also in fathers could be an effective public health initiative to increase FV intake in children. Policy-makers should give special attention to families dwelling in Southern European regions.

All authors are members of the Feel4Diabetes Consortium led by principal investigator Professor Yannis Manios (https://feel4diabetes-study.eu/consortium-members). The mission of this multidisciplinary team from seven universities and one research institute is the prevention of type 2 diabetes, a global health emergency of the 21st century. All partners are experts on diabetes prevention, behaviour, nutrition, physical activity, policy and health economics. The aim of this project was to develop, implement and evaluate a community-based intervention aiming to create a supportive social and physical environment to promote lifestyle and behaviour change to prevent type 2 diabetes among families from low and middle income countries and from vulnerable groups in high income countries residing in six European countries (Belgium, Finland, Greece, Bulgaria, Hungary and Spain). The current study is one of the many publications (https://feel4diabetes-study.eu/publications) reporting the findings of the Feel4Diabetes intervention.

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children, education, family income insecurity, fathers, fruits, vegetables

Highlights

- Fruit and vegetable (FV) intake is an essential component of a healthy diet with respect to overall health benefit effects, strengthening the immune system, and ensuring optimal growth and development in children.
- European children have low FV intake, especially in Southern European countries (Greece, Spain, and Hungary), and are not meeting the recommended FV intake of at least 400 g day^{-1}.
- The present study showed that children with fathers consuming FV daily were more likely to consume fresh FVs 1–2 times per day.
- Implementation of future population-based strategies promoting FV intake not only in mothers, but also in fathers could be an effective public health initiative to increase FV intake in children. Policy-makers should give special attention to families dwelling in Southern European regions.

INTRODUCTION

Fruit and vegetables (FV) are essential components of a healthy diet because they contain important vitamins (e.g., vitamins C and A, folic acid), minerals, fibre and bioactive compounds with antioxidant properties, which have overall health benefits, strengthening the immune system, as well as ensuring optimal growth and development in children.[1] Most importantly, an adequate daily intake of FV could prevent major health implications, such as cardiovascular disease, cancer, premature mortality[2] and diabetes[3] in later life. By contrast to World Health Organization (WHO) guidelines, European children are not meeting the recommended FV intake of at least 400 g day^{-1}.[1] From the scant available data, school children's intake of FVs in Ireland, the Netherlands and the UK ranged from 221 to 272 g day^{-1}, whereas, in Italy and Spain, it ranged from 341 to 350 g day^{-1} and, in Denmark, it averaged 404 g day^{-1}.[4] Given the variability in FV recommendations for school children along with foods classified as FV and considering that the evidence is based on few national dietary surveys[4] and not on a European level, more well-designed European population studies are warranted to address this gap.

The development of children's food preferences is multifactorial, involving the complex interplay between genetics and environmental factors, including the home.[5] In a systematic review, Pearson et al.[6] showed that parental role modelling and parental intake were positively associated with fruit, fruit juice and vegetable intake in children and adolescents. By contrast, in a systematic review of 24 studies investigating the resemblance between parents and children's diet, Wang et al.[7] only found a weak association. Possible limitations of the aforementioned reviews were that there was substantial variability with respect to the study designs, sample size (range 36–8263), children's age, dietary intake assessment tools (food frequency questionnaire [FFQ], food record or 24-h food recall) and variables assessed (individual food items, food groups, nutrients or overall dietary pattern). Some studies assessed associations between family correlates, parent-dyads and children's dietary outcomes for boys and girls combined, whereas others did so separately. Most studies were cross-sectional and at least 50% were conducted in the USA. Therefore, given the high heterogeneity among studies, establishing the direction and causality of associations remains inconclusive.

Regardless of the weak associations reported by the aforementioned systematic reviews, parental influence has been identified as a key determinant of children's food choice and consumption patterns via food availability at home, role modelling, family rules, and their own dietary practices and beliefs.[8] Convincing evidence from cross-sectional studies has shown that, in families where parents consumed FV regularly, children also had an increased intake of healthy foods.[9–11] Traditionally, mothers are viewed as the primary carers and main food providers of children, controlling what food is offered at mealtimes, as well as portion size.[12] However, today with mothers being in the workforce, more fathers are actively involved in the care of their children.[12] Past research has focused primarily on mothers' influence on children's eating habits, whereas little is known about fathers as potential agents of this behaviour.[12,13] Therefore, given the lack of evidence, we endeavoured to investigate the relationshop between fathers' and children's FV intake, as well as to determine whether socio-economic status, as measured by fathers' educational level and family income insecurity, modified the association between fathers' daily FV intake and FV consumption patterns in children. We hypothesised that there are positive associations between fathers' FV intake and the frequency of children's intake of these foods. The

findings of this study will enhance our understanding of the correlates of food intake in children and provide useful insight for the development and implementation of effective intervention programs promoting healthy eating in children.

METHODS

The present study comprises a sub-analysis of baseline data of the Feel4Diabetes study, which was a 2-year school- and community-based intervention designed to prevent type 2 diabetes in vulnerable families across Europe. In brief, the Feel4Diabetes intervention promoted healthy eating and physical activity by creating a supportive environment at three levels, which included the home/family, school and municipalities. Recruitment was based on a standardised multisampling procedure and was conducted in selected provinces in six European countries, namely Bulgaria, Hungary, Belgium, Finland, Greece and Spain. Primary schools were randomly selected and recruited within each area. Eligibility and inclusion criteria were based on families with children attending the first three grades of primary school in the selected municipalities of each country. The screening procedure and methodology have been described in greater detail in a previous study[14] and, for the purpose of the present study, only baseline data involving all families have been used. Ethical approval was obtained from the Human Ethics committees of all participating institutions in each of the six European countries. The study protocol was conducted according to the standards set by the Declaration of Helsinki for human subjects. Prior to enrolment of participants into the study, all parents provided their written informed consent. In the present study, we posited that parenting is one of the main influential components of the home food and social environment that defines children's food consumption patterns.

Assessments

Anthropometry

Children underwent anthropometric measurements that were conducted at school by trained researchers[15] using standard procedures and equipment. Body weight was measured in children wearing light clothing and without shoes to the nearest 0.1 kg using electronic scales (Seca 813) and standing height was measured barefoot, with shoulders in a relaxed position, arms hanging freely and head in the Frankfurt horizontal plane, to the nearest 0.1 cm using a portable stadiometer (Seca 217). Two readings were recorded for each measurement and the mean was used for analytical purposes. Body mass index (BMI) was calculated using Quetelet's equation (kg m^{-2}) and expressed as *z*-scores estimated by the International Obesity Task Force BMI cut-offs.[16]

Socio-demographic details

Socio-demographic details, including country, fathers' and children's age, fathers' educational level and occupation status, as well as family income insecurity, were collected using a self-reported questionnaire. Educational level was measured by the number of years attending school or university and comprised of six categories: <6 years or less, 7–9 years, 10–12 years, 13–14 years, 15–16 years and >16 years. Occupation status was categorised as stay at home, employed (full-time or part-time) and unemployed. Family income insecurity was assessed by the degree of economic ease or difficulty to meet household expenses as: very difficult, difficult, fairly difficult, fairly easy, easy and very easy.[17] Variables related to fathers' socio-demographics were dichotomised as: age <45 years versus ≥45 years, educational level: ≤14 years versus >14 years and family income insecurity by easy versus difficulty to meet household expenses.

Fathers' daily intake of FVs

Fathers' daily intake of FV was assessed by the question "How often do you eat vegetables, fruit or berries?" Possible responses were "every day" or "not every day".

Children's FV intake

Children's FV intake was evaluated using a FFQ that was developed specifically for the Feel4Diabetes Study and was examined for its reliability in a pilot study.[18] Parents were used as a proxy for children's dietary habits. Respondents were instructed to report their usual frequency of consumption of nine food groups in terms of specified serving size. The main food groups included in the questionnaire were fruit and berries (fresh or frozen), fruit and berries (canned or dried), fruit juice (freshly-squeezed or prepacked without sugar) and vegetables. Conventional household measures were used to represent one standard portion size for each food item (1 cup, ½ cup). Frequency of food intake was recorded as weekly or daily consumption of food items, which were categorised as <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 >6 times per day. One serving of fruit was considered to one medium-sized fruit or ½ cup, vegetables ½ cup, canned or dried fruit ½ and ¼ cup, respectively, and fruit juice by 1 cup.

Statistical analysis

SPSS, version 20 (IBM Corp.) was used for all statistical analyses. Continuous variables were assessed for normality using the Kolmogorov–Smirnov test and graphically using

histograms. In the case of nonnormally distributed continuous variables, group differences were determined using the non-parametric Mann–Whitney test, whereas a chi-squared test was used for categorical variables. Socio-demographic and anthropometric characteristics of the sample are presented as medians, 25th and 75th percentiles, total counts (n), and frequencies (%). Correlation between fathers' and children's frequency of food intake was examined using Spearman's rank coefficient (ρ) where values ranging from 0.10 to 0.29 indicate moderate correlation and ≥0.30 strong correlation.[19] Given that the assumptions for ordinal logistic regression were violated,[20] associations between fathers' daily intake of FV and frequency of these foods by children were evaluated by performing a multinomial logistic regression setting each food item from the children's FFQ as the dependent variable and fathers' intake of FV as the dichotomous independent variable. According to previous research, factors such as parental educational level and income status are known to influence family dietary habits, especially FV.[21] Dummy variables were created for independent categorical variables (education level and family income insecurity) and then entered into the regression analysis. Model 1 represents the crude analysis (unadjusted). Model 2 adjusts for fathers' educational level and family income insecurity. Reference values for frequency of FV intake were based on WHO nutritional guidelines for children and adolescents.[1] Multicollinearity amongst predictors was measured using the variance inflation factor (VIF), tolerance statistic and condition index.[22] The goodness of fit of the model was checked using Pearson's and likelihood ratio chi-squared statistics.[22] Furthermore, the degree of variation of the outcome as explained by the predictors was reflected by the Nagelkerke coefficient R^2.[22] The magnitude of the association is represented by the β coefficient, odds ratio (OR) and 95% confidence intervals (CIs). To explore country differences in associations, data were stratified by country and the regression analysis was repeated investigating the association between fathers' daily FV intake and children's frequency of consumption patterns of these foods. $p < 0.05$ was considered statistically significant. All reported p values were two-tailed.

RESULTS

Of the 12,041 European families (parent-dyads) participating in this study, 14.8% (1,787/12,041) lived in Belgium, 12.5% (1,504/12,041) in Finland, 19.0% (2,283/12,041) in Greece, 15.2% (1828/12,041) in Hungary, 24.7% (2972/12,041) in Bulgaria and 13.8% (1,667/12,041) in Spain. From data of 10,038 fathers, the majority of fathers (77.7%) were under 45 years old, 46.1% were well-educated (>14 years of study), 87.0% worked full-time and 50% of families found it "difficult" to cover household expenses. The sample comprised of 12,041 children, median age 8.2 years (interquartile range 1.5 years) of whom 49.3% (5942/12,041) were boys. Socio-demographic and anthropometric characteristics of the sample and per children's sex are shown in Table 1.

Concerning fathers' FV intake, in the total sample, only 65.9% of fathers (6646/10,083) consumed FV daily. Investigation of daily FV intake according to country showed that 79.8% (1267/1588) of fathers' in Belgium responded that they consumed FV daily, whereas 76.6% (1966/2568) in Bulgaria, 71.8% (789/1099) in Finland, 68.6% (968/1411) in Spain, 52.2% (994/1855) in Greece and 43.8% (662/1512) in Hungary consumed FV daily ($p < 0.001$).

Collectively, children had low intake of FV with only 45.6% (5159/11,300) consuming fresh fruit 1–2 times per day and 37.7% (4220/11,194) consuming vegetables at the same frequency. Differences were observed amongst countries (fresh fruits: $p < 0.001$; vegetables: $p < 0.001$). Children's fresh fruit intake of 1-2 times/day ranged from 61.1% (1057/1731) in Belgium, 49.3% (635/1288) in Spain, 49.4% (1434/2902) in Bulgaria, 42.6% (931/2185) in Greece, 35.1% (521/1483) in Finland and 34.0% (581/1711) in Hungary, whereas 61.6% of children (1065/1729) in Belgium, 47.1% (1362/2890) in Bulgaria, 44.0% (655/1487) in Finland, 24.8% (321/1296) in Spain, 23.5% (383/1633) in Hungary and 20.1% (434/2159) in Greece consumed vegetables 1–2 times/day.

Nevertheless, moderate-strong correlations were observed between fathers' daily FV intake and children's intake of fresh fruit (ρ = 0.46, $p < 0.001$), vegetables (ρ = 0.54, $p < 0.001$), canned/dried fruit (ρ = 0.61, $p < 0.001$) or fruit juice (ρ = 0.54, $p < 0.001$).

The association between fathers' daily FV intake and children's daily FV intake

Associations between fathers' daily FV intake and children's frequency of intake are presented in Table 2. Applying the multinomial logistic regression model to explore associations of fathers' daily FV intake and children's frequency of food intake revealed significant positive associations in the crude analysis for children's fresh fruit intake ($p < 0.001$) and vegetables ($p < 0.001$). When fathers consumed daily FV, children were 2.75 times and 2.55 times more likely to consume fresh fruit or vegetables, respectively, 1–2 times per day. Addition of fathers' educational level and family income insecurity did not modify the associations for children's fresh FV intake. The same trend was observed for children's fruit juice intake, although marginally significant in the crude and adjusted analyses (crude OR = 1.46, 95% CI = 0.94–2.28, $p = 0.09$; adjusted OR = 1.52, 95% CI = 0.96–2.42, $p_{adj} = 0.08$). By contrast, no associations were found for canned/or dried fruits.

Regarding the impact of fathers' daily FV intake and children's consumption patterns, disparities were found across countries (Table 3). In the crude and adjusted regression analyses there were positive associations between fathers' daily FV intake and children's intake of fresh fruit 1–2 times per day in Belgium, Greece and Bulgaria only ([Adjusted] children's fresh fruit intake: Belgium OR: 3.95,

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TABLE 1 Socio-demographic, anthropometric and dietary intake characteristics of the sample

Characteristic	Total	Boy	Girl	p[a]
Children' s details				
Sex, % (n)		49.4 (5942/12,041)	50.6 (6097/12,041)	
Age (years)	8.2 (7.4, 8.9)	8.2 (7.5, 9.0)	8.1 (7.4, 8.9)	0.05[b]
Weight (kg)	28.3 (24.7, 33.2)	28.5 (25.1, 33.5)	28.0 (24.4, 33.0)	**<0.001**[b]
Height (cm)	130.2 (125.0, 136.0)	130.8 (125.8, 136.4)	129.6 (124.3,135.4)	**<0.001**[b]
BMI z-score	0.47 (−0.20, 1.3)	0.46 (−0.21, 1.2)	0.48 (−0.17, 1.3)	0.16[b]
Children's FV intake (1–2 times/day)				
Fresh fruit intake (1 fruit or ½ cup), % (n)	45.6 (5159/11,300)	44.5 (2477/5566)	46.8 (2681/5732)	**0.01**
Canned/dried fruit (½ and ¼ cup), % (n)	4.6 (503/1081)	4.4 (238/5351)	4.8 (265/5465)	0.56
Fruit juice (1 cup), % (n)	13.3 (1472/11,083)	14.1 (771/5415)	12.5 (701/5627)	0.25
Vegetables (½ cup), % (n)	37.7 (4220/11,194)	36.3 (2001/5508)	39.0 (2219/5684)	0.09
Fathers' details				
Age, % (n)	77.7 (7800/10,038)	77.4 (3841/4961)	78.0 (3959/5076)	0.49
<45 years				
Education, % (n)	46.1 (4511/9779)	47.2 (2281/4835)	45.1 (2230/4944)	**0.04**[c]
>14 years				
Occupation, % (n)	8.1 (798/9787)	8.2 (397/4843)	8.1 (401/4943)	0.52
Stay at home				
Employed	87.0 (8520/9787)	87.3 (4226/4843)	86.8 (4293/4943)	
Unemployed	4.8 (469/9787)	4.5 (220/4843)	5.0 (249/4943)	
Fruit/vegetable intake, % (n)	65.9 (6646/10,083)	66.2 (3297/4983)	65.6 (3347/5098)	0.62
Everyday				
Family income insecurity				
Covering household expenses[d], % (n)				
Difficult	49.4 (5637/11,402)	48.7 (2727/5595)	50.1 (2910/5806)	0.14

Note: For dichotomous variables fathers' age, fathers' educational level, family income insecurity and fathers' FV intakes, only one category is presented. Values in bold indicate statistically significant sex differences

Abbreviations: BMI, body mass index; FV, fruit and vegetables.

[a]p value estimated using chi-squared test.

[b]Mann–Whitney test.

[c]Significant differences in fathers' educational level when comparing educational attainment ≤14 years versus >14 years.

[d]Values are expressed as medians, 25th and 75th percentiles, total counts (n) and frequencies (%).

95% CI: 1.35–11.51, p_{adj} = 0.012; Greece OR: 3.31, 95% CI: 1.59-6.86, p_{adj} = 0.001; Bulgaria OR: 4.24, 95% CI: 1.39–12.95, p_{adj} = 0.011). The same trend was observed for children's vegetable intake 1–2 times per day in Belgium and Hungary ([adjusted] children's vegetable intake: Belgium OR: 3.44, 95% CI: 1.28–9.28, p = 0.015; Hungary OR: 3.20, 95% CI: 1.16–8.83, p = 0.024). Interestingly, for Greece, a positive association was observed in the crude analysis between fathers' daily FV intake and children's vegetable intake (OR: 2.31, 95% CI: 1.09–4.87, p = 0.029), which became nonsignificant after adjustment (p = 0.270). Hence, it appears that fathers' educational level and income insecurity might be important factors worth considering for FV intake in Greece. No significant associations were noted for canned/dried fruit or fruit juice in any country, which coincides with the original analyses.

DISCUSSION

The promotion of healthy eating in children is crucial because food habits established in childhood may track into adolescence and adulthood.[23] There is substantial evidence suggesting that children's dietary intake and behaviours are

TABLE 2 Association between fathers' daily fruit and vegetable (FV) intake and frequency of children's FV intake derived from the crude multinomial logistic regression analysis (Model 1) and after adjusting for fathers' educational level and family income insecurity (Model 2)

Food item/frequency of children's food intake	Model 1				Model 2			
	β	R^2	OR (95% CI)	p^a	β	R^2	OR (95% CI)	p^b
Fruits/berries (fresh/frozen)								
3–4 times/week	Ref							
1–2 times/day	1.01	8.1%	2.75 (1.95, 3.88)	**<0.001**	0.95	14.6%	2.59 (1.82, 3.69)	**<0.001**
Fruits/berries (canned/dried)								
3–4 times/week	Ref							
1–2 times/day	−0.54	0.70%	0.58 (0.28, 1.20)	0.140	−0.40	12.0%	0.67 (0.31, 1.44)	0.300
Fruit juice								
3–4 times/week	Ref							
1–2 times/day	0.38	0.80%	1.46 (0.94, 2.28)	0.090	0.42	5.0%	1.52 (0.96, 2.42)	0.080
Vegetables								
3–4 times/week	Ref							
1–2 times/day	0.93	8.50%	2.55 (1.80, 3.60)	**<0.001**	0.68	0.0%	1.98 (1.38, 2.86)	**<0.001**

Note: Independent dichotomous variable: father consumes fruit and vegetables (every day/not every day). Dependent variable: children's frequency of fruit and vegetable intake from food frequncy questionnaires. R^2model fit as represented by the Nagelkerke coefficient. Statistically significant values are indicated in bold.

Abbreviations: β, unstandardised β coefficient; 95% CI, 95% confidence interval for Exp(B); OR, odds ratio; R^2, Nagelkerke coefficient; Ref, reference.

[a]Model 1: *p* value estimated from the unadjusted multinomial logistic regression.

[b]Model 2: *p* value adjusted for fathers' educational level and family income insecurity.

influenced by parents, especially mothers, who are key components in the environmental and social context. However, the extent to which fathers' dietary intake influences children's food consumption patterns is unclear. This is of considerable importance given the changes in family structure, with more mothers employed and fathers being responsible for daily care and rearing of their children.[12] The findings of this study support the primary hypothesis that there are positive associations between fathers' FV intake and frequency of children's intake of these foods. This suggests that, apart from mothers, fathers should be considered as potential agents for the implementation of positive feeding practices in children. Even though convincing evidence indicates that fathers exert a positive influence on children's eating habits, direct comparisons are difficult as a result of the lack of studies examining specific father–child FV intakes.[24,25] According to a recent systemic review of 23 studies, fathers' dietary intake was predictive of children's intake, whereas fathers' food parenting style, as represented by their own intake of FV, availability of healthy foods at home and encouragement to consume healthy foods, influenced children's eating behaviours.[26] Co-parenting by mothers and fathers and household rules concerning food being reinforced by both parents produced healthier child food choices. Unfortunately, we did not assess co-parenting and this would be worthy of future investigation. It has been advocated that parenthood could instigate health awareness and motivate the adoption of healthier eating habits such as increased intake of FV by fathers.[27]

Intriguingly, country differences were observed in associations between fathers' FV intake and children's daily intake of fresh FVs, which may be an important factor to consider when devising health promotion strategies. Strong associations were observed for Belgium, Greece, Bulgaria and Hungary. One might speculate that fathers' educational level and income insecurity might be important factors worthy of consideration for FV intake in Greece. A feasible explanation for associations observed between fathers' FV intake and children's consumption patterns of FV might be that, with more women in the workforce, fathers expend more time interacting with children, especially during mealtimes and in the preparation and cooking of meals, including grocery shopping.[12] In this context, paternal dietary behaviour is likely to play an important role in shaping children's diets through positive role modelling of eating habits and by controlling the type and amount of food made accessible and available within the home.[8] From another point of view, fathers' health-related nutrition knowledge is another determinant of children's FV intake. Wolnicka et al.[28] documented positive correlations between parent's knowledge of the recommended intakes of FV and children's frequency of consumption of FV.

These observations highlight that fathers should be aware of the multiple correlates that can influence their children's

TABLE 3 Associations between fathers' daily fruit and vegetable (FV) intake and children's frequency of FV intake by country, derived from the crude multinomial logistic regression analysis (Model 1) and after adjusting for fathers' educational level and family income insecurity (Model 2)

		Children's frequency of food intake							
		Model 1[a]				Model 2[b]			
Food item/frequency of intake	Country	β	R^2	OR (95% CI)	*p*	β	R^2	OR (95% CI)	p_{adj}
Fruits/berries (fresh/frozen)									
3–4 times/week	Ref								
1–2 times/day	Belgium	1.21	12.3%	3.36 (1.27, 8.89)	**0.015**	1.37	40.0%	3.95 (1.35, 11.51)	**0.012**
	Finland	0.39	4.6%	1.47 (0.56, 3.84)	0.429	0.51	33.3%	1.67 (0.55, 5.09)	0.364
	Greece	1.18	10.8%	3.26 (1.69, 6.29)	**<0.001**	1.20	18.6%	3.31 (1.59, 6.86)	**0.001**
	Hungary	0.60	10.4%	1.82 (0.78, 4.26)	0.165	0.55	43.6%	1.73 (0.68, 4.44)	0.253
	Bulgaria	1.28	10.5%	3.61 (1.30, 9.99)	**0.014**	1.44	39.6%	4.24 (1.39, 12.95)	**0.011**
	Spain	0.60	15.5%	1.81 (0.59, 5.57)	0.297	0.61	43.7%	1.83 (0.56, 5.95)	0.315
Fruits/berries (canned/dried)									
3–4 times/week	Ref								
1–2 times/day	Belgium	−0.13	1.8%	0.87 (0.14, 5.58)	0.888	0.02	35.5%	1.02 (0.12, 8.92)	0.990
	Finland	−0.56	1.3%	0.57 (0.11, 3.07)	0.511	−0.92	30.0%	0.40 (0.06, 2.89)	0.360
	Greece	−19.46	5.3%	Not computable		−1.73	2.5%	0.18 (0.00, 15.98)	0.450
	Hungary	−0.98	7.9%	0.37 (0.08, 1.80)	0.220	−0.35	46.4%	0.70 (0.13, 3.88)	0.680
	Bulgaria	−0.85	3.2%	0.43 (0.05, 3.52)	0.430	−0.51	0.0%	0.60 (0.04, 8.55)	0.710
	Spain	0.47	3.7%	1.60 (0.24, 10.81)	0.630	0.80	7.8%	2.22 (0.25, 19.77)	0.470
Fruit juice									
3–4 times/week	Ref								
1–2 times/day	Belgium	−0.19	5.4%	0.83 (0.23, 2.98)	0.771	0.36	35.2%	1.43 (0.33, 6.10)	0.630
	Finland	−0.37	5.4%	0.69 (0.08, 5.64)	0.727	−1.05	29.5%	0.35 (0.03, 3.84)	0.390
	Greece	0.44	5.3%	1.55 (0.79, 3.03)	0.205	0.45	17.6%	1.57 (0.76, 3.21)	0.220
	Hungary	0.78	3.9%	2.18 (0.53, 9.02)	0.283	0.99	11.3%	2.70 (0.54, 13.63)	0.230
	Bulgaria	0.77	2.3%	2.17 (0.39, 12.06)	0.377	0.47	25.2%	1.60 (0.25, 10.09)	0.620
	Spain	0.74	5.7%	2.10 (0.59, 7.45)	0.251	0.54	39.1%	1.71 (0.45, 6.47)	0.430
Vegetables									
3–4 times/week	Ref								
1–2 times/day	Belgium	1.17	8.0%	3.24 (1.28, 8.19)	**0.013**	1.24	39.7%	3.44 (1.28, 9.28)	**0.015**
	Finland	0.74	5.0%	2.09 (0.78, 5.61)	0.141	0.83	34.0%	2.29 (0.76, 6.91)	0.140
	Greece	0.83	10.1%	2.31 (1.09, 4.87)	**0.029**	0.42	7.1%	1.52 (0.72, 3.19)	0.270
	Hungary	0.93	10.6%	2.53 (1.03, 6.20)	**0.043**	1.16	49.9%	3.20 (1.16, 8.83)	**0.024**
	Bulgaria	0.97	9.2%	2.64 (0.96, 7.20)	0.059	1.01	0.0%	2.74 (0.87, 8.64)	0.090
	Spain	−0.13	5.2%	0.88 (0.32, 2.41)	0.796	−0.03	42.5%	0.97 (0.34, 2.76)	0.950

Note: Independent dichotomous variable: father consumes fruit and vegetables (every day/not every day). Dependent variable: children's frequency of fruit and vegetables intake from food frequncy questionnaires. R^2 model fit as represented by the Nagelkerke coefficient. Statistically significant values are indicated in bold.

Abbreviations: β, unstandardised β coefficient; 95% CI, 95% confidence interval for Exp(B); OR, odds ratio; R^2, Nagelkerke coefficient; Ref, reference.

[a]Model 1: Crude regression analysis.

[b]Model 2: Regression analysis adjusted for fathers' educational level and family income insecurity

food intake, including the impact of their own food choices and eating behaviour. Ultimately, foods preferred and consumed by parents (both mothers and fathers) are those foods that children are habitually exposed to and define children's choices and intake.[26,29] School children are likely to be consuming two-thirds of meals at home, with parents mostly controlling children's diets rather than peers and the school environment. Accordingly, explicit displays of good paternal eating behaviours, home availability and accessibility of FV, combined with encouragement that promotes the consumption of healthy foods in children, might comprise a useful parenting strategy for the adoption of desirable eating habits in children.[30] On the other hand, non-adherence to healthy eating guidelines in parents could undermine attempts to ensure healthy eating in children. Therefore, interventions focusing on improving the quality of both parents' diets could be effective for improving their children's eating habits.

Unexpectedly, we found that educational level and family income insecurity did not alter our observations. By contrast, in a national survey of school children participating in the COSI study, Petrauskienė et al.[21] found that the odds ratio of daily fresh fruit consumption was 1.4 times higher in children with fathers of high educational level compared to those of low educated parents. The odds ratio of children's fresh fruit consumption was 1.5 times higher in families with a high income compared to a low income. A plausible explanation for differences between our study and previous research might be attributed to population differences, variability in definition of socio-economic status, categorisation of educational levels and measurement of family income (quantitative vs. qualitative).

Despite the overwhelming evidence of the positive health benefits of consuming a varied diet abundant in FV, in our study, overall, 60% of fathers and less than 50% of children consumed FV 1–2 times/day, which does not comply with the current WHO recommendations of consuming an abundance of FV as part of a healthy diet.[1] Interestingly, families in Southern European countries (i.e., Greece and Spain), as well as in Hungary, continue to have poor dietary habits, as indicated by the low intake of FV. This is consistent with the findings of dietary surveys in Europe reporting considerable variability in FV intake across and within countries, reflecting the prevailing economic, cultural, geographical and agricultural diversity.[31] Nevertheless, there is a propensity for people with high educational attainment to eat more FVs compared to those with low educational levels (14% vs. 10%, respectively).[32] Our observation is highly significant because childhood is a critical period during which eating behaviours and food preferences evolve, providing an opportunity to develop and foster healthy eating habits that carries into adulthood.

Strengths/limitations

The present study endeavoured to unravel the complex environment–dietary behaviour interaction in the research area of food parenting. Traditionally, past research has focused on the influence of maternal eating habits on children's food intake and our study is unique in that it explored the impact of fathers, thereby extending to the literature.[12] Although FV intake was not assessed quantitatively (g day^{-1}), the European Prospective Investigation into Cancer and Nutrition study demonstrated that, in adults, the frequency of FV consumption was more important than serving size when distinguishing between an increased and decreased intake of these foods.[33] Another forte of the present study was the large sample size comprising data from six European countries, homogeneity amongst participants with respect to age, and selection (all school children) along with the use of standardised assessment tools, which guarantees higher internal validity. From a statistical point of view, in the regression analysis, assessment of the model fit as described by low values of the R^2 coefficient suggests that variation in the dependent variable cannot be exclusively explained by the predictors and that there might be other factors affecting children's intake of FV, which warrants further investigation. Nevertheless, assessment of multicollinearity amongst predictor variables yielded no collinearity, as represented by values of VIF < 4, tolerance statistic > 0.2 and condition index < 15.[22]

In light of the limitations of the present study, the direction of the relationship between fathers' and children's FV intake cannot be established as a result of the cross-sectional nature of the data. There is a possibility that the association between fathers' FV consumption and children's might be bidirectionally modified through social interaction. Another drawback is that we did not evaluate concepts such as household norms regarding the serving of FV daily as part of the family meals, as well as home support (encouragement) for the consumption of healthy foods.[34] Then again, parental feeding practices were beyond the scope of the present study, although they deserve consideration in future studies to determine parental traits that favour the fostering of healthy eating patterns in children. In addition, we did not have data available concerning country differences in the availability and variety of FV consumed in the family setting. Furthermore, we used family income insecurity in lieu of family income as a socio-economic status index, and therefore it is unknown how much of the family income was spent on food. It has been reported that food expenditure was strongly related to children's FV consumption.[10] Alternatively, we did not have details on the cost of FV and average family income per country, which could be a source of bias. Representing one more factor, details on family structure were not collected. Previous studies have shown that the consumption of FV amongst children from single-parent families was lower compared to in those with two parents [35,36] as a result of low income and the higher cost of healthy foods such as FV.[37] Concerning dietary assessment methods that use self-administered FFQs, the scale used to categorise frequency of food intake, reporting and social desirability bias are all common disadvantages that may lead to overestimation of healthy

food intake and an underestimation of unhealthy foods in parents and children.[38,39] Furthermore, children's FFQ could resemble that of the parent completing the questionnaire.[40] Nonetheless, uniform to all dietary guidelines of the participating countries is the recommendation for an increased intake of FV for health benefits and the prevention of future chronic disease.[4]

CONCLUSIONS

Family comprises an important social environment where children learn and adopt their eating habits. Parents play a crucial role as health promoters, role models and educators influencing the food choices of their children. Baseline data from the large-scale Feel4Diabetes study highlighted that families in Southern European countries (i.e., Greece and Spain), as well as in Hungary, continue to have poor dietary habits as indicated by the low FV intake. The present study showed that fathers' daily FV intake was positively associated with children's intake of these foods. Implementation of future population-based strategies promoting FV intake not only in mothers, but also in fathers could be an effective public health initiative to increase FV intake in children. Policy-makers should give special attention to families dwelling in Southern European regions.

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CONFLICT OF INTERESTS

The authors declare that there are no conflict of interests.

AUTHOR CONTRIBUTIONS

MMP, YM and GM were responsible for study conceptualisation. MMP, YM and GM were responsible for methodology. MMP conceived the concept for the analysis, conducted the statistical analysis and is the principle author of the first and final draft of the manuscript. GM and CM were responsible for investigation and data collection. MMP, GM, CM and YM were responsible for data curation. MMP, GM and CM were resposible for writing the original draft and final draft preparation. YM, GM, CM, GC, FDeV, JK, PF-B, SL, KM, VI, RI, LM, TT and NU were resposible for reviewing and editing. YM was responsible for supervision. YM was responsible for project administration. All authors have read and agreed to final version of version of the manuscript submitted for publication.

ETHICAL STATEMENT

This study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving research study participants were approved by the Ethics committees of the relevant institutions in the six European countries. Written informed consent was obtained from all subjects.

TRANSPARENCY DECLARATION

The lead author affirms that this manuscript is an honest, accurate and transparent account of the study being reported. The reporting of this work is compliant with the STROBE guidelines. The lead author affirms that no important aspects of the study have been omitted and that any discrepancies from the study as planned have been explained.

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REFERENCES

1. WHO. WHO/FAO. Fruit and vegetables for health, report of a joint FAO/WHO workshop. 2004 [cited 2020 Oct]. Available from: https://apps.who.int/iris/handle/10665/43143
2. Aunene D, Giovannucci E, Boffetta P, Fadnes LT, Keum N, Norat T, et al. Fruit and vegetable intake and the risk of cardiovascular disease, total cancer and all-cause mortality-a systematic review and dose-response meta-analysis of prospective studies. Int J Epidemiol. 2017;46:1029–56. https://doi.org/10.1093/ije/dyw319
3. Li M, Fan Y, Zhang X, Hou W, Tang Z, Tang Z. Fruit and vegetable intake and risk of type 2 diabetes mellitus: meta-analysis of prospective cohort studies. BMJ Open. 2014;4:e005497. https://doi.org/10.1136/bmjopen-2014-005497
4. McCarthy R, Kehoe L, Flynn A, Walton J. The role of fruit and vegetables in the diets of children in Europe: current state of knowledge on dietary recommendations, intakes and contribution to energy and nutrient intakes. Proc Nutr Soc. 2020. 1–8. https://doi.org/10.1017/S0029665120007090
5. Scaglioni S, De Cosmi V, Ciappolino V, Parazzini F, Brambilla P, Agostoni C. Factors influencing children's eating behaviours. Nutrients. 2018;10:706. https://doi.org/10.3390/nu10060706
6. Pearson N, Biddle SJ, Gorely T. Family correlates of fruit and vegetable consumption in children and adolescents: a systematic review. Public Health Nutr. 2009;12:267–83. https://doi.org/10.1017/S1368980008002589
7. Wang Y, Beydoun MA, Li J, Liu Y, Moreno LA. Do children and their parents eat a similar diet? Resemblance in child and parental dietary intake: systematic review and meta-analysis. *Journal of Epidemiol.* Community Health (Bristol). 2011;65:177–89. https://doi.org/10.1136/jech.2009.095901
8. Scaglioni S, Arrizza C, Vecchi F, Tedeschi S. Determinants of children's eating behavior. Am J Clin Nutr. 2011;94:2006s–2011s. https://doi.org/10.3945/ajcn.110.001685
9. Draxten M, Fulkerson JA, Friend S, Flattum CF, Schow R. Parental role modeling of fruits and vegetables at meals and snacks is associated with children's adequate consumption. Appetite. 2014;78:1–7. https://doi.org/10.1016/j.appet.2014.02.017
10. Jones LR, Steer CD, Rogers IS, Emmett PM. Influences on child fruit and vegetable intake: sociodemographic, parental and child factors in a longitudinal cohort study. Public Health Nutr. 2010;13:1122–30. https://doi.org/10.1017/S1368980010000133
11. Rodenburg G, Oenema A, Kremers SP, van de Mheen D. Parental and child fruit consumption in the context of general parenting, parental education and ethnic background. Appetite. 2012;58:364–72. https://doi.org/10.1016/j.appet.2011.11.001
12. Khandpur N, Blaine RE, Fisher JO, Davison KK. Fathers' child feeding practices: a review of the evidence. Appetite. 2014;78:110–21. https://doi.org/10.1016/j.appet.2014.03.015
13. Latomme J, Huys N, Cardon G, Morgan PJ, Lateva M, Chakarova N, et al. Do physical activity and screen time mediate the association between European fathers' and their children's weight status? Cross-sectional data from the Feel4Diabetes-study. Int J Behav Nutr Phys Act. 2019;16:100. https://doi.org/10.1186/s12966-019-0864-8
14. Manios Y, Androutsos O, Lambrinou CP, Cardon G, Lindstrom J, Annemans L, et al. A school- and community-based intervention to promote healthy lifestyle and prevent type 2 diabetes in vulnerable families across Europe: design and implementation of the Feel4Diabetes-study. Public Health Nutr. 2018;21:3281–90. https://doi.org/10.1017/S1368980018002136
15. Androutsos O, Anastasiou C, Lambrinou C-P, Mavrogianni C, Cardon G, Van Stappen V, et al. Intra- and inter- observer reliability of anthropometric measurements and blood pressure in primary schoolchildren and adults: the Feel4Diabetes-study. BMC Endocr Disord. 2020;20:27. https://doi.org/10.1186/s12902-020-0501-1
16. Cole TJ, Lobstein T. Extended international (IOTF) body mass index cut-offs for thinness, overweight and obesity. Pediatr Obes. 2012;7:284–94. https://doi.org/10.1111/j.2047-6310.2012.00064.x
17. Festy P, Gaymu J, Thévenin M. Évaluer la situation budgétaire de son ménage, en tête-à-tête avec l'enquêteur ou en présence du partenaire. Population (Paris). 2014;69:85–107. https://doi.org/10.3917/popu.1401.0085
18. Anastasiou CA, Fappa E, Zachari K, Mavrogianni C, Van Stappen V, Kivelä J, et al. Development and reliability of questionnaires for the assessment of diet and physical activity behaviors in a multi-country sample in Europe the Feel4Diabetes Study. BMC Endocr Disord. 2020;20:135. https://doi.org/10.1186/s12902-019-0469-x
19. Britton D. SPSS e tutor Measures of Association and Correlation. 2020 [cited 2021 Feb]. Available from: https://subjectguides.esc.edu/c.php?g=659059%26p=4626955
20. Norusis M. Chapter 4: Ordinal logistic regression. In: IBM SPSS Statistics 19 Advanced Statistical Procedures Companion. Prentice-Hall; 2019. [cited 2021 Feb]. Available from: https://www.norusis.com/pdf/ASPC_v13.pdf
21. Petrauskienė A, Žaltauskė V, Albavičiūtė E. Family socioeconomic status and nutrition habits of 7-8 year old children: cross-sectional Lithuanian COSI study. Ital J Pediatr. 2015;41:34.
22. Laerd Statistics. Ordinal logistic regression using SPSS statistics. Statistical tutorials and software guides. Statistics. 2015 [cited 2020 Dec]. Available from: http://www.statistics.laerd.com
23. Birch LL, Fisher JO. Development of eating behaviors among children and adolescents. Pediatrics. 1998;101:539–49.
24. Hall L, Collins CE, Morgan PJ, Burrows TL, Lubans DR, Callister R. Children's intake of fruit and selected energy-dense nutrient-poor foods is associated with fathers' intake. J Am Diet Assoc. 2011;111:1039–44. https://doi.org/10.1016/j.jada.2011.04.008
25. Robinson LN, Rollo ME, Watson J, Burrows TL, Collins CE. Relationships between dietary intakes of children and their parents: a cross-sectional, secondary analysis of families participating in the Family Diet Quality Study. J Hum Nutr Diet. 2015;28:443–51. https://doi.org/10.1111/jhn.12261
26. Litchford A, Savoie Roskos MR, Wengreen H. Influence of fathers on the feeding practices and behaviors of children: a systematic review. Appetite. 2020;147:104558. https://doi.org/10.1016/j.appet.2019.104558
27. Ek S. Gender differences in health information behaviour: a Finnish population-based survey. Health Promot Int. 2015;30:736–45. https://doi.org/10.1093/heapro/dat063
28. Wolnicka K, Taraszewska AM, Jaczewska-Schuetz J, Jarosz M. Factors within the family environment such as parents' dietary habits and fruit and vegetable availability have the greatest influence on fruit and vegetable consumption by Polish children. Public Health Nutr. 2015;18:2705–11. https://doi.org/10.1017/S1368980015000695
29. Birch LL. Children's preferences for high-fat foods. Nutr Revs. 1992;50:249–55. https://doi.org/10.1111/j.1753-4887.1992.tb01341.x
30. Walsh AD, Hesketh KD, van der Pligt P, Cameron AJ, Crawford D, Campbell KJ. Fathers' perspectives on the diets and physical activity behaviours of their young children. PLoS One. 2017;12:e0179210. https://doi.org/10.1371/journal.pone.0179210
31. Hall JN, Moore S, Harper SB, Lynch JW. Global variability in fruit and vegetable consumption. Am J Prev Med. 2009;36:402–409. https://doi.org/10.1016/j.amepre.2009.01.029. e405.
32. OECD. Health at a glance: Europe 2016—State of health in the EU cycle. Paris: Organization for Economic Co-operation and Development (OECD); 2016. https://doi.org/10.1787/9789264265592-en (accessed February 2021)

33. Ashfield-Watt PA, Welch AA, Day NE, Bingham SA. Is 'five-a-day' an effective way of increasing fruit and vegetable intakes? Public Health Nutr. 2004;7:257–61. https://doi.org/10.1079/PHN2003524
34. Sleddens EF, Kremers SP, Stafleu A, Dagnelie PC, De Vries NK, Thijs C. Food parenting practices and child dietary behavior. Prospective relations and the moderating role of general parenting. Appetite. 2014;79:42–50. https://doi.org/10.1016/j.appet.2014.04.004
35. Zugravu C. Eating habits and influential factors for mothers and children in Romania. Internat J Collab Res Internal Med Public Health. 2012;4:362–74. Available from: https://internalmedicine.imedpub.com/eating-habits-and-influential-factors-for-mothers-andchildren-in-romania.php?aid=6099
36. Baek YJ, Paik HY, Shim JE. Association between family structure and food group intake in children. Nutr Res Pract. 2014;8:463–468. https://doi.org/10.4162/nrp.2014.8.4.463
37. Drewnowski A, Darmon N. The economics of obesity: dietary energy density and energy cost. Am J Clin Nutr. 2005;82:265s–273s. https://doi.org/10.1093/ajcn/82.1.265S
38. Moghames P, Hammami N, Hwalla N, Yazbeck N, Shoaib H, Nasreddine L, et al. Validity and reliability of a food frequency questionnaire to estimate dietary intake among Lebanese children. Nutr J. 2016;15:4. https://doi.org/10.1186/s12937-015-0121-1
39. Subar AF, Freedman LS, Tooze JA, Kirkpatrick SI, Boushey C, Neuhouser ML, et al. Addressing current criticism regarding the value of self-report dietary data. J Nutr. 2015;145:2639–45. https://doi.org/10.3945/jn.115.219634
40. Vepsäläinen H, Nevalainen J, Fogelholm M, Korkalo L, Roos E, Ray C, et al. Like parent, like child? Dietary resemblance in families. Int J Behav Nutr Phys Act. 2018;15:62. https://doi.org/10.1186/s12966-018-0693-1

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Healthy Growth Study, Feel4Diabetes, Helena Study and Food4Me and is one of the most active and recognized researchers with years of experience in studying the interactions among behavioural, demographic and physiological indices leading to the development of non-communicable diseases (NCDs) as well as in developing and implementing interventions for their prevention. He has over 600 publications and 20,923 citations and continues to be a driving force in public health nutrition.

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