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Relationship between perception of emotional home atmosphere and fruit and vegetable consumption in European adolescents: results from the I.Family survey

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Abstract

Objective: Consumption of fruits and vegetables (F&V) among adolescents falls below recommendations in many Western countries. The impact of social and emotional aspects of family life on adolescent dietary behaviour may contribute to this, yet remains under-investigated. The present study examines the association between adolescents' perceptions of emotional home atmosphere (EHA) and their F&V consumption frequency.

Design: An FFQ was used to assess F&V consumption frequency. EHA was assessed by an eight-item measure with three subscales: perceived home warmth, strictness and relational tension. EHA subscales were used as binary variables: a score equal to or above the median value was considered as a higher perception, while a score below the median was considered as a lower perception of the EHA in question. Country differences in meeting the European 5-a-day recommendations were described. Further, the association between EHA and F&V consumption frequency was investigated using multiple linear regression.

Setting: Regional examination centres in eight European countries.

Participants: Adolescents (n 3196) aged 12–18 years.

Results: The mean F&V consumption frequency was 3·27 (SD 2·84) times/d. Only 16·1 % of boys and 18 % of girls in our study sample met the recommendation of five F&V daily. After controlling for age, sex, education level of the parents and country of origin, perceived home warmth was associated with a 16 (95 % CI 9, 22) % higher F&V consumption frequency ($P < 0·001$).

Conclusions: F&V consumption frequency was suboptimal in the survey areas. Interventions targeting perceived warmth as a component of EHA could potentially have a positive effect on adolescents' dietary behaviour.

Keywords
Adolescents
Fruits and vegetables
Emotional home atmosphere
Socio-emotional
Family

The period of adolescence is of particular public health interest due to its psychobiological features[1] as well as the impact of practices adopted during adolescence on a number of adult outcomes including future dietary practices[2–4]. Adolescents' diet quality has been a concern in different regions across the globe[5–9]. A recent population-based study reported that diet quality among adolescents was the worst compared with other age groups[10].

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Fruit and vegetable (F&V) consumption is protective against some diseases, is associated with more favourable body weight[11–14] and is considered one of the markers of a healthy lifestyle[15]. However, epidemiological evidence from different countries suggests that F&V intake during adolescence is often inadequate[7,9,16–18].

A number of factors besides accessibility are associated with adolescent diet adequacy[8] including individual, social and family factors[19–22]. Families are considered an important frame of reference for dietary choices[23]. Eating attitude, as assessed along a continuum of disturbed eating, has been reported to be related to female adolescents' perception of emotional family closeness[24], while family support was found to be directly related to F&V intake among African-American teenagers[25].

There are concerns that family function has not been well researched in relation to youth health behaviours and weight status[26]. Most of the research in this area focuses on the home 'food environment'[27] or on the prototypes of parenting[28]. Parenting styles have been described in a number of different ways[29–32]. One of the earlier and frequently cited parenting typologies in the literature is the Baumrind model, which based the parenting style classification on three dimensions: (i) parental control and demands; (ii) parent child communication; and (iii) nurturance as expressed by affection and involvement[31,32]. Parenting styles have been related to a number of important outcomes in adolescents' lives such as physical activity, body weight and alcohol drinking behaviour[33–35]. However, the relationship between parenting styles and F&V consumption remains inconclusive[28,36].

Parenting styles involve the assessment of different aspects of family life. Although the emotional home atmosphere (EHA) can be considered a meaningful context for all family interactions, little is known about how it relates to dietary practices. This seems to be a knowledge gap given that EHA has been related to a number of important health issues, such as metabolic outcomes and neuropsychiatric disorders[37,38]. Some studies pointed to the association between 'home food environment' and dietary intake[39,40] but to the best of our knowledge the association between EHA and dietary practices has not been explored. The aim of the present study was to examine the association between adolescents' perceptions of EHA and their usual F&V consumption frequency. We hypothesized that a positive EHA and F&V consumption frequency are positively associated.

Methods

Population and data collection

The present study includes participants between the ages of 12 and 18 years from the community-oriented I.Family study in eight participating countries: Belgium, Cyprus, Estonia, Germany, Hungary, Italy, Spain and Sweden. Each participating country had an ethically approved study centre coordinating cohort recruitment and examinations. Details of the study design and instruments have been previously described in detail[41].

Exposure variable: emotional home atmosphere

Participating adolescents were asked 'To what extent do the following describe the atmosphere of your home?' The response categories were 'warm/caring', 'encouraging', 'trusting/understanding', 'open', 'strict', 'unjust/unfair', 'quarrelsome' and 'indifferent', with a five-point answering scale ranging from 'not at all' to 'very much so' (0 to 4 points). This measure was used to compose three separate additive subscales as described by Latendresse *et al.*[35]:

1. A four-item subscale of perceived warmth ('warm/caring'; 'encouraging'; 'trusting/ understanding'; 'open'). This subscale had minimum of 0 and a maximum of 16 with a Cronbach's α coefficient of 0·833.
2. A single-item subscale reflecting perceived strictness (i.e. 'strict'). This subscale had a minimum of 0 and a maximum of 4.
3. A three-item subscale of perceived relational tension ('unjust unfair'; 'quarrelsome', 'indifferent'). This subscale had a minimum of 0 and a maximum of 12 with a Cronbach's α coefficient of 0·613 which, although not optimal, has been previously used in other published research[35].

EHA subscales were then used to create binary variables for each EHA, where participants with a score equal to or above the median value were considered to have a higher perception of the EHA in question whereas those with a score below the median were considered to have a lower perception. The respective medians were 13 for perceived warmth, 2 for strictness and 1 for tension. For further exploration, EHA were also divided into tertiles with cut-offs given by 12 and 14 for perceived warmth; 1 and 2 for perceived strictness; and 1 and 3 for perceived tension.

Outcome variable: fruit and vegetable intake

Usual consumption frequencies of F&V were assessed using a self-administered, reproducible and validated forty-three-item FFQ[42]. Adolescents were asked how often (over the preceding month) they consumed fruits and vegetables. In the FFQ, fruits and vegetables were broken down into six categories: (i) potatoes (cooked not fried); (ii) other cooked vegetables (with provision of local examples); (iii) legumes (e.g. beans, lentils, chickpeas as well as local examples); (iv) raw vegetables (mixes salad, carrot, fennel, cucumber, lettuce, tomatoes as well as local examples); (v) fresh fruits (also as freshly squeezed juice) without sugar; and (vi) fresh fruits (also as freshly squeezed juice) with added sugar. Response categories included: 'never/less than once a week', '1–3 times a week', '4–6 times a week', '1 time per day', '2 times per day', '3 times

per day' and '4 or more times per day'. The responses for consumption of all fruits and all vegetables were summed into a single score representing weekly consumption frequency, which was then divided by 7 to obtain the average daily consumption frequency. The daily consumption frequency of F&V was skewed to the right; therefore, values were log-transformed in order to achieve normality. In order to include observations of zero intake (n 28) in the log-transformed variable, we added the value of the lowest reported frequency of 0·29 times/d to the zero intake. A sensitivity analysis was performed by excluding participants with zero frequency of F&V. Based on the daily F&V intake frequency, a binary variable indicated whether participants met the dietary recommendations of at least five daily intakes of F&V or not.

Inclusion criteria

All respondents aged 12 years or more who did not have missing data regarding the exposure or outcome were included; see flowchart (Fig. 1) for more details.

Covariates

Educational and income levels were self-reported by parents. The highest educational attainment of the parents was standardized according to the International Standard Classification of Education, 2011 (ISCED) and recategorized into two categories: low–medium (ISCED level 0–5) and high (ISCED level 6–8), for cross-country comparisons. The low education category was merged with the medium because it included too few participants for analysis[43]. Income level was derived based on country-specific data and was classified into three categories: (i) low, representing families with low and low-to-medium incomes; (ii) medium; and (iii) high, representing families with high and medium-to-high incomes.

Statistical analysis

Descriptive analyses compared F&V consumption frequency and participant characteristics by survey country. Multiple linear regression was used to investigate the association between F&V consumption frequency and EHA scores, adjusted for age, sex, parental education and country. Only participants with complete data for age, sex, parental education (as a proxy for socio-economic status) and country were included in the regression models as shown in Fig. 1. Sensitivity analyses were performed where the models were also adjusted for family income level and participants with missing income data (n 554) were excluded. Because F&V consumption was skewed to the right, log(F&V) was used as outcome variable, which provided normally distributed residuals. The results of linear regression of log(F&V) *v.* a predictor X ($\log(\text{F\&V}) = a + b \times X$) are given in terms of percentage change in F&V consumption frequency per unit of the predictor, % change in mean $\text{F\&V} = [\text{F\&V}(X+1) - \text{F\&V}(X)]/\text{F\&V}(X) \times 100\,\% = [\exp(b) - 1] \times 100\,\%$, where $\exp(\cdot)$ denotes the inverse of the logarithmic function, i.e. $\text{F\&V} = \exp(a + b \times X)$.

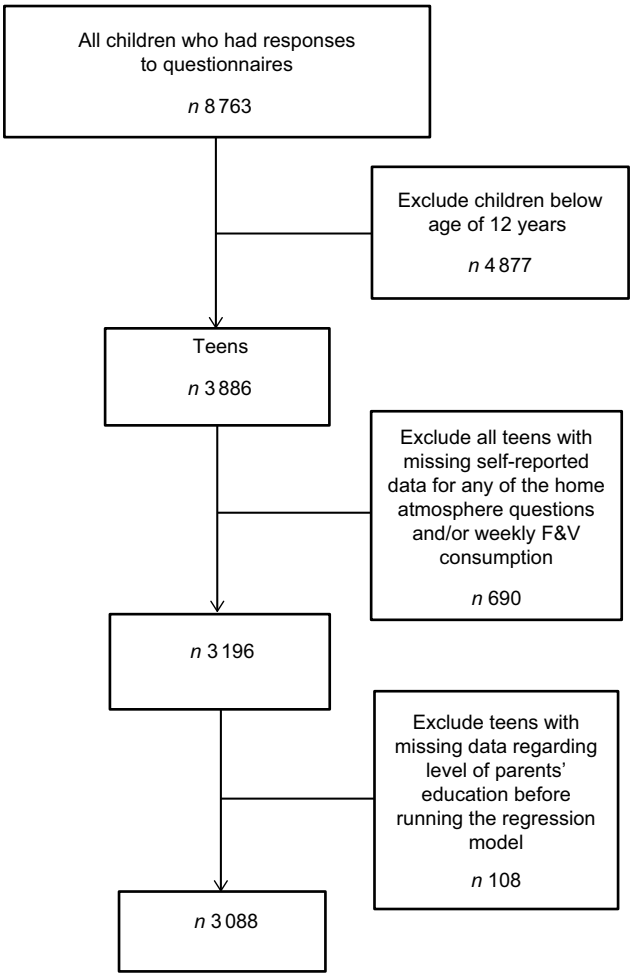

Fig. 1 Inclusion/exclusion of I.Family study participants in the current study sample (F&V, fruit and vegetable)

In separate models, potential interactions between perceived EHA and country of origin, sex of the adolescent and parental education were tested by including the corresponding product terms in the model. Differences in background variables were investigated for participants with missing values for exposure or outcome. All analyses were performed using the statistical software package IBM SPSS Statistics version 23.

Results

Descriptive statistics

The descriptive statistics are presented by country in Table 1. Girls and boys were similarly represented in all countries except Belgium. The total means for EHA scores were respectively 12·78 (SD 2·87) for perceived warmth, 1·45 (SD 1·06) for perceived strictness and 2·11 (SD 2·14) for perceived tension. The overall mean F&V consumption frequency was 3·27 (SD 2·84) times/d. The lowest mean frequency of F&V consumption was observed in the Italian

Table 1 Characteristics of the study population of adolescents (*n* 3196) aged 12–18 years and distribution of covariates by survey country, I.Family study, 2013/2014

	Survey country								
	ITA	EST	CYP	BEL	SWE	GER	HUN	ESP	Total
Total *n*	539	482	807	65	236	440	468	159	3196
Male sex (%)	48·6	44·2	51·9	38·5	48·7	47·0	51·9	44·0	48·6
Age (years), mean	13·31	13·75	13·84	13·21	13·44	13·80	13·62	13·45	13·64
SD	0·77	0·57	1·42	0·97	0·91	1·16	0·96	0·67	1·06
Parental education, *n*	507	476	767	64	234	431	454	155	3088
High (%)	19·7	66·0	58·3	81·3	76·9	38·7	45·8	60·0	50·6
Household income level, *n*	447	425	641	35	220	318	392	128	2606
Low (%)	62·9	16·5	34·5	8·6	4·5	29·6	22·4	8·6	29·9
Medium (%)	26·4	28·2	40·1	42·9	31·8	47·8	38·8	40·6	35·9
High (%)	10·7	55·3	25·4	48·6	63·6	22·6	38·8	50·8	34·2
EHA: perceived warmth (0–16), mean	12·74	12·25	13·18	13·03	12·80	12·58	12·93	12·38	12·78
SD	3·08	3·07	2·52	2·32	2·66	3·14	2·78	2·78	2·87
EHA: perceived strictness (0–4), mean	0·56	1·57	1·76	1·54	1·42	1·44	1·65	2·04	1·45
SD	0·91	0·99	0·96	1·03	0·94	0·96	1·01	1·14	1·06
EHA: perceived tension (0–12), mean	1·48	2·21	1·98	1·85	2·39	2·61	1·94	3·36	2·11
SD	2·15	2·01	1·99	1·91	2·10	2·37	1·94	2·39	2·14
Daily F&V consumption (times/d), mean	2·93	3·41	3·31	3·33	3·47	3·12	3·13	4·37	3·27
SD	2·59	2·89	2·87	2·40	2·38	2·70	2·92	3·80	2·84
F&V consumption ≥ 5 times/d (%)									
Boys	13·0	17·8	15·3	20·0	20·0	14·5	14·0	31·4	16·1
Girls	15·2	21·6	15·5	5·0	23·1	18·0	17·3	27·0	18·0
Total	14·1	19·9	15·4	10·8	21·6	16·4	15·6	28·9	17·1

ITA, Italy; EST, Estonia; CYP, Cyprus; BEL, Belgium; SWE, Sweden; GER, Germany; HUN, Hungary; ESP, Spain; EHA, emotional home atmosphere; F&V, fruit and vegetable.

survey centre, 2·93 (SD 2·59) times/d, and the highest in the Spanish survey centre, 4·37 (SD 3·80) times/d. Overall, only 16·1 and 18·0 % of the boys and girls, respectively, consumed F&V five times or more daily. The highest percentage of adolescents meeting the recommendations was seen in the Spanish sample (28·9 %) while the lowest percentage was seen in Belgium (10·8 %). Mean total F&V consumption frequency was slightly higher among girls (3·31 (SD 2·64) times/d) than boys (3·23 (SD 3·03) times/d; data not shown). Mean total F&V consumption frequency was higher among adolescents whose parents had a higher level of education (3·34 (SD 2·57) times/d) compared with those whose parents had lower education level (3·19 (SD 3·07) times/d). No differences in F&V consumption frequency were observed by family income (data not shown).

Participants with missing data about EHA did not differ significantly from those included in the current analysis with regard to age, sex, BMI *Z*-score, parental education or family income level. However, there were some significant country differences in missing EHA data. In contrast, participants who had missing data on the outcome variable, i.e. F&V consumption, were significantly different from those included in the following aspects: (i) sex, where males had more missing values than females (12·5 *v.* 9·3 %); (ii) mean BMI *Z*-score of included participants was significantly lower than that of the excluded ones (0·58 *v.* 0·71); and (iii) some country differences, with the highest percentage of missing F&V values in Belgium (22·7 %) and the lowest in Hungary (3·0 %).

Modelling emotional home atmosphere and fruit and vegetable intake

Table 2 (model 1) shows that among the EHA subscales, only perceived warmth was significantly associated with mean F&V consumption frequency, whereas no significant associations were observed for perceived strictness or perceived tension. Perceived warmth was associated with a 16 (95 % CI 9, 22) % higher value for F&V consumption frequency. In absolute amounts, an independent *t* test showed that the mean daily F&V consumption frequency among adolescents who perceived a higher degree of warmth was 3·5 times/d, *v.* 3·0 times/d for those who did not ($P < 0·001$; data not shown). When based on tertiles of perceived warmth, a 16·5 (95 % CI 8·9, 24·7) % higher value for F&V consumption frequency was seen in the highest tertile, and a 9·5 (95 % CI 2·3, 17·3) % higher value in the intermediate tertile, compared with the lowest tertile. Girls reported 6·7 (95 % CI 1·1, 12·6) % higher F&V consumption than boys, and high parental education was associated with a 10·3 (95 % CI 4·2, 16·7) % higher F&V consumption frequency than low–medium parental education, independent of EHA.

Table 2 (models 2–5) shows that a positive association between higher perceived warmth and F&V consumption was observed in both boys and girls and in both education strata, but the interaction effects by perceived warmth and sex or parental education were not significant. Overall, there were no interaction effects between EHA and background variables including country of origin or family

Table 2 Association of perceived emotional home atmosphere (EHA) with adolescents' fruit and vegetable (F&V) intake, stratified by sex and parental education level, among adolescents (*n* 3088) aged 12–18 years, I.Family study, 2013/2014

Model	Stratum	*n*	EHA exposure (higher *v.* lower)	% Change†	95 % CI
1‡	All participants	3080	Warmth	16***	9, 22
			Strictness	2	−4, 8
			Tension	1	−5, 7
2§	Boys	1493	Warmth	14**	5, 24
			Strictness	1	−8, 10
			Tension	2	−7, 11
3§	Girls	1595	Warmth	18***	9, 27
			Strictness	3	−5, 12
			Tension	−1	−9, 8
4‖	Low–medium parental education	1527	Warmth	12*	3, 22
			Strictness	9	−1, 20
			Tension	−2	−12, 8
5‖	High parental education	1561	Warmth	20***	11, 29
			Strictness	−4	−11, 4
			Tension	3	−4, 12

*$P < 0{\cdot}05$, **$P < 0{\cdot}01$, ***$P < 0{\cdot}001$.
†Percentage change = $[\exp(b) - 1] \times 100$ %, where b denotes the beta value in the regression equation $\log(\text{F\&V}) = a + b \times X$.
‡Model for F&V consumption *v.* perceived EHA adjusted for age, sex, survey country and parents' education.
§Model adjusted for age, parents' education level (high *v.* less) and country.
‖Model adjusted for age, sex and country.

income (data not shown). Furthermore, sensitivity analyses revealed that the associations shown in Table 2 remained unchanged after adjusting for family income (see online supplementary material, Supplemental Table S1) as well as when excluding participants reporting zero F&V consumption frequency (Supplemental Table S2).

Figure 2 illustrates the mean F&V intake by EHA as higher *v.* lower perception of warmth for each survey country. In all countries, F&V consumption frequency in adolescents with higher perception of warmth exceeded that of adolescents with lower perception.

Discussion

The present study sheds light on the suboptimal consumption frequency of F&V among girls and boys from eight European countries and uniquely describes associations with three subscales of perceived EHA, which, to our knowledge, has not been previously reported.

The majority of participating adolescents did not meet the recommendations for F&V consumption. These findings are consistent with previous dietary studies. In Finland only 32 and 23 % of girls and boys, respectively, reported daily fruit consumption[18], while in England only 21 % of boys and girls consumed five or more servings of F&V daily[44]. Results from the HELENA (Healthy Lifestyle in Europe by Nutrition in Adolescence) study indicated that adolescents ate half of the recommended amount of F&V[45]. In South-East Asia, more than 75 % of adolescents did not meet dietary requirements for F&V[17] while in the Eastern Mediterranean region this percentage increases to over 80 %[16]. In light of the widely accepted concept that adequate F&V consumption has a protective influence against many chronic diseases[11–13], these results suggest there is cause for concern. Our results also demonstrate an overall sex difference in F&V consumption frequency where girls generally had higher consumption frequency than boys. This is in agreement with other European dietary studies[18,45,46]. This failure to meet daily F&V intake recommendations can perhaps be viewed in the context of previous empirical findings demonstrating that positive behavioural engagement decreased between the ages of 11 and 15 years (the mean age in our sample is 13·6 years). Moreover this decrease was more pronounced among boys than girls[47] in accordance with the present findings.

The cardinal aim of the present work was to investigate the association between perception of a particular EHA and F&V consumption frequency in European adolescents. Our results show that a higher perception of warmth at home was robustly associated with a 16 % increase in F&V consumption frequency, independently of the study covariates. This finding is congruous with some previous empirical findings but given the variety of study designs, direct comparisons are difficult to make. A number of studies pointed out the association between some family-related attributes and F&V consumption, but the family attributes most investigated were concerned with parental modelling and family rules rather than with EHA[48]. It was recently reported that higher family functioning was associated with consumption of more F&V servings among adolescent girls[26] and that certain positive family characteristics (e.g. high parental encouragement, modelling of healthful eating and frequent family meals) were associated with higher F&V consumption for both sexes[49]. In a study

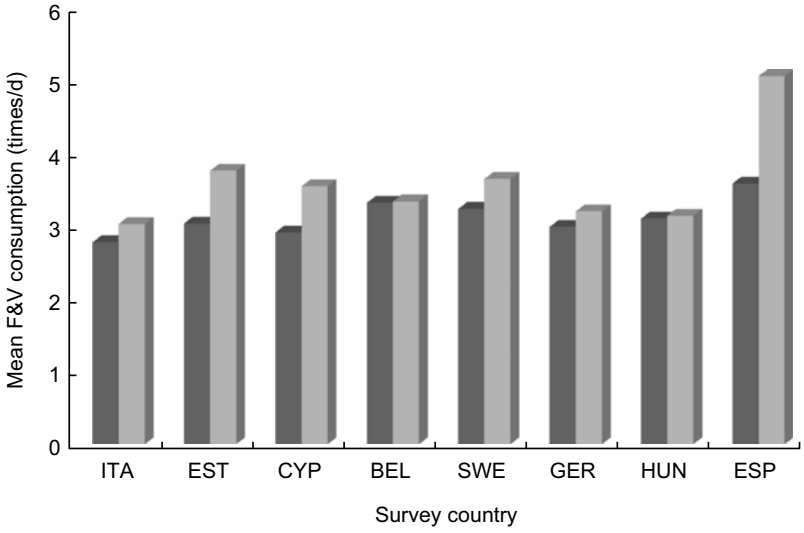

Fig. 2 Fruit and vegetable (F&V) consumption by perceived emotional home atmosphere (■, no warmth; ■, warmth) and survey country among adolescents (*n* 3196) aged 12–18 years, I.Family study, 2013/2014 (ITA, Italy; EST, Estonia; CYP, Cyprus; BEL, Belgium; SWE, Sweden; GER, Germany; HUN, Hungary; ESP, Spain)

population of similar age to ours, van der Horst *et al.* and Libuda *et al.* found that perceived parental involvement, but not strictness, was associated with lower consumption of sugar-sweetened beverages, a proxy for low diet quality[50,51]. This is consistent with our findings on F&V consumption frequency, which may be considered a proxy for high diet quality.

However, our findings on perceived strictness and home tension are not consistent with Alsharairi and Somerset[36] who found that parental control scores were significantly associated with F&V consumption frequency among girls. This discrepancy might be due to two factors: (i) the difference in age group of the studied populations (Alsharairi and Somerset had younger study participants aged 4–9 years); and (ii) the method of assessment of the exposure variable (whereas they used parent-reported data, our scores are constructed using information obtained first hand from the adolescents themselves). There has been evidence that children's and/or adolescents' reports of exposures are more related to behavioural outcomes than parental reports[35,52]. In another study with adolescent participants from both Belgium and Italy, it was reported that a high level of family food rules in terms of both restriction and obligation was associated with increased frequency of F&V consumption[46], which may imply that higher levels of strictness are associated with increased frequency of F&V consumption. However, it must be noted that our sample is much more culturally diverse than theirs and that their assessment of F&V consumption frequency was rather crude by their own accord.

The association between warmth and F&V consumption frequency was independent of age, sex, country and socioeconomic status while strictness had no relationship to F&V consumption frequency. This may be explained by the tendency of adolescents within intact stable families to demonstrate less risky behaviours in general, as recently reported by a study conducted in Hong Kong[53]. Likewise, it has previously been demonstrated that adolescent perception of parental warmth is associated with increased likelihood of 'engagement in positive behavior'[47]. In light of these findings we should perhaps consider that, at least in the age group in question, warmth is a more important correlate of dietary behaviour than strictness and parental control. It is worth noting that the association between warmth and the frequency of F&V consumption was more pronounced among the females, which can perhaps be explained by recent findings demonstrating that health behaviours were more related to family conditions among adolescent females than among males[54]. Our results also suggest that the effect of warmth was more pronounced among adolescents whose parents are highly educated, which might be related to highly educated parents being more likely to understand the importance of F&V consumption and thus more likely to make them available at home.

Our findings may explain some inconsistencies in the evidence regarding the effect of parenting styles on F&V consumption frequency[28,36]. In assessing parenting styles, researchers usually use specific indices or instruments designed to capture the prototypic patterns of parenting[31,55]; thus investigating many family variables simultaneously. However, it might be the case that not all indices used to assess parenting have an impact on adolescent dietary behaviour or at least that different indices have different impacts. Consequently, investigating elements of the family life individually to explore their unique association with dietary habits may be more informative. The present work represents a step in this direction.

Although the magnitude of the association between perceived warmth and F&V consumption frequency might be

considered small, it was robust in adjusted models and remained statistically significant. We have shown that the majority of the studied adolescents did not meet the general European recommendations for F&V consumption frequency. This applies to all countries and to both sexes. As such, a 16 % higher consumption is not a trivial effect. Family variables related to parenting style and EHA are modifiable and it is therefore possible to make them targets for intervention. In fact, the positive effects of interventions targeting parenting on children's as well as parents' behaviours have already been reported[56,57]. Moreover, as EHA has already been found to be related to a number of other important health issues, such as metabolic outcomes and neuropsychiatric disorders[37,38], it may be assumed that the emotional home environment is a pivotal intervention platform and if tackled appropriately would lead to significant improvement in a range of health as well as behavioural outcomes. Increasing F&V consumption would have multiple health and societal benefits[58]. Furthermore, increasing F&V intake in place of other lower-quality food items is an important measure to reduce the burden of obesity which is one of the current priorities of public health[59].

Strengths and limitations

The present work contributes to the literature in at least two important ways. First, it expands the knowledge about adolescent F&V consumption frequency as an indicator of overall diet quality in a culturally diverse population; and second, it approaches the association between family life and dietary behaviour from a novel perspective where we consider family life to consist of a number of different facets that can potentially have diverse relationships with adolescent dietary behaviour rather than addressing the dimensions of parenting style as indivisible entities. To the best of our knowledge, there has not been any research to date that focused on EHA as a correlate of F&V consumption frequency among adolescents. We also have the advantage of a large sample size in which both sexes are similarly represented. Furthermore, EHA was adolescent-perceived rather than parent-reported, which is considered a better indicator of behavioural and health-related outcomes among adolescent populations[35,52]. Moreover, the comparability of methods across the study centres[41] overcomes earlier misgivings about standardization of food consumption methods in cross-country food studies[60].

Still as a matter of course, the present study has its limitations. Due to the sampling design adopted in the I.Family study, our results cannot be assumed to be representative of the countries investigated, which means that we cannot generalize the observed country differences. However, one should bear in mind that country-specific family atmosphere characteristics are potential confounding factors and in this context country differences are reported for the purpose of completeness. Moreover, there might be other correlates of F&V consumption that were not addressed in the present work, for example individual characteristics (e.g. preferences) or environmental characteristics (e.g. availability). However, as our findings were consistent across the socio-economic spectrums as well as in both sexes, it might be inferred that the influence of home environment is relevant independent of personal and environmental characteristics. Furthermore, no causalities can be inferred as the design of the study is cross-sectional. Fruit and vegetable consumption frequencies were not analysed separately but as a combined proxy for health-related diet quality, as has been done in other studies[28,36]. Another limitation where F&V consumption is concerned is that no inference can be made to quantities because the FFQ used in the survey did not specifically describe a serving size. Finally, teenagers' reports of their food intake may be inaccurate and subject to systematic errors. However, it may be relevant to note that early evidence from this cohort indicates that FFQ filled out by parents gave reproducible estimates of food consumption[42]. In this context we cannot rule out the possibility that reports of F&V consumption frequency may have been biased due to social desirability. Many of the adolescents had been exposed to an earlier intervention programme that stressed the advantages of F&V consumption in 2008/2009 and then completed questionnaires included in the present study in 2013/2014[41]. Social desirability has been known to account for some of the variance in dietary reports[61]. Thus, it might be the case that the true numbers of adolescents not meeting the general recommendations are larger than we report here.

Conclusion and implications

Our findings show that the adolescents' consumption of F&V was suboptimal and even more so among adolescents from households with less perception of warmth. Interventions targeting the perceived warmth could thus potentially have a positive effect on adolescents' F&V consumption which in turn would be a public health achievement. We recommend more in-depth exploration of the association between F&V intake and perceived EHA in future research; in particular, mechanisms for positively influencing the home environment which could be of public health value in diverse socio-economic environments.

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Supplementary material

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