GENDER AND REGIONAL VARIATION IN FRUIT AND VEGETABLE CONSUMPTION AND DETERMINANTS AMONG 11- TO 13 - YEAR OLD PORTUGUESE CHILDREN

Wind M[I], Vea O[I], Franchini B[II], Vaz de Almeida MD[II], Klepp KI[I]

[I] Department of Nutrition, University of Oslo, Oslo NO-0316 Norway

[II] Faculty of Nutrition and Food Sciences, University of Porto, 4200-465 Porto Portugal

belafranchini@fcna.up.pt

Abstract

Objective

Results from the European Pro Children study showed that intake of fruit and vegetables was highest among Portuguese children, but still lower than the daily recommended intake levels. The objective of this study was to identify gender and regional differences in intake and related personal and environmental determinants among 11- to 13- year old Portuguese children.

Design/setting/subjects

As part of the Pro Children study a cross-sectional survey was carried out in October-December 2003 among 2134 Portuguese children and 1314 mothers. Data was collected by means of self-administered questionnaires. Intake was assessed by a 24-hour recall and food frequency questions. Potential determinants were demographic, personal, perceived social-environmental and perceived physical-environmental factors and mother's frequency of intake.

Results

Children's intake of fruit and vegetables was low for both genders and in all regions. Boys reported less frequent intake than girls in all regions except for fruit in Lisboa. Children from Lisboa and Algarve reported lowest mean and least frequent intake of fruit and vegetables. Knowledge of daily recommended intake levels, taste preferences, perceived parental modelling behaviour, and mother's intake were strongest associated with children's daily intake of fruit and vegetables. These determinants were associated fairly consistently across genders and regions.

Conclusions

This study did not reveal large gender and regional differences in determinants related to intake of fruit and vegetables. Interventions should in particular address children's knowledge and taste preferences and parental intake.

Key-words:

Fruit and vegetable intake; Determinants; Portugal; Gender; Region.

Resumo

Objectivo

Os resultados do projecto europeu Pro Children demonstraram que o consumo de fruta e hortícolas pelas crianças portuguesas foi o mais elevado, mas ainda assim inferior às recomendações. O objectivo deste estudo foi identificar as diferenças entre géneros e regiões, em crianças portuguesas de 11 a 13 anos de idade, no consumo de fruta e hortícolas e determinantes pessoais e ambientais.

Metodologia

Como parte do projecto Pro Children foi levado a cabo um estudo transversal de Outubro a Dezembro de 2003 com 2134 crianças portuguesas e 1314 mães. Os dados foram recolhidos através de questionários de auto-administração. O consumo foi avaliado através da recordação das 24 horas anteriores e questões de frequência alimentar. Os potenciais determinantes foram factores demográficos, pessoais, sócio-ambientais e físico-ambientais e a frequência de consumo pela mãe.

Resultados

O consumo de fruta e hortícolas pelas crianças foi baixo para ambos os géneros e em todas as regiões. Os rapazes reportaram uma ingestão menos frequente do que as raparigas em todas as regiões, excepto para a fruta em Lisboa. As crianças pertencentes a Lisboa e Algarve reportaram uma ingestão média e

frequência de ingestão inferiores. O conhecimento das recomendações de ingestão, as preferências, a percepção da modelagem parental e o consumo das mães foram os factores com associação mais forte à ingestão diária de fruta e hortícolas pelas crianças. Estes determinantes estiveram associados de forma consistente nos dois géneros e nas diversas regiões.
Conclusões
Este estudo não revelou grandes diferenças em função do género ou da região nos determinantes de consumo de fruta e hortícolas. Futuras intervenções devem focar o conhecimento sobre as recomendações, as preferências das crianças e a ingestão parental.

Palavras-chave:
Consumo de fruta e hortícolas; Determinantes; Portugal; Género; Região.

INTRODUCTION

Fruit and vegetable consumption among European children has shown to be low compared with the WHO population goal and national recommendations [1, 2, 3]. Fruit in general probably protect against cancers of the mouth, pharynx, larynx, oesophagus, lung, and stomach [4]. An adequate fruit and vegetable consumption might also be related to the prevention of chronic diseases later in life [5]. Increasing children's and adolescents' fruit and vegetable intake is important since they have higher physiological needs for nutrients as they grow. Moreover healthy food habits acquired early in life might track into adulthood [6-9]. In addition, food preferences and habits might be easier to change during childhood [10].
The Pro Children cross-sectional survey was carried out in October-December 2003 and designed to gather information about the actual fruit and vegetable consumption among 11- to 13-year-old children and their parents in nine European countries. Results showed that the consumption was low in all countries and gender differences were found [1, 11]. Between country differences in fruit and vegetable consumption were found, but no clear North-South gradient as reported in previous studies [12-15]. The traditional diet in Portugal, as in other Southern European countries, has a high content of fruit and vegetables and is often referred to as the "Mediterranean diet" [16]. It has been suggested that people in the southern countries are changing their dietary habits, and gradually adopting a more "northern" diet including more meat and animal fat [13, 17].
Several studies and reviews have shown that personal factors, such as knowledge and taste preferences, and environmental factors, such as availability, are related to children's fruit and vegetable intake[18, 19, 20].
Recent socio-demographic and economic changes in Portugal, as well as changes in food availability, may indicate that the Portuguese have acquired different dietary habits over the past decades. However, the only Portuguese national dietary survey was conducted back in 1980 [16]. An observed decrease in the mean availability of fruit and vegetables from 1990 to 2000 [21], together with a high prevalence of overweight and obesity among children [22, 23], further state the need to focus on fruit and vegetable intake among children as an important health-related policy objective. Investigating gender and regional differences in fruit and vegetable intake within Portugal might give new insight into how these changes in dietary habits occur. To assess regional differences, the five different administrative regions; i.e. Norte, Centro, Lisboa e Vale doTejo (Lisboa), Alentejo and Algarve in which Portugal is organized, were used [21].
The aims of this present study, with a specific focus on gender and regional differences, are to (1) assess the intake of fruit and vegetables among Portuguese children, both in grams per day and usual frequency of intake, (2) describe the proportion of children reporting positively to potential personal, social and environmental determinants, (3), assess strength of the associations between presumed determinants and daily frequency of intake.

METHODS

Study population

Schools were chosen as the sampling unit, and 2535 children from 27 schools, randomly distributed and from all the five Portuguese regions and an equal number of parents were included. The participation rate was high with 98.4% of the children and 83.4% of the parents participating. Data from 2134 children and 1660 parents, of which 79.2% were mothers, was entered after exclusion of questionnaires due to lack of reliability and parental written consent [1, 25]. Research clearance and written consents from the parents were obtained before including the children in the cross-sectional survey. The completion of the questionnaire

was voluntary and parents could demand that their child's questionnaire should be destroyed. The Pro Children project adheres to the Helsinki Declaration and the convention of the Council of Europe on human rights and biomedicine.

The instrument

A precoded self- administered questionnaire (http://www.prochildren.org) to assess fruit and vegetable intake as well as possible determinants [26] was developed based on a theoretical model [27], a literature review [18] and interviews [28]. The Pro Children theoretical framework distinguished the most distal physical environmental determinants, social environmental determinants and the most proximal personal determinants of fruit and vegetable intake [27] i.e. applied a social-ecological approach, as has been suggested by others [29, 30].

All children were asked to fill in the questionnaire during one school session, in the classroom under the supervision of the classroom teacher. In addition, all participating children received a closed envelop with a questionnaire to take home to be filled in by one of their parents. This questionnaire was again returned by the children to the classroom teacher.

Fruit and vegetable consumption was assessed among both the children and the parents, by means of a 24-hour recall asking about yesterday's fruit and vegetable intake and food frequency questions (FFQ) measuring usual daily fruit and vegetable intake. The 24-hour recall was used for measuring group mean intake. The FFQ included one question assessing daily intake of fresh fruit and three questions assessing daily vegetable intake (salad, raw vegetable and cooked vegetables) [31, 32].

The potential determinants were assessed among the children and divided into demographic, personal, perceived social environmental and perceived physical environmental factors. The demographic factors included were gender, age and region. In addition mother's educational level (completed more or less than 10 years of education) was included from the parents' questionnaire. The personal factors included were knowledge about the national recommendations, general liking of fruit and vegetables and preferences for 12 different kinds of fruit and vegetables. The perceived social-environmental factors were modelling, active parental encouragement, demand family rule and parental facilitation. Of the perceived physical-environmental factors availability at home was included. All factors, except knowledge, were assessed using a bipolar five-point scale, ranging from never/I fully disagree/dislike very much (=-2) to yes, always/I fully agree/like very much (=2). When less than half of the items for a scale were given, the scale was coded as missing. Prior to data collection, validity and reliability of questionnaires have been tested in separate studies. Spearman rank correlations between the frequency questions and 7-day food records were between 0.40-0.53. Test-retest Spearman rank correlations were between 0.47-0.84 [32]. Further information about the reliability and validity of the potential determinants assessed in the children's questionnaire [26] as well as reliability and validity of the dietary part of the children's questionnaire 31 and parents' questionnaire [32] has been previously published. For this study internal consistency of the scales has been assessed again, and revealed Cronbach's alpha values between 0.52-0.80 for fruit and 0.73-0.89 for vegetables, indicating similar or better reliability than in the reliability study [26].

Statistical analysis

All analysis were done separately for fruit and vegetables. First descriptive statistics were conducted to assess intake of fruit and vegetables, both in grams and in frequency, as well as proportions of the children consuming at least 400 grams, i.e. the amount recommended by the WHO [5]. Second, proportions of children responding positively to the different determinants were assessed. Finally, logistic regression analyses were run to assess possible determinants of daily fruit and vegetable intake (0, no daily intake versus 1, daily intake). Determinants were also dichotomized into 0 (negative or neutral, -2 to 0.49) or 1 (positive, >0.49 to 2) [33]. Data from the mothers, i.e: mothers' frequency of intake and educational level, was only included in a second model to maintain the large sample and statistical power. The proportion of children reporting positively to the different factors and the results from the logistic regression will only be presented for both genders and the five regions separately, due to previous publications presenting data from the total Portuguese sample [11, 33]. The programme software SPSS (Statistical package for Social Science) version 14.0 was used for all analyses. All p-values are two-sided and 5% level of significance was used.

RESULTS

Characteristics of the sample

Characteristics of the study population are shown in Table 1. The largest proportion of children came from

Norte, while less than 10 percent came from each of Alentejo and Algarve regions. The mean age was 11.5 years (SD = 0.45) and the gender distribution was almost equal.

Table 1: Characteristics of the study population: The Portuguese Pro Children Study

Characteristics		N	%
Region			
	Norte	766	35.9
	Centro	461	21.6
	Lisboa e Vale do Tejo	543	25.4
	Alentejo	176	8.2
	Algarve	188	8.8
Gender			
	Girls	1122	52.6
	Boys	1012	47.4
Age			
	11 years	1270	59.5
	> 11 years	864	40.5
Educational level of mother			
	<10 years	723	62.0
	≥10 years	443	38.0

Intake of fruit and vegetables

Children's mean intake, both in grams and daily frequency of intake, is shown in Table 2. Fewer children reported to consume vegetables daily compared to fruit. For frequency gender differences were found, with more girls then boys reported to eat fruit ($p<0.05$) and vegetables ($p<0.001$) daily. Regional differences were found for intake in grams ($p<0.001$) as well as for daily intake ($p<0.001$). Highest mean intake of fruit was reported in Norte and lowest in Lisboa. Most daily fruit consumers were found in Centro, and fewest in Lisboa. Centro showed the highest mean vegetable intake as well as with the highest percentage of daily vegetables consumers, while lowest intake in grams and frequency was found in Algarve.

Table 2: Intake (in grams) from the 24-h recall, and percentage of children reporting daily intake from the FFQ: The Portuguese Pro Children Study

Fruit	24-hour recall (grams)									FFQ (%)		
	Total sample (n= 2118)					Girls (n= 1115)		Boys (n=1003)		Total sample (n=2095)	Girls (n=1107)	Boys (n=988)
	Mean	95% CI	Median	25th	75th	Mean	Median	Mean	Median			
Total	153	147-158	150	50	200	152	150	153	125	56.5	59.0	53.7
Norte	165	155-174	150	100	200	164	150	165	150	55.8	59.7	51.8
Centro	153	143-164	150	100	200	156	150	149	150	63.2	65.5	60.4
LVT	132	122-141	100	50	200	126	100	137	100	49.6	49.4	49.8
Alentejo	156	137-176	150	50	200	151	150	165	150	59.8	60.7	58.2
Algarve	159	141-177	150	100	200	166	150	152	100	59.6	63.5	55.2

Vegetables	Total sample (n=2118)					Girls (n=1115)		Boys (n=1003)		Total sample (n=2110)	Girls (n=1112)	Boys (n=998)
	Mean	95% CI	Median	25th	75th	Mean	Median	Mean	Median			
Total	111	107-115	80	30	160	112	90	110	80	50.1	55.8	43.9
Norte	117	110-124	96	40	170	114	100	120	90	51.0	57.2	44.5
Centro	123	113-132	100	40	180	128	120	116	100	58.2	64.3	50.5
LVT	101	93-110	80	0	160	100	80	103	80	45.0	51.1	39.0
Alentejo	118	101-134	100	30	180	113	80	125	100	53.1	54.2	51.5
Algarve	80	67-94	60	0	120	91	80	69	40	38.7	41.7	35.6

Only 21.4% of the children reported to reach the WHO recommendation of 400 grams of fruit and vegetables per day. No significant gender differences were found, but regional differences were found ranging from 11.8% of the children in Algarve to 25.4% of the children in Norte.

Proportion reporting positively to factors regarding fruit and vegetable consumption

Table 3 shows the proportion of girls and boys in each region reporting positively to the different determinants of fruit and vegetable consumption. Overall, more children reported positively to determinants of fruit intake than to determinants of vegetable intake. One exception was found for parental facilitation, with more children reporting parental facilitation for vegetable intake than parental facilitation for fruit intake.

Fruit

Significant gender differences were found for liking ($p<0.05$) and preferences ($p<0.001$), with girls being more positive than boys in most regions, while more boys reported positively to parental facilitation than girls ($p<0.001$). Significant regional differences were found for knowledge about the recommended intake levels ($p<0.05$), with Centro showing least and Alentejo showing most children reporting correct knowledge. The proportion of children reporting to perceive their parents to actively encourage and to demand them to eat fruit daily was lowest in Algarve and highest in Alentejo and Centro ($p<0.05$). Proportion of children responding positive parental facilitation was lowest in Lisboa and highest in Centro ($p<0.05$).

Table 3a: Proportion (%), with 95% confidence intervals of boys/girls reporting positively to determinants regarding fruit intake: The Portuguese Pro Children Study

Fruit	Regions									
	Norte		Centro		LVT		Alentejo		Algarve	
Determinants	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys
Personal factors										
Knowledge	42.8	41.8	40.0	45.3	44.4	38.0	57.5	57.4	44.8	48.9
	(37.9-47.7)	(36.8-46.9)	(33.9-46.1)	(38.4-52.1)	(38.5-50.3)	(32.1-43.9)	(48.0-67.1)	(45.5-69.3)	(34.7-54.9)	(38.6-59.2)
Liking	95.4	93.4	97.7	94.4	92.8	93.9	98.1	92.6	94.7	86.4
	(93.1-97.7)	(91.0-95.7)	(95.3-100)	(91.8-97.1)	(89.8-95.8)	(90.9-97.0)	(94.3-100)	(87.9-97.3)	(88.8-100)	(80.3-92.5)
Preferences	95.4	91.3	94.9	88.6	93.2	89.9	93.3	92.4	96.8	94.6
	(92.9-97.8)	(88.7-93.8)	(91.7-98.2)	(84.8-92.3)	(89.9-96.6)	(86.5-93.2)	(88.4-98.3)	(86.2-98.7)	(92.7-100)	(90.4-98.8)
Perceived social environmental factors										
Modelling	83.7	81.1	85.5	82.5	79.9	81.3	81.1	79.1	87.2	73.6
	(79.9-87.5)	(77.2-85.0)	(81.0-90.0)	(77.4-87.6)	(75.1-84.6)	(76.6-86.1)	(73.5-88.8)	(69.5-88.7)	(79.3-95.2)	(65.3-81.8)
Active parental encouragement	77.5	76.9	84.0	79.9	77.9	78.8	84.4	82.8	69.3	73.5
	(73.2-81.9)	(72.5-81.3)	(79.1-88.9)	(74.3-85.4)	(72.7-83.1)	(73.6-84.1)	(76.9-91.9)	(73.6-92.0)	(59.8-78.9)	(63.6-83.3)
Demand family rule	74.6	73.6	77.2	80.0	77.1	74.5	87.7	77.6	65.6	67.8
	(70.2-79.0)	(69.1-78.1)	(72.1-82.3)	(74.1-85.9)	(71.9-82.3)	(69.2-79.8)	(80.7-94.8)	(68.8-86.5)	(55.9-75.3)	(57.8-77.8)

Parental facilitation	32.2	40.1	39.5	45.7	26.2	38.8	31.1	49.3	34.4	39.8
	(27.4-37.0)	(35.2-45.0)	(33.4-45.6)	(38.8-52.6)	(20.5-31.9)	(33.1-44.4)	(21.9-40.3)	(37.7-60.8)	(24.5-44.3)	(29.6-50.0)
Perceived physical environmental factors										
Availability at home	95.3	92.7	90.2	93.0	95.4	91.6	96.3	94.1	93.7	88.8
	(93.0-97.7)	(90.3-95.1)	(86.7-93.6)	(89.1-96.9)	(92.4-98.4)	(88.7-94.6)	(92.3-100)	(89.1-99.1)	(88.0-99.4)	(82.9-94.7)

Vegetables

No significant gender differences were found regarding potential determinants of vegetable intake. Some regional differences were observed. Proportion of children reporting correct knowledge was lowest in Centro and highest in Alentejo ($p<0.001$). Algarve had the lowest number of children reporting positively to liking while Alentejo and Centro scored highest ($p<0.05$). Demand family rule was lowest in Algarve and highest in Alentejo ($p<0.05$). Proportion of children reporting positively to modelling and parental facilitation was lowest in Algarve and highest in Centro ($p<0.05$).

Table 3b: Proportion (%), with 95% confidence intervals of boys/girls reporting positively to determinants regarding vegetable intake: The Portuguese Pro Children Study

Vegetables	Regions									
Determinants	Norte		Centro		LVT		Alentejo		Algarve	
	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys
Personal factors										
Knowledge	38.1	37.9	30.8	35.4	38.9	36.2	59.6	40.6	38.5	42.7
	(33.3-43.0)	(33.0-42.9)	(25.0-36.6)	(28.8-41.9)	(33.0-44.9)	(30.2-42.1)	(50.1-69.2)	(28.8-52.3)	(28.6-48.5)	(32.4-53.0)
Liking	65.0	64.5	68.1	64.1	64.6	63.6	66.7	82.1	57.4	50.0
	(60.3-69.8)	(59.6-69.4)	(62.3-73.9)	(57.5-70.7)	(58.8-70.5)	(57.8-69.4)	(58.2-75.2)	(71.4-92.7)	(47.3-67.6)	(39.6-60.4)
Preferences	50.4	43.4	52.0	53.3	53.6	52.7	53.8	62.7	52.7	50.6
	(45.4-55.4)	(38.3-48.6)	(45.8-58.1)	(46.3-60.3)	(47.6-59.7)	(46.6-58.7)	(44.3-63.4)	(50.7-74.6)	(42.4-63.0)	(40.1-61.1)
Perceived social environmental factors										
Modelling	74.0	69.5	74.1	72.7	60.7	66.0	62.9	73.8	56.4	62.5
	(69.4-78.5)	(65.0-74.1)	(68.7-79.6)	(66.6-78.9)	(54.8-66.6)	(60.2-71.9)	(53.8-71.9)	(62.3-85.3)	(46.4-66.4)	(52.1-72.9)
Active parental encouragement	73.1	63.0	76.2	70.9	67.8	66.5	69.1	80.3	65.2	71.1
	(68.3-77.9)	(58.2-67.8)	(70.6-81.7)	(64.5-77.4)	(61.8-73.9)	(60.6-72.5)	(60.2-78.1)	(69.6-91.0)	(55.4-75.0)	(60.4-81.7)
Demand family rule	64.2	64.1	68.3	65.7	61.0	64.0	76.2	71.6	55.3	57.8
	(59.4-69.0)	(59.2-69.0)	(62.4-74.1)	(59.1-72.2)	(55.1-66.9)	(58.0-69.9)	(67.7-84.6)	(61.1-82.2)	(45.2-65.5)	(47.4-68.1)
Parental facilitation	52.3	53.9	57.2	54.4	46.3	47.9	49.5	53.7	42.6	40.0
	(47.3-57.3)	(48.8-59.0)	(51.0-63.4)	(47.4-61.4)	(40.1-52.4)	(41.7-54.0)	(39.8-59.2)	(41.6-65.8)	(32.5-52.6)	(29.7-50.3)
Perceived physical environmental factors										
Availability at home	82.5	83.0	81.6	81.3	79.2	79.2	86.7	86.6	79.6	72.2
	(78.7-86.2)	(79.1-86.8)	(76.8-86.4)	(75.9-86.8)	(74.2-84.1)	(74.2-84.2)	(80.1-93.3)	(78.3-94.8)	(70.8-88.3)	(63.3-81.1)

Determinants of daily fruit and vegetable intake

Results from the logistic regression analyses are shown in Table 4, again for both genders and the different regions. When including mothers' data in a second model, the sample size decreases dramatically (fruit n=999, vegetables n=1002). Since only small differences between both models were found, only results from the analyses excluding data from the mother's questionnaire are presented in Table 4, while significant differences found when including mother's data are described.

Daily fruit intake

Daily fruit intake was more likely to be reported by children who had correct knowledge, who liked fruit, with a preference for many different fruits, who experienced positive role models and by those who perceived their parents to demand them to eat fruit every day. Only girls reported more frequent fruit intake when they perceived more parental demand. In most regions daily fruit intake was associated with knowledge, liking and/or preferences for fruit. Parental influences, i.e. modelling or demand family rules were significantly associated with daily fruit intake only in Norte, Lisboa and Alentejo. When including mothers' data, mothers' intake of fruit was significantly associated with daily fruit intake in the same regions.

Table 4a: Logistic regression (OR and 95% CI) with reported frequency of daily fruit intake as dependent variable and demographic, personal, social environmental, and physical environmental factors per region: The Portuguese Pro Children Study

Fruit							
Variables	Total sample		Regions				
	Girls (n=946)	Boys (n=814)	Norte (n=656)	Centro (n=380)	Lisboa[1] (n=427)	Alentejo (n=148)	Algarve(n=149)
Region							
Norte	1(ref)	1(ref)					
Centro	1.25(0.85-1.82)	1.35(0.90-2.04)					
LVT	0.72(0.50-1.04)	1.07(0.74-1.55)					
Alentejo	0.82(0.50-1.35)	1.03(0.56-1.88)					
Algarve	0.94(0.56-1.59)	1.02(0.59-1.77)					
Gender							
Girls			1(ref)	1(ref)	1(ref)	1(ref)	1(ref)
Boys			0.76(0.54-1.06)	0.85(0.55-1.33)	1.18(0.78-1.80)	1.07(0.49-2.32)	0.79(0.40-1.59)
Age							
11 years	1(ref)	1(ref)	1(ref)	1(ref)	1(ref)	1(ref)	1(ref)
> 11 years	1.16(0.87-1.53)	0.91(0.67-1.23)	0.82(0.58-1.15)	1.25(0.80-1.96)	1.22(0.80-1.87)	1.36(0.64-2.87)	0.72(0.36-1.45)
Personal factors							
Knowledge	1.78(1.34-2.36)	2.02(1.50-2.73)	1.85(1.32-2.61)	1.67(1.06-2.63)	2.19(1.43-3.34)	2.87(1.34-6.14)	1.94(0.97-2.88)
Liking	3.75(1.72-8.17)	2.31(1.15-4.64)	4.44(1.60-12.34)	2.06(0.56-7.60)	3.24(1.13-9.30)	8.92(0.86-92.24)	0.68(0.18-2.62)
Preferences	3.60(1.83-7.06)	2.67(1.53-4.66)	3.58(1.57-8.13)	3.00(1.29-6.95)	3.96(1.70-9.23)	1.55(0.36-6.64)	1.47(0.20-10.72)
Perceived social-environmental factors							
Modelling	2.08(1.41-3.06)	1.86(1.24-2.77)	1.83(1.16-2.91)	1.63(0.85-3.13)	2.13(1.19-3.81)	4.49(1.57-12.83)	1.53(0.59-3.97)
Active parental encouragement	0.90(0.60-1.36)	1.06(0.69-1.62)	1.61(1.00-2.60)	0.93(0.44-1.94)	0.67(0.36-1.24)	0.30(0.09-1.07)	0.59(0.24-1.49)
Demand family rule	1.58(1.07-2.32)	1.45(0.97-2.17)	1.61(1.03-2.54)	1.06(0.54-2.10)	2.52(1.38-4.57)	2.91(0.92-9.26)	0.76(0.32-177)
Parental facilitation	1.12(0.82-1.51)	0.98(0.72-1.32)	1.18(0.83-1.69)	0.87(0.55-1.37)	1.02(0.65-1.61)	0.86(0.40-1.87)	1.35(0.65-2.79)
Perceived physical environmental factors							
Availability at home	1.21(0.64-2.27)	1.11(0.60-2.07)	1.30(0.59-2.91)	0.61(0.25-1.48)	2.55(0.89-7.28)	1.11(0.11-11.39)	2.71(0.62-11.82)

Daily vegetable intake

As for fruit, daily vegetable intake was more likely to be reported by children with correct knowledge, who liked vegetables and preferred many different kinds of vegetables, and who experienced positive role models. Some gender differences were found regarding parental influences; i.e. boys reported more frequent vegetable intake when they perceived more parental demand, while girls reported more frequent intake when they experienced more parental facilitation or higher availability.

Some regional differences were found. In Norte, Centro and Lisboa, likelihood of daily vegetables intake was higher if being a girl. Knowledge, liking, preferences and modelling were significant in most regions, except Algarve and Alentejo probably due to smaller sample sizes. In Lisboa mothers' intake of vegetables was significantly associated with children's intake while mother's educational level was significantly associated with daily vegetable intake in Norte and among girls; i.e. higher intake when higher mothers' educational level.

Table 4b: Logistic regression (OR and 95% CI) with reported frequency of vegetable daily intake as dependent variable and demographic, personal, social environmental, and physical environmental factors per region: The Portuguese Pro Children Study

Vegetables							
	Total sample		Regions				
Variables	Girls (n=945)	Boys (n=836)	Norte (n=682)	Centro (n=379)	Lisboa[1] (n=426)	Alentejo (n=144)	Algarve (n=150)
Region							
Norte	1(ref)	1(ref)					
Centro	1.44(0.99-2.11)	1.12(0.75-1.68)					
LVT	0.95(0.65-1.37)	0.81(0.55-1.18)					
Alentejo	0.93(0.55-1.57)	1.06(0.58-1.93)					
Algarve	0.64(0.37-1.09)	0.68(0.38-1.22)					
Gender							
Girls			1(ref)	1(ref)	1(ref)	1(ref)	1(ref)
Boys			0.63(0.45-0.88)	0.48(0.31-0.76)	0.55(0.36-0.84)	0.55(0.36-0.84)	0.81(0.40-1.65)
Age							
11 years	1(ref)	1(ref)	1(ref)	1(ref)	1(ref)	1(ref)	1(ref)
> 11 years	0.90(0.68-1.21)	0.99(0.73-1.33)	0.87(0.61-1.23)	0.89(0.56-1.40)	1.10(0.71-1.69)	1.09(0.53-2.26)	1.08(0.53-2.20)
Personal factors							
Knowledge	1.56(1.16-2.09)	1.97(1.45-2.67)	1.87(1.32-2.64)	1.63(1.00-2.67)	2.15(1.40-3.31)	1.21(0.57-2.55)	1.23(0.59-2.55)
Liking	2.28(1.66-3.14)	2.00(1.41-2.83)	2.49(1.71-3.64)	2.07(1.26-3.41)	2.15(1.31-3.54)	1.66(0.67-4.17)	1.71(0.73-3.97)
Preferences	1.40(1.05-1.88)	1.96(1.43-2.68)	1.57(1.11-2.21)	1.93(1.21-3.09)	1.49(0.95-2.34)	1.25(0.59-2.65)	2.14(1.00-4.58)
Perceived social-environmental factors							
Modelling	1.70(1.19-2.42)	1.52(1.05-2.20)	1.72(1.12-2.64)	2.26(1.26-4.07)	1.68(1.02-2.75)	1.53(0.58-4.00)	0.68(0.28-1.66)
Active parental encouragement	0.97(0.64-1.47)	1.03(0.70-1.53)	1.25(0.81-1.93)	0.71(0.35-1.45)	0.88(0.49-1.58()	1.19(0.40-3.57)	0.63(0.23-1.77)
Demand family rule	1.18(0.80-1.76)	1.61(1.09-2.36)	1.41(0.93-2.14)	1.48(0.74-2.94)	1.77(0.98-3.20)	1.10(0.42-2.89)	1.03(0.38-2.79)
Parental facilitation	1.45(1.07-1.97)	1.02(0.74-1.40)	1.17(0.82-1.66)	1.19(0.71-1.98)	1.21(0.77-1.90)	1.55(0.73-3.28)	1.44(0.65-3.22)
Perceived physical-environmental factors							
Availability at home	1.61(1.07-2.44)	0.95(0.61-1.48)	1.16(0.71-1.90)	1.43(0.71-2.88)	1.16(0.61-2.21)	1.62(0.51-5.16)	1.56(0.61-3.95)

DISCUSSION

This study showed that both gender and regional differences were found for intake. Girls report a more frequent consumption of both fruit and vegetables than boys. Children in Algarve reported low vegetable intake, both in portions and frequency. Lisboa, an urban area, was found to be the region where children reported the lowest and least frequent intake of fruit and vegetables.

To our knowledge, regional differences in intake of fruit and vegetables among Portuguese children have not been studied previously. Our study did not reveal determinants that could be of more importance in this

region than in other regions, but low intake among mothers, particularly observed in this region, might play a role. Knowledge of daily recommended intake levels, which was low in all regions, liking, modelling and parental facilitation were found to be relevant in most regions and across both genders. Home availability was not significantly associated with intake. Smaller sample size in Alentejo and Algarve, might explain why almost none of the determinants remained significant in these regions. The effect sizes were in general larger for determinants of daily fruit intake than for daily vegetable intake and girls reported being more positive to factors regarding fruit and vegetable consumption than boys.

A recent comprehensive review [18] supports the finding that girls tend to have a higher or more frequent intake of fruit and/or vegetables. The low consumption of fruit and vegetables among Portuguese children is supported by the HBSC study [2]. Earlier studies among households [16, 21] show differences in food consumption between urban-rural areas. People in urban areas have been suggested to be the ones changing the dietary habits more rapidly, moving away from the traditional diet. However a previous study found that urban areas have a higher consumption of fruit than more rural areas [16,] while we found the opposite.

Knowledge, liking and modelling and parental facilitation were also found to be significant determinants in other European countries [11]. Preferences and parental intake were found to be important determinants in other studies as well [18].

Larger effect sizes or determinants of daily fruit intake and girls being more positive to than boys, is in line with the previous results from the other countries in the Pro Children study 11. Why more boys report more positively to parental facilitation, especially for fruit, needs to be further assessed, but may reflect the fact that boys have a lower intake and therefore parents may try to facilitate the consumption more than they do for girls.

Low levels of knowledge in theory should be simple to increase, and in view of the new dietary recommendations in Portugal, published in November 2006 [3], an important aim for the future should be to teach the recommendations to all children in elementary schools.

Availability at home was not associated with intake, which might be explained by the fact that almost all children reported to perceive high availability. However high availability does not necessarily implicate high accessibility [34]. Lately there has been an increased focus on the school food environment in Portugal, and recognition of problems has lead to new recommendations published by the Portuguese Ministry of education. A high proportion of the Portuguese children eat lunch at school, and schools might be a good setting to generate an enabling environment for fruit and vegetable consumption, which has shown to be effective in Norway [35].

This study has some strengths and limitations. Fruit and vegetables are perceived as healthy and social acceptable foods which may lead to a tendency to give social desirable answers. Not knowing the recommendations may also lead to overestimation of intake [28]. The 24 hour recall covered only one day, and all data are self-reported. However, self-reported data may be the only way to assess the beliefs, feelings and experiences of people. Processing and quality control of the data [27] and the prior validity and reliability studies are strengths of this study [26, 31, 32]. Moreover, a broad range, both personal and environmental determinants, based on a theoretical framework were included [27]. Future research should include more questions on the most important determinants, and also more sophisticated analyses, such as mediation analyses or testing interaction terms, using multilevel analyses and a longitudinal study design. However, the aim of this exploratory study was to get a better understanding of differences in schoolchildren's fruit and vegetable intake among boys and girls in five Portuguese regions.

For this study a national representative sample is used. The number of children participation per region was lowest in Algarve and Alentejo, but the number of schools was not much smaller than in the other regions. Therefore we believe that the local samples are sufficiently representative for the regions. Geographical regions may however not be the best way to divide Portugal. Unfortunately we could not assess urban/rural differences, due to difficulties classifying schools in terms of rural/urban location. Therefore we choose to use the five geographic regions.

In conclusion, this study shows that intake of fruit and vegetables is low among both boys and girls in all Portuguese regions. Further, this study showed that personal factors and parental influences are among the most important determinants and should therefore be targeted by an intervention. We did not find strong differences in determinants between both genders and the five geographical regions. More studies are needed to get a better understanding gender and regional differences in fruit and vegetable intake and related determinants. Studies assessing urban/rural differences can be recommended, as well as longitudinal studies assessing the most relevant determinants with multi-item scales and exploring interactions and associations

between personal determinants and the complex social and physical environment.

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REFERENCES

1. Yngve A, Wolf A, Poortvliet E, Elmadfa I, Brug J, Ehrenblad B, et al. Fruit and vegetable intake in a sample of 11-year-old children in 9 European countries: The Pro Children Cross-sectional Survey. Ann Nutr Metab 2005; 49: 236-45.
2. Currie C, Robert C, Morgan A, Smith R, Settertobulte W, Samdal O, et al. (eds.). Young People's Health in Context. Health Behaviour in School-Aged Children (HBSC) Study: International Report from 2001/2002 Survey. 2004; Health Policy for Children and Adolescents, No. 4. The Regional Office for Europe. Geneva, WHO.
3. Rodrigues SS, Franchini B, Graca P, de Almeida MDV. A new food guide for the Portuguese population: development and technical considerations. J Nutr Educ Behav 2006; 38: 189-95.
4. World Cancer Research Fund / American Institute for Cancer Research. Food, Nutrition, Physical Activity, and the Prevention of Cancer: a Global Perspective 2007; Washington DC: AICR.
5. World Health Organization. Diet, Nutrition and the Prevalence of Chronic Diseases 2003; Report of a joint WHO/FAO Expert Consultation. Technical Report Series 916. Geneva, WHO.
6. Lien N, Lytle LA, Klepp KI. Stability in consumption of fruit, vegetables, and sugary foods in a cohort from age 14 to age 21. Prev Med 2001; 33: 217-26.
7. Lytle LA, Seifert S, Greenstein J, McGovern P. How do children's eating patterns and food choices change over time? Results from a cohort study. Am J Health Promot 2000; 14: 222-8.
8. Mikkilä V, Rasanen L, Raitakari OT, Pietinen P, Viikari J Longitudinal changes in diet from childhood into adulthood with respect to risk of cardiovascular diseases: The Cardiovascular Risk in Young Finns Study. Eur J Clin Nutr 2004; 58: 1038-45.
9. te Velde SJ, Twisk JW, Brug J. Tracking of fruit and vegetable consumption from adolescence into adulthood and its longitudinal association with overweight. Br J Nutr 2007; 98: 431-8.
10. Birch LL. Development of food preferences. Annu Rev Nutr 1999; 19: 41-62.
11. De Bourdeaudhuij I, Te Velde SJ, Brug J, Due P, Wind M, Sandvik C, et al. Personal, social and environmental predictors of daily fruit and vegetable intake in 11-year-old children in nine European countries. Eur J Clin Nutr 2008; 62(7): 834-41.
12. Agudo A, Slimani N, Ocké MC, Naska A, Miller AB, Kroke A, et al. Consumption of vegetables, fruit and other plant foods in the European Prospective Investigation into Cancer and Nutrition (EPIC) cohorts from 10 European countries. Public Health Nutrition 2002; 5: 1179-96.
13. Roos G, Johansson L, Kasmel A, Klumbiene J, Prattala R. Disparities in vegetable and fruit consumption: European cases from the north to the south. Public Health Nutr 2001; 4: 35-43.
14. Rumm-Kreuter D. Comparison of the eating and cooking habits of northern Europe and the Mediterranean countries in the past, present and future. Int J Vitam Nutr Res 2002; 71: 141-8.
15. Trichopoulou A, Naska A, Costacou T. Disparities in food habits across Europe. Proc Nutr So 2002; 61: 553-8.
16. Rodrigues SS, de Almeida MDV. Portuguese household food availability in 1990 and 1995. Public Health Nutr 2001; 4: 1167-71.
17. Hill MJ. Changing pattern of diet in Europe. Eur J Cancer Prev 1997; 6(Suppl 1): S11-3.
18. Rasmussen M, Krolner R, Klepp KI, Lytle L, Brug J, Bere E, et al. Determinants of fruit and vegetable consumption among children and adolescents: a review of the literature. Part I: quantitative studies. Int J Behav Nutr Phys Act 2006; 3: 22.
19. Blanchette L, Brug J. Determinants of fruit and vegetable consumption among 6-12-year-old children and effective interventions to increase consumption. J Hum Nutr Diet 2005; 18: 431-43.
20. Jago RT, Baranowski T, Baranowski JC. Fruit and vegetable availability: a micro environmental mediating variable? Public Health Nutr 2007; 10: 681-9.
21. European Food Availability Databank based on Household Budget Surveys The DAta Food NEtworking (DAFNE) project 2007 [http://www.nut.uoa.gr/Dafnesoftweb/].
22. Padez C, Mourao I, Moreira P, Rosado V. Prevalence and risk factors for overweight and obesity in Portuguese children. Acta Paediatr 2002; 4: 1550-7.
23. Yngve A, De Bourdeauduij I, Wolf A, Grjibovski A, Brug J, Due P, et al. Differences in prevalence of overweight and stunting in 11-year olds across Europe: The Pro Children Study. Eur J Public Health 2007; 2: 126-30.
24. Ministério do Planeamento e da Administração do Território. Decreto-Lei n.º 46/89 de 2 de Fevereiro de 1989. Diário da República – Série I. Estabelece as matrizes de delimitação geográfica da Nomenclatura de Unidades Territoriais para Fins Estatísticos (NUTS).
25. Wolf A, Yngve A, Elmadfa I, Poortvliet E, Ehrenblad B, Pérez-Rodrigo C, et al. Fruit and vegetable intake of mothers of 11-year-old children in nine European countries: The Pro Children Cross-sectional Survey. Ann Nutr Metab 2005; 49: 246-54.
26. De Bourdeaudhuij I, Klepp KI, Due P, Rodrigo CP, de Almeida M, Wind M, et al. Reliability and validity of a questionnaire to

measure personal, social and environmental correlates of fruit and vegetable intake in 10-11-year-old children in five European countries. Public Health Nutr 2005; 8: 189-200.
27. Klepp KI, Pérez-Rodrigo C, De Bourdeaudhuij I, Due PP, Elmadfa I, Haraldsdóttir J, et al. Promoting fruit and vegetable consumption among European schoolchildren: rationale, conceptualization and design of the Pro Children project. Ann Nutr Metab 2005; 49: 212-20.
28. Wind M, Bobelijn K, De Bourdeaudhuij I, Klepp KI, Brug J. A qualitative exploration of determinants of fruit and vegetable intake among 10- and 11-year-old schoolchildren in the low countries. Ann Nutr Metab 2005; 49: 228-35.
29. French SA, Story M, Jeffery RW. Environmental influences on eating and physical activity. Annu Rev Public Health 2001; 22, 309-35.
30. Sallis JF & Owen N. Ecological models of health behavior. In: K Glanz, BK Rimer, FM Leweis (eds). Health Behavior and Health Education: Theory, Research, and Practice. Jossey-Bass: San Francisco; 2002, pp. 153-65.
31. Haraldsdóttir J, Thorsdóttir I, de Almeida MDV, Maes L, Pérez Rodrigo C, Elmadfa I, et al. Validity and reproducibility of a precoded questionnaire to assess fruit and vegetable intake in European 11- to 12-year-old schoolchildren. Ann Nutr Metab 2005; 49: 221-7.
32. Kristjansdóttir AG, Andersen LF, Haraldsdóttir J, De Almeida MDV, Thorsdóttir I. Validity of a questionnaire to assess fruit and vegetable intake in adults. Eur J Clin Nutr 2007; 60: 408-15.
33. Sandvik C, De Bourdeaudhuij I, Due P, Brug J, Wind M, Bere E, et al. Personal, social and environmental factors regarding fruit and vegetable intake among schoolchildren in nine European countries. Ann Nutr Metab 2005; 49: 255-66.
34. Bere E and Klepp KI. Changes in accessibility and preferences predict children's future fruit and vegetable intake. Int J Behav Nutr Phys Act 2005; 2: 15.
35. Bere E, Veierød MB, Skare Ø, Klepp KI. Free School Fruit – sustained effect three years later. Int J Behav Nutr Phys Act 2007; 4: 5