Fruit and Vegetables

consumption and determinants among Portuguese schoolchildren and their mothers

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Fruta e Hortícolas

avaliação do consumo e seus determinantes em crianças Portuguesas em idade escolar e suas mães

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Abstract

Adequate consumption of fruit and vegetables helps to promote health and prevent chronic diseases. However epidemiological studies in different countries consistently show that many children and adults do not meet recommended intake. A better understanding of current consumption and potential determinants of fruit and vegetable intake are vital in planning and developing effective interventions aiming to promote their consumption.

Large discrepancies in fruit and vegetable intake have been associated with sociodemographic and psychosocial determinants, but most studies were carried out in the United States of America and in the United Kingdom.

Healthy eating habits may be easier to establish at younger ages and there is evidence that healthy eating in childhood is, to some extent, maintained into adulthood. In addition, parents constitute an important target group, as they are responsible for the eating environment at home, decide what food to purchase and what to serve, and they also important role models.

The present thesis is part of the European Pro Children Cross-Sectional Survey and aims to assess fruit and vegetable consumption and their determinants among Portuguese schoolchildren and their mothers, as well as to evaluate the relationship of fruit and vegetable consumption between children and their mothers.

Self-administered questionnaires were developed for children and their parents to assess fruit and vegetable intake and to identify the determinants of their fruit and vegetable intake.

A national representative sample of 11-13 year old schoolchildren, during October-December 2003, completed a questionnaire in the classroom and took a questionnaire home to be completed by one parent or guardian. A total of 3,044 questionnaires filled in by schoolchildren and 2,375 questionnaires filled in by parents were received. In this thesis, from the questionnaires filled in by parents, only data from the mothers were analyzed.

The majority of the Portuguese schoolchildren and their mothers did not meet the population goal of 400 grams of fruit and vegetable per day. Vegetable soup was the main contributor to total vegetable consumption among schoolchildren and their mothers.

Overall, boys reported less frequent consumption than girls. Pupils from the Lisbon area reported

the lowest and less frequent consumption of fruit while in the Algarve similar results were found for vegetable consumption.

Significant associations were found between the mother-child pairs' consumption of fruit and vegetables. Moreover, mothers' consumption of fruit and vegetables revealed a higher effect on their children's consumption than the several dimensions of parenting styles.

The best predictors of daily fruit and vegetable consumption in Portuguese schoolchildren were knowledge, liking, self-efficacy, preferences, modelling, demand family rule and taking fruit to school. Fruit and vegetable consumption was more likely to be high among mothers belonging to high social classes and seems to be positively associated with the dimension involvement of their own parenting style, while high educational level was associated with higher vegetable intake. The contribution of vegetable soup to total vegetable consumption among mothers seems to be associated with household characteristics (size and composition of household).

The present research findings constitute an important basis for planning, designing and implementing effective policies aiming to promote fruit and vegetable intake in children and adults.

Resumo

O consumo adequado de fruta e hortícolas é um factor de promoção da saúde e prevenção de doenças crónicas. No entanto, vários estudos epidemiológicos em diferentes países têm demonstrado de forma consistente que muitas crianças e adultos não atingem as recomendações alimentares. Compreender os hábitos de consumo de fruta e hortícolas e os seus potenciais determinantes é crucial no planeamento e desenvolvimento de intervenções com o objectivo de promover o consumo destes alimentos.

Determinantes sociodemográficos e psicossociais têm sido associados a grandes discrepâncias no consumo de fruta e hortícolas. No entanto, a maioria destes estudos foram realizados nos Estados Unidos e no Reino Unido.

Para além disso, é mais fácil adquirir hábitos alimentares saudáveis em idades mais precoces e existe evidência de que uma alimentação saudável na infância se mantém, até certo ponto, na idade adulta. Os pais constituem um grupo alvo importante, uma vez que são responsáveis pelas práticas alimentares em casa, nomeadamente pelas decisões relativas ao que comprar e oferecer, e podem servir de modelo para os filhos.

A presente tese integra-se no estudo transversal europeu Pro Children e tem como objectivo geral avaliar o consumo de fruta e hortícolas e seus determinantes em crianças Portuguesas em idade escolar e suas mães, bem como as relações do consumo de fruta e hortícolas entre crianças e mães.

Foram desenvolvidos questionários de auto-administração para as crianças e seus pais com o objectivo de avaliar a ingestão de fruta e hortícolas e identificar os seus determinantes de consumo.

Entre Outubro e Dezembro de 2003, uma amostra nacional representativa de crianças (11-13 anos de idade) preencheu um questionário na sala de aula e levou outro para casa para ser preenchido por um dos seus pais ou encarregado de educação. Foram recebidos 3044 questionários preenchidos pelos alunos e 2375 preenchidos por um dos seus pais. No âmbito desta tese, dos questionários preenchidos pelos pais apenas foram analisados os das mães.

A maioria das crianças Portuguesas e suas mães não atingiram a recomendação de consumir pelo

menos 400 gramas de fruta e hortícolas por dia. A sopa foi o maior contribuidor para o consumo total de hortícolas nas crianças e mães.

Os rapazes reportaram um consumo menos frequente do que as raparigas; as crianças da região de Lisboa e Vale do Tejo reportaram um consumo de fruta mais baixo e menos frequente, enquanto que na região do Algarve foram encontrados resultados similares para o consumo de hortícolas.

Encontraram-se associações significativas entre mães e crianças no que respeita ao consumo de fruta e hortícolas. O consumo das mães revelou um maior efeito no das crianças do que as várias dimensões dos estilos parentais.

Os melhores preditores do consumo diário de fruta e hortícolas nas crianças foram: o conhecimento, o gosto, a auto-eficácia, as preferências, a modelagem, a exigência familiar e levar fruta para a escola.

O consumo de fruta e hortícolas foi mais elevado em mães pertencentes a classes sociais mais altas e parece estar positivamente associado à dimensão envolvimento do seu próprio estilo parental, enquanto que níveis educacionais mais elevados foram associados a uma maior ingestão de hortícolas.

O contributo da sopa para o consumo total de hortícolas nas mães parece estar associado com a dimensão e a composição do agregado familiar.

Os resultados desta tese constituem uma base sólida para o planeamento, desenho e implementação de políticas efectivas de promoção do consumo de fruta e hortícolas em crianças e adultos.

Résumé

La consommation adéquate de fruits et de légumes est un facteur promoteur de la santé et de la prévention de maladies chroniques. Cependant, la recherche épidémiologique dans différents pays a démontré d'une manière consistante que beaucoup d'enfants et d'adultes n'atteignent pas les recommandations alimentaires.

Des déterminants sociodémographiques et psychosociaux ont été associés à de grandes divergences dans la consommation de fruits et de légumes. Portant, la majorité de ces études a été effectué aux États-Unis et au Royaume-Uni.

La compréhension de la consommation effective de fruits et légumes et de ses potentiels déterminants, est d'extrême importance pour planifier et développer d'interventions pour promouvoir la consommation de ces aliments.

En plus, il est plus facile d'acquérir des habitudes alimentaires saines à un âge plus jeune et on sait qu'une alimentation saine durant l'enfance est maintenue, jusqu'à un certain point, à l'âge adulte. Les parents font part d'un groupe cible important, vu qu'ils sont les responsables par les pratiques alimentaires à la maison, notamment au niveau des décisions relatives aux achats et peuvent, aussi, servir comme exemple pour leurs enfants.

Cette thèse fait partie de l'étude transversale Pro Children et a comme objectif général d'évaluer la consommation de fruits et de légumes et de ses déterminants, des enfants portugais en âge scolaire et de leurs mères, ainsi que les relations de consommation de fruits et de légumes entre enfants et leurs mères.

Des questionnaires d'auto-administration pour enfants et parents ont été développés afin d'évaluer la consommation de fruits et de légumes et identifier les déterminants de consommation.

Entre Octobre et Décembre 2003, des enfants ont rempli un questionnaire en classe et un autre questionnaire a été envoyé à la maison pour être rempli par un des parents ou par la personne en charge de l'éducation de l'enfant. Une totalité de 3044 questionnaires ont été remplis para les élèves et 2375 para les responsables d'éducation. Pour cette thèse, des questionnaires remplis par les parents seulement ceux remplis par les mères ont été analysés.

La majorité des enfants et des mères n'ont pas atteint la recommandation d'au moins 400 grammes de fruits et de légumes par jour. La soupe a été la plus importante source de légumes parmis les enfants et les mères.

Les garçons ont enregistré une consommation moins fréquente que les filles; les enfants de la région de Lisboa e Vale do Tejo ont enregistré une consommation de fruits inférieure et moins fréquente, alors que pour la région de l'Algarve, des résultats semblables ont été rapportés pour la consommation de légumes.

Des associations significatives ont été trouvées entre les mères et les enfants en ce qui concerne la consommation de fruits et de légumes. De plus, la consommation des mères a une plus grande influence sur la consommation des enfants que celle des styles parentaux.

Les meilleurs prédicteurs de la consommation quotidienne de fruits et de légumes pour les enfants portugais ont été: la connaissance, le goût, l'auto-efficacité, les préférences, le modelage, l'exigence familiale et le fait d'emporter des fruits à l'école.

La consommation de fruits et de légumes a une probabilité d'être plus élevée pour les mères appartenant aux classes sociales plus élevées et semble être positivement lié à la dimension de son style parental, alors que les parents avec des niveaux éducationnels plus élevés ont eu une plus grande consommation de légumes. La contribution de la soupe pour la consommation totale de légumes des mères semble être associée aux caractéristiques de la famille (nombre de personnes et composition du ménage).

Les résultats de cette thèse sont essentiels pour planifier et concevoir d'interventions effectives pour promouvoir la consommation de fruits et de légumes chez les enfants et les adultes.

1 Introduction

1.1 Fruit and vegetables: health benefits, definitions and measurement

Epidemiological and clinical studies in the field of nutrition have proved that adequate fruit and vegetable consumption is associated with lower risk of major chronic diseases, including certain types of cancer (AIRC, 2007; WHO, 2003), cardiovascular diseases (Hu, 2003; Joshipura et al., 2001; Liu et al., 2000; Ness & Powles, 1997) and obesity.(Lanza et al., 2001; McCrory et al., 1999; Pesa & Turner, 2001; Rolls et al., 2004) In addition, other scientific evidence supports a proactive role for fruit and vegetables in prevention of strokes, cataract formation, chronic obstructive pulmonary disease, diverticulosis, and possibly, hypertension (Van Duyn & Pivonka, 2000). Moreover, the consumption of fruit and vegetables may contribute to the prevention and the reduction of several micronutrient deficiencies, especially in less developed countries (WHO, 2003).

According to the World Health Report 2002, it is estimated that the low consumption of fruit and vegetables is responsible for about 19% of gastrointestinal cancers, 31% of ischemic heart disease; 11% of myocardium stroke and that, potentially, more than 2.7 million lives could be saved each year if fruit and vegetable consumption was sufficiently increased. The same report identifies the low consumption of fruit and vegetables as one of the ten main risk factors of both mortality and morbidity in the world (WHO, 2002). In the European Union, inadequate fruit and vegetable consumption has been estimated to be responsible for over one million deaths annually (Pomerleau et al., 2006).

Fruit and vegetables are plant foods. Botanically, vegetables are edible parts of plants and fruit is the seed-containing part of the plant. Despite the precision of botanical definitions, culinary uses and definitions are commonly preferred. Based on cultural uses of foods, they correspond to what is understood by lay people. For instance, cucumber, pepper or tomato are considered vegetables in culinary practice but are indeed fruits. Additionally, definitions of fruit and vegetables should always be related to their nutritional qualities. From a nutritional point of view, fruit and vegetables are large diverse groups of low energy dense foods, relatively rich in vitamins, minerals and other bioactive compounds such as phytochemicals and are a good source of fiber (AIRC, 2007).

The mechanisms that explain the health benefits of fruit and vegetables are yet to be determined, but are likely to be multiple in origin (Van Duyn & Pivonka, 2000). The disease preventive potential probably reflects the phytochemicals content of fruit and vegetables. Phytochemicals are a wide group of substances such as carotenoids, phenolics, alkaloids, nitrogen-containing compounds

and organosulfur compounds that can have complementary and overlapping mechanisms of action. These include modulation of detoxification enzymes, scavenging of oxidative agents, stimulation of the immune system, regulation of gene expression in cell proliferation and apoptosis, modulation of cholesterol synthesis and absorption, reduction of blood pressure and antibacterial and antiviral activity (Lampe, 1999; Liu, 2004).

Different approaches to measure fruit and vegetable intake have been used in epidemiological studies. Each approach has its relative merits and drawbacks. Food supply data at the national level, such as food balance sheets, provide estimates of food availability at the national level but do not provide food consumption data. Household budget surveys focus on consumption but do not provide information on food distribution among individual members. Aggregate methods are useful for making overall comparisons among geographic areas and for monitoring overall trends over time (Gibson, 2005; Margetts & Nelson, 1997; Vinas et al., 2006).

Methods used to collect individual information on food and nutrient are mainly based on records of current intake such as "food diaries" or recall of previous intake such as the "24-hour dietary recall", the "food frequency questionnaire" or the "diet history" methods (Agudo, 2005; Bartrina & Majem, 2006; Bartrina & Rodrigo, 2006; Jiménez & Martin-Moreno, 2006; Majem & Barba, 2006). The combination of two different methods may improve the estimation of the subjects' food intake. The most commonly used instruments to estimate fruit and vegetable consumption are the food frequency questionnaire and 24-hour dietary recall. Both are based on memory, and recall problems may occur. However, both methods have good compliance: the 24-hour dietary recall is particularly well suited to assess group mean intake, assuming that the population sample is representative and that there is a well-balanced distribution of the 24-hour dietary recall surveys by season and week-days; while the food frequency questionnaire is better suited to ranking subjects by level of intake (Agudo, 2005).

1.2 Recommendations and consumption

Many national dietary guidelines, only provide broadly vague qualitative advice, such as "increase your fruit and vegetable consumption", "eat a variety of fruit and vegetables every day", or "eat plenty of fruit and vegetables" but other give information in quantitative terms as portions or servings without however a definition of what is meant by such a portion or serving (Agudo, 2005). An universal definition of portion size for fruit and for vegetables does not exist (Agudo, 2005) but through consumption estimates the average value of 80 grams per portion is assumed to be adequate, when a variety of both fruit and vegetables is consumed (Agudo et al., 2002; Ashfield-Watt et al., 2004; Slimani et al., 2002).

Several countries and organizations, including the World Health Organization (WHO), have established recommendations for fruit and vegetable consumption (Naska et al., 2000; WHO, 2003; Williams, 1995). Most of these recommendations support an intake of fruit and vegetables of at least 400 grams/day, excluding potatoes and other tubers and roots. This recommended amount is considered

as a population average and is important for the maintenance of health. The 5-a-day message, originated in the United States in 1991 (Havas et al., 1995), has been adopted by countries all over the world, with a portion often defined as 80 grams. Fruit juices are usually included in the recommendations but counted as no more than one portion/day (WHO, 2003).

Data from Food Balance Sheets, provided by Food and Agriculture and Organization (FAO), and from some dietary studies revealed a "North-South gradient" in fruit and vegetable consumption among European countries, with the highest intake in Southern Europe and the lowest in Northern and Eastern Europe (Roos et al., 2001). However, this gradient is gradually fading as Southern European countries are rapidly changing their dietary pattern while an increase in fruit and vegetable consumption in Northern European countries has occurred (Hill, 1997).

Portugal has gradually moved away from a traditional Mediterranean diet to a more Westernized one (Marques-Vidal et al., 2006; Rodrigues & de Almeida, 2001). Portuguese household budget surveys from 1989/90 to 2000/01, demonstrated that the availability of fruit and vegetables decreased whereas the availability of meat, meat products and soft-drinks increased (Rodrigues et al., 2007)

Data from the Health Behavior in School-aged Children Study 2001/2002 (HBSC), which included different countries, showed that less than two-fifths of young people ate fruit every day, and only about a third ate vegetables each day (WHO, 2004). In Portugal the percentage of children who ate fruit and vegetables every day decreased from 11– to 15- year old age group. Moreover, 11- year old Portuguese children had the highest percentage of daily fruit consumption, but their vegetable consumption was median when compared to the total sample (Currie, 2004).

There is a growing interest in the development of national projects aiming to promote the consumption of fruit and vegetables. The WHO and FAO announced, in 2003, a joint initiative to promote these foods. As a result of this initiative, a first "Fruit and Vegetables for Health Workshop" was set up in 2004 in Kobe, Japan, and a set of guidelines were established for the promotion of fruit and vegetables (WHO, 2005).

In Portugal, the General Health Directorate together with the Preventive Medicine Institute of the Medical Faculty of Lisbon University, organized a workshop entitled "Promotion of fruit and vegetables in Portuguese speaking countries" that took place in September 2005. This event was based on the referred guide and on the exchange of knowledge and experiences of the invited participants. It intended to create opportunities of initiating programs of fruit and vegetables promotion in Portuguese speaking countries, and therefore contribute to the wellbeing of the populations (OMS, 2006).

A year later, in 2006 the "5-a-day Programme, helps you grow and gives you energy", was launched in Portugal with the support of several governmental and non-governmental organizations. The aim was to promote fruit and vegetable consumption among schoolchildren; it started in the Lisbon area and was later extended to other regions of the country (MARL, 2009).

In 2009, the Portuguese "School Fruit Programme" was launched in all state primary schools. It provides two pieces of fruit or vegetable per week to each student, throughout the academic year. The programme also includes additional school activities in order to develop both skills and knowledge about health eating (MADR/MPS/ME, 2009).

1.3 Target groups and determinants

The promotion of fruit and vegetable consumption in children, adolescents, and their parents is crucial for several reasons. Evidence suggests that healthy foods habits acquired in childhood tend to continue into adolescence and adulthood (Kelder et al., 1994; Lien et al., 2001; Mikkila et al., 2004) and children are more prone to change their food habits than adults (Birch, 1999; Savage et al., 2007). In addition, parents constitute an important target group, as they define most of their children's eating environment (Birch & Fisher, 1998). Parents can influence their offspring's eating behaviors by actively encouraging, discouraging or controlling certain consumptions (Brug et al., 2008).

Parents are responsible for the eating environment at home, decide what food to purchase and what to serve, and serve as important role models (Bere & Klepp, 2004). Parent's behaviour has therefore been an obvious area for attention (Faith et al., 2004; Johnson & Birch, 1994; Savage, et al., 2007; Wardle et al., 2005).

In order to design effective interventions to increase the consumption of fruit and vegetables by children and adolescents, the mediators or determinants of such patterns need to be identified. In addition, acceptable intervention strategies that can effectively change mediators are to be planned and implemented (Baranowski et al., 1999; Brug et al., 2005; Jones et al., 2010).

In the past few years, several potential determinants for children and adolescents' fruit and vegetable consumption have been proposed and evaluated. Based in five systematic reviews in regards to this issue, the strongest determinants of fruit and vegetables consumption in young people were availability/accessibility at home, preferences, parental intake and parental modelling (Blanchette & Brug, 2005; Geller & Dzewaltowski, 2009; Pearson et al., 2009; Rasmussen et al., 2006; van der Horst et al., 2007).

Parental fruit and vegetable consumption (Arcan et al., 2007; Bere & Klepp, 2004; Cooke et al., 2004; Cullen et al., 2003; Fisher et al., 2002; Hanson et al., 2005; Reinaerts et al., 2007; Young & Fors, 2001) particularly maternal consumption (Jones, et al., 2010; Wardle, et al., 2005; Yung et al., 2010) has been reported as a potential determinant of children's and adolescents' fruit and vegetable consumption. Mothers are of particular interest for children's eating behaviour, as they have been shown to spend more time than fathers in direct interactions with their children in several family situations, including mealtimes (Hannon et al., 2003; Mchale et al., 1995; Neumark-Sztainer et al., 2003; Scaglioni et al., 2008).

Although parental consumption is often used as a "modelling measure", some researchers argue that parental consumption is more than just an example (model) for children (Reinaerts, et al., 2007).

Furthermore parenting style and parents' practices have also been studied. From studies on the association between general parenting styles and children's health behaviors, it appears that authoritative parenting, i.e. a parenting style characterized by high parental involvement as well as strictness, is associated with more positive health behavior including higher fruit and vegetables consumption, compared to adolescents who reported authoritarian (high strictness, low involvement) or neglectful

(low strictness, low involvement) parenting styles (Kremers et al., 2003; Lytle et al., 2003; Patrick et al., 2005; Young & Fors, 2001).
In relation to parents' practices the outcomes are controversial: some studies indicated that higher control can increase adolescents' preference for restricted foods (Birch, 1999; Fisher, et al., 2002; Wardle, et al., 2005) whereas other studies have yielded an association between stricter parental restriction and healthy eating habits (De Bourdeaudhuij, 1997a, 1997b; De Bourdeaudhuij & Van Oost, 2000).
Other possible determinants have been examined such as gender, age, socio-economic position (Lien et al., 2002; Rasmussen et al., 2006) knowledge levels (Edwards & Hartwell, 2002; Gibson et al., 1998; Osler & Hansen, 1993; Resnicow et al., 1997; Reynolds et al., 2004; Reynolds et al., 1999; Reynolds et al., 2002) self-efficacy (Baranowski, et al., 1999; Domel et al., 1996; Heatey & Thombs, 1997; Kratt et al., 2000; Lien et al., 2002; Resnicow, et al., 1997; Reynolds, et al., 1999; Reynolds, et al., 2002; Young et al., 2004); peer influences (Cullen et al., 2000; Cullen et al., 1998; Resnicow, et al., 1997; Reynolds, et al., 2002; Vereecken et al., 2005) and TV viewing (Blanchette & Brug, 2005; Boynton-Jarrett et al., 2003; Coon et al., 2001; Story & French, 2004).
Among adults, and therefore parents, potential determinants of fruit and vegetable consumption have also been studied. According to a systematic review developed by Kamphuis et al, (2006) the strongest determinants were household income, marriage and good local availability of fruit and vegetables; moreover, another review by Shaikh et al, (2008) demonstrated a strong evidence for self-efficacy, social support and knowledge. In Europe, a positive association between higher level of education or occupation and a greater consumption of both fruit and vegetables was observed (De Irala-Estevez et al., 2000).
Identical results were found among the Portuguese population in previous research, developed by Moreira & Padrão (2004). This study showed a positive association between education level and the consumption of vegetable soup. In both genders, consumption of vegetable soup, vegetables and fruit were higher among those with higher educational levels. The same outcome was not observed in low and high income groups, which were similar in regard to several food groups' consumption.
The Epi Porto study, carried out among Portuguese adults living in Porto, demonstrated that the consumption of fruit and vegetables (excluding vegetable soup) was higher in women compared to men. In regards to vegetable soup the mean intake was similar between sexes (Lopes et al., 2006).

1.4 Pro Children project and thesis outline

The majority of studies about fruit and vegetable consumption and their determinants among different age groups have been conducted in the United States, while there is a lack of published research regarding these issues in European countries.
In an attempt to shed more light about consumption of fruit and vegetables and their determinants, a European project was designed: Pro Children project – "Promoting and Sustaining Health through

Increased Vegetable and Fruit Consumption among European School Children". This project, carried out in nine European countries, including Portugal, was organized in two strands: 1) a cross-sectional study which investigated consumption of fruit and vegetables and its determinants in 11-year-old schoolchildren and their parents; 2) an intervention study, which took place in only three of the countries (Spain, Norway and the Netherlands), to develop and test strategies for fruit and vegetables' promotion (Klepp et al., 2005). This thesis is based on the Pro Children Cross-Sectional Study in Portugal.

Following this brief introduction, the aims of this thesis are identified and the methodology is described. The data analysis is presented in seven scientific papers, of which the candidate is the co-author (first three) and main author (next four papers). In a final chapter the main findings are summarized and implications for practice and research are addressed.

2 Research aims

The overall aim of this thesis was to assess fruit and vegetable consumption and their determinants among Portuguese schoolchildren and their mothers, as well as to evaluate the relationship of fruit and vegetable consumption between children and their mothers.

The specific aims were:

- to assess fruit and vegetable consumption among Portuguese schoolchildren (Papers I and III) and to compare it with other European countries (Paper I);
- to identify personal, social and environmental predictors of the daily fruit and vegetable consumption among Portuguese schoolchildren (Paper II);
- to assess fruit and vegetable consumption and its determinants in Portuguese schoolchildren according to gender and geographical regions (Paper III);
- to assess fruit and vegetable consumption in mothers of Portuguese school children (Papers III and IV) and to analyse its sociodemographic determinants (Paper IV);
- to evaluate the relationship between parenting styles and fruit and vegetable consumption amongst mothers of Portuguese schoolchildren (Paper V);
- to evaluate the association of fruit and vegetable consumption between mothers and their children and to analyse this association according to the children's gender and mothers' parenting style (Paper VI);
- to analyze both the effect of mothers' consumption of fruit and vegetable and the dimensions of the parenting styles (strictness and involvement) on children's intake (Paper VI);
- to assess the contribution of vegetable soup to total vegetable consumption amongst mothers of Portuguese schoolchildren and to examine the association between this contribution and sociodemographic characteristics (Paper VII).

3 Methodology

3.1 The Pro Children project

The Pro Children project, "Promoting and Sustaining Health through Increased Vegetable and Fruit Consumption among European Schoolchildren" was an European Union funded research project carried out in nine countries: Austria, Belgium, Denmark, Iceland, the Netherlands, Norway, Portugal, Spain and Sweden (Klepp, et al., 2005).

The Pro Children Cross-Sectional Survey was conducted between October and December 2003 involving national representative samples of schools in all countries, with the exception of Austria and Belgium.

Schools constituted the sampling unit, and random samples of at least 20 schools and a minimum of 1300, 11-year-old children were recruited from each country.

This project was in line with the Helsinki Declaration and the conventions of the Council of Europe on Human Rights and Biomedicine. Research permission was obtained from national and local schools authorities, as well as from the school managements before parents and students were contacted.

Self-administered questionnaires were developed (one for children, one for parents and one for school staff) and applied in all countries. The instruments were translated into national languages (and back translated to English) and tested for reliability and validity in multiple pilot-tests prior to final administration. More details about this are given elsewhere (De Bourdeaudhuij et al., 2005; Haraldsdottir et al., 2005; Kristjansdottir et al., 2006).

Children's data collection was performed directly in the classroom with the help of the teachers who received careful instructions prior to the investigation. All pupils received a closed envelope with an additional questionnaire to take home to be completed by one of their parents. The parent questionnaires were brought back by the children to the teachers, who in turn sent them to each national research centre. The national data sets were pooled in a joint data base at the Data Management Centre, where further quality control was carried out.

All data processing was done according to standardized codebooks and protocols.

3.2 The cross-sectional survey in Portugal

From a list of 1,050 state and private Portuguese schools, with fifth and sixth grade (11- to 13- years old), provided by the Portuguese Ministry of Education, 60 were randomly selected for participation in the study. These schools were invited to participate by an initial letter sent to the headteacher. All schools agreed to participate but only 34 returned the questionnaires.
A total of 3,044 questionnaires filled in by schoolchildren and 2,375 questionnaires filled in by one of their parents (1,853 by mothers and 522 by fathers or guardians) were received.

3.3 Instrument

The self-administered questionnaires included three parts: the first part measured the intake of fruit and vegetables; the second covered different issues to study social and physical-environmental factors of daily fruit and vegetable intake; and a third part comprised information about social-economic, demographic characteristics and parenting style.
The information about parenting style was only applied in four countries: Belgium, the Netherlands, Portugal and Spain. All protocols and questionnaires can be viewed at www.prochildren.org.

3.3.1 Fruit and vegetable consumption

The dietary part of the questionnaire included two sections: a precoded 24 hour recall and a food frequency. The pre-coded 24-hour recall part of the questionnaire was included to give information about both the intake of the group and the amount and types of vegetables, whereas the food frequency part ranked individuals according to levels of usual intake.
In the 24-hour recall section participants were asked to write what they had eaten the day before. This pre-coded section asked in detail for the consumption of fresh fruit juice, fresh fruit, salad, other raw vegetables, cooked vegetables and vegetable soup and referred to three different time intervals: (1) before school; (2) school time and lunch; (3) after school, dinner and after dinner. Specific questions on vegetables as part of composite dishes were not included. Amounts were indicated in terms of number of pieces, slices or portions eaten, and standard weights were attributed in order to quantify intake (see Table 1). The total vegetable intake was calculated by summarising all answers about vegetables.
The food frequency section included five questions about the usual intake of fresh fruit, salad, other raw vegetables, cooked vegetables and natural fruit juice. In order to prevent participants from including potato in the cooked vegetables group, a separate question on potato intake was included. Eight response categories were used, ranging from “Never” to “Every day, more than twice a day”.

The frequency of intake was converted into grams per day (using mean portions previously defined) and the total vegetable intake and combined fruit and vegetable intake were calculated (Haraldsdottir, et al., 2005; Kristjansdottir, et al., 2006).
Children and parents who reported a total daily intake of fruit and vegetables of more than 1000 g/day were excluded from the analyses.

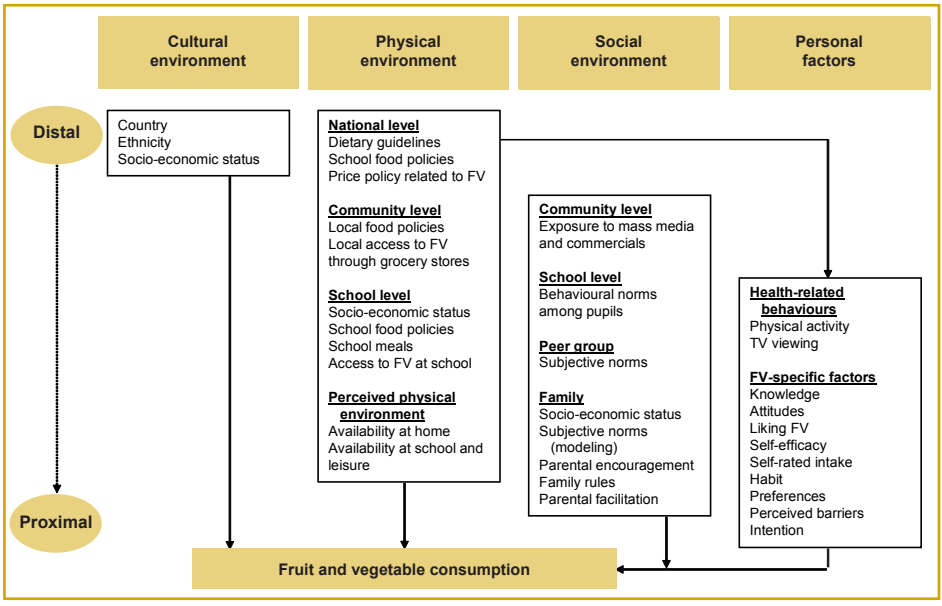
Table 1. Definition of portion sizes for the questionnaire used in the Pro Children cross-sectional study (Haraldsdottir, et al., 2005; Kristjansdottir, et al., 2006).

Food item	**Portion size (g/portion)**
24-hour recall	
Fruit	
- Apple, banana, orange, pear (pieces)	100
- Tangerine (piece), melon (slice)	50
- Fruit salad (portion)	100
- Other fruits (pieces/portion)	100
Fruit juice	200
Raw vegetables	
- Tomato (piece)	50
- Cucumber (slice)	10
- Carrot (piece)	65
- Other raw vegetables (portion)	50
Salad	40
Cooked vegetables	60
Vegetable soup	80 (per 250 g soup)
Food frequency	
Fruit	100
Fruit juice	200
Raw vegetables	50
Salad	40
Cooked vegetables	60

3.3.2 Determinants of fruit and vegetable consumption

In order to assess the determinants of fruit and vegetable consumption, a systematic review was previously conducted by Rasmussen at al.,(2006) and complemented by focus groups interviews among schoolchildren (Wind et al., 2005). The constructs from different behavioural theories were included, to ensure inclusion of potential determinants at the individual, social and environmental level. The questionnaires were mainly inspired by Flay's Theory of Triadic Influences (Flay & Petraitis, 1994) and extended with constructs from the "attitude, social influences, self-efficacy (ASE) model" (De Vries et al., 1998; Kok et al., 1996) and Bandura's Social Cognitive Theory (Bandura, 1997), as well as a social-ecological perspective on health behaviour (French et al., 2001). In the final Pro Children model, four levels of determinants were distinguished. Firstly the most distal demographic determinants, secondly the physical environmental ones, followed by social environmental determinants and finally the most proximal personal determinants of fruit and vegetable consumption, (see Figure 1) (Klepp, et al., 2005).

Figure 1. Theoretical framework applied to children's fruit and vegetable consumption in the Pro Children project (Klepp, et al., 2005).



Potential correlates of fruit and vegetable intake were measured within the domain of personal, socio-environmental and physical-environmental factors.

- Personal factors:

  - knowledge about recommended daily intake levels;
  - attitudes towards eating of fruit and vegetables;
  - general self-efficacy to eat fruit and vegetables;
  - liking fruit and vegetables;
  - preferences for fruit and vegetables; and
  - perceived barriers to prevent eating fruit and vegetables.

- Perceived socio-environmental factors:

  - modelling behaviour of friends and parents;
  - active parental encouragement;
  - whether parents facilitate intake of fruit and vegetables by cutting them for their children (parental facilitation);
  - whether they demand that their child eat fruit and vegetables (parental demand);
  - whether they allow their child to eat as much fruit and vegetables as they want (parental allowance); and
  - bringing fruit/vegetables to school.

- Perceived physical-environmental factors:

  - availability of fruit and vegetables at home; and
  - availability of fruit and vegetables in other settings, i.e. at school and their friends' home.

All factors, except knowledge, were assessed using a bipolar five-point scale: never/I fully disagree/dislike very much (-2) to yes/I fully agree/like very much (+2). To assess knowledge of recommended daily intake levels, children were asked on an eight-point scale how much fruit or vegetables they should eat every day. Response options ranged from "no fruit or vegetables" (0) to "five pieces or portions per day or more" (7). This was subsequently recoded into a dichotomous variable (less than the recommended daily intake levels versus the recommended daily intake levels or more).

3.3.3 Socio-economic and demographic variables

Household size and composition, education level, social class and region of residence were obtained through the parents' questionnaire.

Educational level was measured by four categories: (1) less than 7 years, (2) 7-9 years, (3) 10-12 years and (4) more than 12 years of schooling.

To code occupational social class, three kinds of job characteristics were used: educational requirements, management skills requested and control over economic assets (ownership/self-employed). This model defines a common hierarchical structure, which categorises all occupations into five social classes (I-V) and three extra groups (Group VI-VII), see Table 2 (Due et al., 2003; Holstein et al., 2004)

Table 2. Social class applied in Pro Children cross-sectional study (Due, et al., 2003; Holstein, et al., 2004)

Class/Group	Profession/Occupation
Class I	Top managers in big organizations and companies; top level civil servants; top of the educational hierarchy, with at least four years of university training (e.g. medical doctors, lawyers, administrators, professionals, executives)
Class II	Other managers; medium level civil servants; primary school teachers; social workers
Class III	Lower level white collar workers within administrative jobs; nurses; jobs which require medium level of theoretical vocational training for specialised job functions
Class IV	Skilled manual workers, i.e. jobs which require years of practical training to acquire necessary skills (plumber, electrician, carpenter, car mechanic, nurse assistant)
Class V	Unskilled and semi-skilled workers (e.g factory workers, lorry drivers, construction workers)
Class VI	Economically active but insufficient information to code the occupation
Class VII	Economically inactive, (e.g. housewives, retired people, people who make their living from social welfare benefits – unemployment benefit, sickness benefit, disability pension, …)
Class VIII	Category for students who are underway for an education of at least 1 ½ years theoretical education, (e.g. social worker, medical doctor – do not include short-term courses)

The distribution of the sample by Portuguese mainland was based on the classification of the Official Portuguese Territorial Division NUT II: North, Centre, Lisbon area, Alentejo and Algarve (see Figure 2) (MPAT, 1989).

Figure 2. Division of the Portuguese mainland, based on the classification of the Official Portuguese Territorial Division NUT II (MPAT, 1989).

3.3.4 Parenting style

Additionally in four of the nine countries (Belgium, the Netherlands, Portugal and Spain) of the Pro Children project an optional measure on parenting style was included in the parent questionnaire.

Parenting style was assessed based on studies by Avenevoli et al. (1999) Lamborn et al. (1991) and Steinberg et al. (1989). Two dimensions, involvement and strictness, were measured with nine and seven items respectively. Parents were asked about different statements with five response possibilities ranging from "completely untrue" to "completely true". The mean score of all items for each dimension was used in the analyses (range 1-5). Internal consistency was satisfactory for both scales: α=0.80 for involvement and α=0.78 for strictness.

In order to define the four parenting styles, the scales were dichotomised by median split. Parents were subsequently categorised as authoritative (above median on both scales), authoritarian (above median for strictness, below median for involvement), indulgent (above median for involvement, below median for strictness) and neglectful (below median for both scales).

4 Papers

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Fruit and Vegetable Intake in a Sample of 11-Year-Old Children in 9 European Countries: The Pro Children Cross-Sectional Survey

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Key Words

European schoolchildren · Fruit intake · Vegetable intake · 24-Hour recall · Food frequency · Pro Children study

Abstract

Background/Aims: An adequate fruit and vegetable intake provides essential nutrients and nutritive compounds and is considered an important part of a healthy lifestyle. No simple instrument has been available for the assessment of fruit and vegetable intake as well as its determinants in school-aged children applicable in different European countries. Within the Pro Children Project, such an instrument has been developed. This paper describes the cross-sectional survey in 11-year-olds in 9 countries. ***Methods:*** The cross-sectional survey used nationally, and in 2 countries regionally, representative samples of schools and classes. The questionnaires, including a precoded 24-hour recall component and a food frequency part, were completed in the classroom. Data were treated using common syntax files for portion sizes and for merging of vegetable types into four subgroups. ***Results:*** The results show that the fruit and vegetable intake in amounts and choice were highly diverse in the 9 participating countries. Vegetable intake was in general lower than fruit intake, boys consumed less fruit and vegetables than girls did. The highest total intake according to the 24-hour recall was found in Austria and Portugal, the lowest in Spain and Iceland. ***Conclusion:*** The fruit and vegetable intake in 11-year-old children was in all countries far from reaching population goals and food-based dietary guidelines on national and international levels.

Introduction

For promotion of eating habits which are in line with recent food-based dietary guidelines [1–4], it is important to have valid and reliable, simple assessment tools avail-

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Table 1. WHO population goal[1] and national food-based dietary guidelines for fruit and vegetable intake

Country	Recommendation			Comments
	fruit	vegetables	total	
WHO Europe			≥ 400g	tubers excluded; all age groups included
Austria	250 g	250 g	5 times/day	potatoes excluded; for 10- to 12-year-olds
Belgium	1–3 portions	300 g		juice and potatoes excluded; from 6 years and onwards
Denmark	3 portions	3 portions	600 g	potatoes excluded, juice included as maximum one portion; for children from 10 years and above and adults; portions used for evaluation of intake
Iceland	>200 g	>200 g	500 g	potatoes excluded, fruit juice included in total; all age groups
Netherlands	2 pieces of fruit	150 g		potatoes excluded; one piece of fruit can be taken as juice; a piece equals approx. 125 g of fruit, or one apple
Norway	2 portions	3 portions	750 g	potatoes and fruit juice included; for adults; same number of portions for children although smaller
Portugal	3–5 portions	3–5 portions		potatoes excluded; portions used for evaluation of energy/calories intake: 3–5 portions for 2,200 kcal – general population; 5 for >3,000 kcal
Spain	3 portions	2 portions	≥ 400 g	potatoes and fruit juice excluded; same number of portions for children although smaller; portions used for evaluation of intake
Sweden			≥ 400–500 g	potatoes excluded, fruit juice counted as maximum 100 g; 400 g for children up to 10; 500 for all >10 years of age

[1] Population intake goals represent the population average intake that is judged to be consistent with the maintenance of health in a population.

able. No such assessment tool exists in Europe for use in cross-national comparisons. During the last decades, an increasing amount of attention has been paid to the importance of a high fruit and vegetable intake as an essential part of a healthy lifestyle [1, 2]. The importance of fruit and vegetables for providing essential nutrients such as folate, vitamin C and β-carotene has been emphasized by several reports [1–5], as well as for providing antioxidants of nonvitamin nature and so-called phytoestrogens [1–5]. A number of international recommendations [1, 3, 4] and population targets [2] have been published regarding the desirable level of consumption of fruit and vegetables for adults. A summary of the range reported in the national food-based dietary guidelines for fruit and vegetable intake in the European region is 'more than 400–600 g per day' [6], where the range stands for the variability between countries. The WHO population goal [3] for fruit and vegetable intake is 400 g per day. National food-based dietary guidelines for adults can be found in all investigated countries [3, 7–15], specific guidelines for children exist in some of the investigated countries [3, 7, 10–13, 15–17] (table 1). The guidelines in some cases include suggestions for how they can be used to evaluate intakes.

Fruit and vegetable intake of children has not been extensively monitored on the European level, but has been studied in some national [18–20] surveys. There have been attempts to quantify the intake of individual members of the household from household budget surveys [21], thereby providing possibilities for identifying the fruit and vegetable intake of children. The Health Behaviour in School-Aged Children Study [22] has collected data on fruit and vegetable intake through a simple food frequency questionnaire since 1985. A common protocol for a slightly more sophisticated method of investigating the fruit and vegetable intake in schoolchildren has been missing in the European context.

The Pro Children Project

The Pro Children cross-sectional survey was designed to provide information on actual levels of fruit and veg-

Table 2. Sample selection, response rates, dropout and data cleaning description by country

Country	Partici-pants	Response rate		Dropout rate		Data entry		Data included in the analyses		
		n	% of part	n	% of part	n	% of part	n	% of part	% of data entry
Norway	1,347	1,205	89.5	9	0.7	1,196	88.8	1,157	85.9	96.7
Spain	1,410	1,335	94.7	22	1.6	1,313	93.1	1,289	91.4	98.2
Iceland	1,392	1,235	88.7	39	2.8	1,196	85.9	1,176	84.5	98.3
Denmark	2,111	1,942	92.0	23	1.1	1,919	90.9	1,859	88.1	96.9
Portugal	2,535	2,494	98.4	360	14.2	2,134	84.2	2,118	83.6	99.3
Austria	1,857	1,769	95.3	77	4.1	1,692	91.1	1,656	89.1	97.9
Netherlands	1,396	1,113	79.7	8	0.6	1,105	79.2	1,096	78.5	99.2
Sweden	1,752	1,476	84.2	69	3.9	1,407	80.3	1,364	77.9	96.9
Belgium	1,604	1,355	84.5	12	0.7	1,343	83.7	1,322	82.4	98.4
Total	15,404	13,924	90.4	619	4.0	13,305	86.4	13,037	84.6	98.0

part = Participants.

etable intake among European schoolchildren and their parents as well as the determinants of such consumption patterns. The Pro Children cross-sectional survey constitutes the first ever cross-national comparison of fruit and vegetable intake performed in children, while including determinants (cultural, socioeconomic, and sociocognitive factors). The large variation seen in eating habits across Europe, including practices related to the fruit and vegetable intake, made it particularly important to conduct such a study.

The main objective of the present paper was to describe the results of the Pro Children cross-sectional survey with regard to the total fruit and vegetable intake and frequency of consumption in children in all the participating countries, compared to relevant dietary guidelines.

Method

The cross-sectional survey of the schoolchildren and their parents was conducted in all 9 countries during October to December 2003. Schools constituted the sampling unit, and from each country samples of at least 20 schools and a minimum of 1,300 eligible children were included. The student sample size was seen as sufficient to allow for the planned within-country comparisons (gender, socioeconomic status and urban-rural differences) and take the school component of the variance into account. The target group was children born in 1992. Nationally statistically representative samples of schools were drawn in each country with the exception of Austria and Belgium. For Austria, the sample is statistically representative of the eastern region (population of approximately 4 million; 42% of total population). For Belgium, the sample is statistically representative of Flanders (the Dutch-speaking north-western half of the country, population of approximately 6 million, 58% of total population). The response rates, dropouts and incomplete questionnaires rejected during data cleaning are described in table 2, while the age and gender distribution of the final sample is described in table 3. Only 1.7% of the 24-hour recall (0.6 girls/1.1 boys) and 1.9% of the food frequency (0.9 girls/1.0 boys) questionnaires were excluded from the analysis due to incomplete answers in the dietary intake part of the questionnaire.

The Instrument

A comprehensive survey instrument assessing fruit and vegetable intake and psychosocial factors associated with these consumption patterns was developed for both pupils and their parents. The instruments were originally developed in English prior to translation into the relevant languages within each participating country. These national versions were then back-translated into English by language-proficient individuals not involved in the development of the instruments.

The dietary questionnaire comprises two sections: a precoded 24-hour recall component asking in detail about yesterday's fruit and vegetable intake, and a food frequency part with 5 questions on usual fruit and vegetable intake. The 24-hour recall component was used for measuring group mean intake and for specifying the type of fruits and vegetables eaten, whereas the food frequency part was used for ranking subjects according to their usual intake. The instrument is further described by Haraldsdottir et al. [23]. Multiple pilot tests, including reliability and validity testing, were conducted in a number of countries before the final instrument was decided upon [23]. Based on formal testing of the child instruments in Belgium, Denmark, Iceland, Norway and Portugal, it was concluded that the questionnaire instrument was valid and reliable in giving national group means of fruit and vegetable intake among 11-year-old children as well as ranking them by intake.

The Procedure

The headmasters of the schools were approached about their willingness to participate, and the class teachers were asked to col-

Table 3. Age and gender distribution of the final sample by country and total

Country	Total			Girls			Boys			
	n	age	SD	n	age	SD	n	age	SD	% boys
Austria	1,656	11.0	0.59	871	11.0	0.59	785	11.1	0.60	47.4
Belgium	1,322	11.5	0.46	606	11.5	0.46	716	11.5	0.46	54.2
Denmark	1,859	11.4	0.38	918	11.3	0.35	941	11.4	0.39	50.6
Iceland	1,176	11.3	0.33	562	11.3	0.34	614	11.3	0.31	52.2
Netherlands	1,096	11.7	0.46	590	11.7	0.44	506	11.8	0.48	46.2
Norway	1,157	11.3	0.32	569	11.3	0.32	588	11.3	0.31	50.8
Portugal	2,118	11.5	0.45	1,115	11.5	0.43	1,003	11.5	0.47	0.47
Spain	1,289	11.4	0.44	599	11.4	0.41	690	11.4	0.46	53.5
Sweden	1,364	11.4	0.47	687	11.4	0.47	677	11.4	0.46	49.6
Total	13,037	11.4	0.48	6,517	11.3	0.47	6,520	11.4	0.48	50.0

lect the data using standardized instructions. The data for the children's intake were collected directly in the classroom using the validated instrument. Data were entered at the national centers, according to a standardized protocol, prior to submission to the joint Data Management Centre at the University of Vienna, where data processing and quality control has taken place.

Data Treatment

The results from the 24-hour recalls regarding vegetables were merged into four subgroups, i.e. salad, raw vegetables, cooked vegetables and soup vegetables, in order to provide useful information for the design of interventions. The results from the food frequency questionnaire were converted to 'once a day or more' regarding frequency of total fruit and vegetable intake. Portion sizes were corrected for differences in standard servings between countries, in particular for cucumber and carrots (due to different slicing habits for pieces or slices). A maximum number of portions consumed per meal was determined for each fruit and vegetable item and intakes were adjusted using a standardized script. The results were tested for age-related differences. As no such differences could be identified, the results are presented only according to gender and country.

Research Clearance

The cross-sectional survey involves children (9–13 years of age) and their parents (healthy volunteers). Self-administered questionnaires are the only research instruments used. Parental written consent was obtained prior to including the children in the cross-sectional survey. Furthermore, research clearance was obtained from research ethics committees in all countries where this was regulated for this kind of noninvasive study.

Data Analysis

Data analysis was conducted using the program software Statistical Package for Social Sciences 12.0 (SPSS). For age and gender differences, statistical significance was established as $p < 0.05$. Non-parametric Mann-Whitney U tests corrected with Shaffer were used, due to the absence of normal distribution of consumption data even after logarithmic transformation.

Results

24-Hour Recall

Fruit, fruit juice, vegetable, as well as added fruit and vegetable intake are presented in table 4a–d. Girls had a significantly higher fruit, vegetable and total fruit and vegetable intake than boys ($p < 0.000$) and a slightly higher fruit juice intake, though not significant ($p = 0.098$). A large variation in consumption was found between the countries. The highest overall fruit intakes were found in Austria, Denmark and Portugal (171, 157 and 153 g). Fruit intakes were lowest in Iceland and Spain (90 and 118 g). Children in Portugal, Sweden and Belgium showed the highest overall vegetable intakes in this study (mean 111, 109 and 105 g). The countries with the lowest vegetable intakes were Iceland and Spain (mean 54 and 58 g). The highest overall fruit and vegetable intakes were found in Austria and Portugal (265 and 264 g), while the lowest intakes were found in Iceland and Spain (143 and 176 g). The highest juice intakes were found in Austria and the Netherlands (360 and 267 g), the lowest in Portugal and Denmark (142 and 143 g).

Figure 1 presents the average fruit intake in grams per day per country. Figure 2 shows vegetable intake in grams/day per country indicating the type of vegetables eaten. Raw vegetables were consumed much more in the northern countries. In Portugal and Spain, the main intake of vegetables came from vegetable soup.

Food Frequency Questionnaire

The food frequency data are presented in figures 3 and 4. The percentage of children choosing the alternatives

Table 4. The 24-hour recall (P = percentile)

a Fruit intake (g)

Country	Total						Girls		Boys	
	mean	95% CI	median	P25	P75	P90	mean	median	mean	median
Austria	171	163–179	150	0	250	400	171	125	171	150
Belgium	137	130–145	100	0	200	300	142	100	133	100
Denmark	157	150–164	100	0	200	400	168	150	146	100
Iceland	90	83–96	50	0	100	250	87	50	93	50
Netherlands	134	126–142	100	0	200	300	142	100	125	100
Norway	149	140–158	100	0	200	375	157	100	141	100
Portugal	153	147–158	150	50	200	300	152	150	153	125
Spain	118	111–125	100	0	200	300	117	100	118	100
Sweden	129	122–136	100	0	200	300	134	100	125	100
Total	141	138–143	100	0	200	300	144	100	137	100

b Juice intake (g)

Austria	360	343–378	300	0	600	800	348	300	375	400
Belgium	225	210–240	200	0	400	600	215	200	234	200
Denmark	143	133–154	0	0	200	400	144	0	142	0
Iceland	211	197–225	200	0	400	600	200	200	221	200
Netherlands	267	250–284	200	0	400	600	287	200	244	200
Norway	195	179–211	0	0	400	600	207	100	184	0
Portugal	142	133–150	0	0	200	400	135	0	150	0
Spain	213	202–225	200	0	400	500	212	200	214	200
Sweden	197	182–212	0	0	400	600	186	0	209	0
Total	213	208–217	200	0	400	600	209	200	215	200

c Vegetable intake (g)

Austria	94	89–99	60	0	140	240	99	60	88	60
Belgium	105	100–110	80	30	150	235	101	80	108	80
Denmark	84	79–89	40	0	125	231	92	60	76	40
Iceland	54	49–59	10	0	70	165	57	30	50	0
Netherlands	70	65–75	60	0	100	160	73	60	67	60
Norway	67	62–73	30	0	105	195	75	40	60	10
Portugal	111	107–115	80	30	160	250	112	90	110	80
Spain	58	54–62	40	0	80	160	56	40	60	40
Sweden	109	103–115	75	20	155	265	118	80	100	65
Total	86	85–88	60	0	130	220	90	60	83	60

d Fruit plus vegetable intake (g)

Austria	265	254–275	210	100	390	590	269	220	259	200
Belgium	242	232–252	200	100	340	500	243	210	242	200
Denmark	241	231–250	200	80	350	535	260	215	222	180
Iceland	143	134–153	100	0	200	350	144	100	143	100
Netherlands	204	194–214	165	100	284	430	214	180	193	160
Norway	216	204–228	160	60	315	505	232	200	201	143
Portugal	264	256–271	240	130	361	500	264	240	263	240
Spain	176	168–185	145	50	250	390	174	150	179	140
Sweden	238	228–249	200	93	340	500	251	225	225	190
Total	227	224–230	190	80	330	500	235	200	219	180

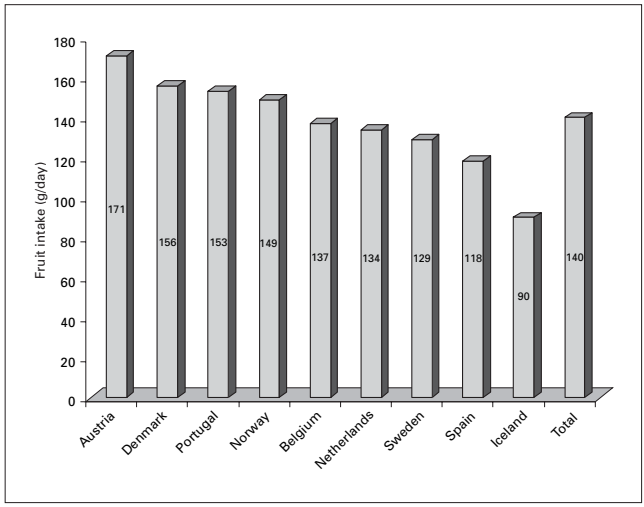

Fig. 1. Mean consumption of fruit (g/day).

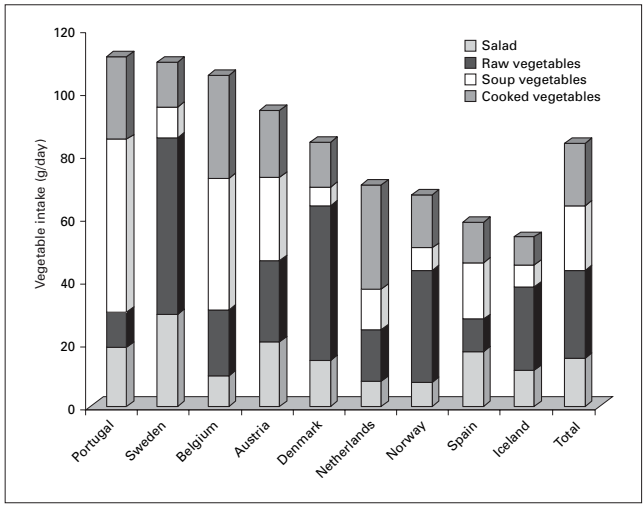

Fig. 2. Mean consumption of vegetables, shown as subgroups and total (g/day).

once every day, twice every day, more than twice every day for both fruit and vegetable is shown. Less than half of all the investigated children indicated that they eat fruit (48%) or vegetable (45%) every day.

Discussion

Among the 9 European countries participating in this cross-sectional survey, a diverse and complicated picture of fruit and vegetable intake emerged. Children in all

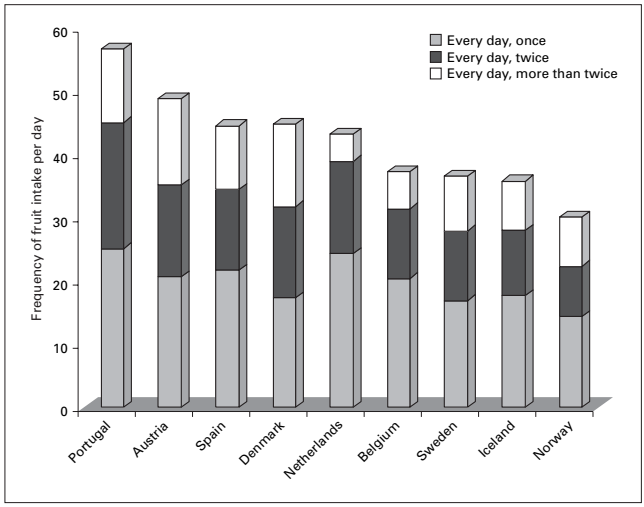

Fig. 3. Frequency of intake of fruit, ≥1 time per day.

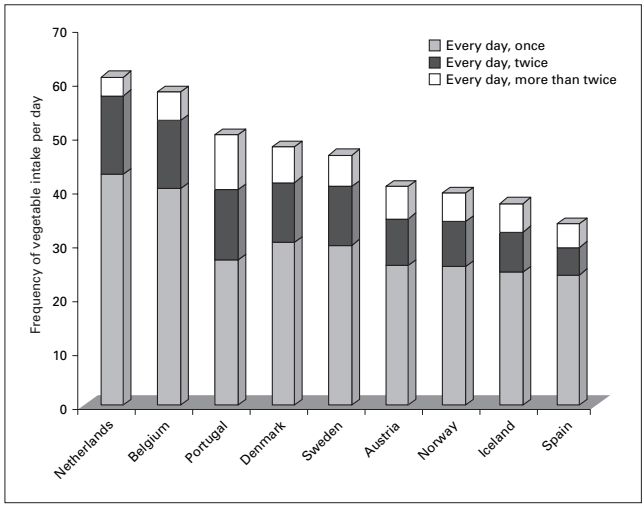

Fig. 4. Frequency of intake of vegetables, ≥1 time per day.

countries showed relatively low intakes of both fruit and vegetables with consistently lower intakes of vegetables. Boys had in general a lower fruit and vegetable intake than girls. There was no clear north-south gradient, except for the type of vegetables eaten (raw vegetables, cooked vegetables and vegetable soup). The higher intake of raw vegetables in the northern countries might reflect different preferences, but could also have been due to culturally dependent factors related to food preparation and availability.

The response rates were overall unusually high, probably due to the use of schools and classes as sampling units. Due to the school-based survey, respondent bias (overrepresentation of healthy, well-educated subjects) was probably lower than in other types of studies. Because of the statistically representative samples in all countries except for Belgium and Austria, the results should be representative for the countries, and for Belgium and Austria for the chosen regions. Comparisons between the countries could however present some problems, due to differences in food culture and perception of portion sizes.

The main limitation of the 24-hour recall in this precoded instrument was that intakes were recorded for one weekday only and therefore did not reflect usual intake. The food frequency questionnaire should to some extent have corrected for this and in comparison, the ranking of countries based on actual intake (24-hour recall) fits rather nicely with the ranking of usual intake (food frequency questionnaire). In Spain, we could, however, see that the ranking for usual intake seemed higher than the actual intake for fruit, and in the Netherlands the ranking for usual intake was higher for vegetables than the one for actual intake. Group averages of weekday intakes were considered relatively reliable due to the narrow age range and such large samples in each country.

Another problem with the instruments was the portion size estimation for carrots and cucumber that was performed by the Pro Children consortium, where the ways of serving these vegetables turned out to be diverse between countries (e.g. sticks of different sizes, thick or thin slices). Also, as was shown in focus groups [24], children in Belgium had problems distinguishing fruit juice from lemonades and other fruit-based drinks, which is why the data on fruit juice should be interpreted with caution.

Fruit juice intake seemed high in some countries, and may have contributed substantially to the intake of vitamin C and folate. Another problem with the survey results was the fact that different vegetables have very different contents of active compounds of nutrients and other potentially nutritionally important components.

In adding up intakes of different kinds of fruits and vegetables to total intake levels, we therefore neglected possibly relevant differences within the fruit and vegetable food groups. We did not include potatoes in the analysis, which might provide substantial amounts of vitamin C in countries where potato consumption is high. Another problem was the season when the data were collected. October and November are in many countries, except for Spain, the period when nationally or locally grown fruit, berries and vegetables are available in vast amounts. This could mean that data for fruit and vegetable intake collected at other times of the year could be even lower, or in the case of Spain that fruit and vegetable intake would be higher if collected at another time of the year.

Generally, the results of the present study were in line with the results from earlier studies on fruit and vegetable intake in the participating countries [9, 19, 25–30] when taking the differences in methodology and year of survey into account. The results of the present study for both fruit and vegetable intake frequency also show roughly the same ranking of countries as the Health Behaviour in School-Aged Children Study [22]. However, data on availability of fruits and vegetables [31, 32] show a north-south gradient, where the southernmost countries had the highest availability; a finding that was not reflected in the present results.

The WHO population goal [3] for consumption of fruit and vegetables (table 1) is 400 g per day. It does not specify whether fruit juice should be included. The WHO population goal represents the population average that is judged to be consistent with the maintenance of health. No clear guidelines on how to interpret the population goal for intake evaluation purposes could be identified. Our analyses indicate that average intakes of children in almost all countries exceeded the population goal of 400 g when our data on fruit juice were included. However, we showed earlier [24] that children of this age had problems distinguishing fruit juice from other fruit drinks or lemonades. After exclusion of juice intake, the results showed that mean intakes of fruit and vegetables in all countries were lower than the WHO population goal. Children in Austria and Portugal, with the highest intakes of fruit and vegetables, both reached a mean intake of about 264 g per day.

No guidelines for how to interpret population goals for this specific age group were identified either. Possibly, children of this age group should end up somewhere in the lower end of the range compared with the range of intake for the whole population. Due to this problem, it was even more difficult to judge to which extent the population of children in this study achieved the WHO population goal.

An attempt was made to use a British example [33] of identifying compliers and noncompliers of the WHO population goal of 400 g. This was done by ranking the sum of vegetable and fruit intake and selecting a cutoff point when the group mean reached 400 g. The cutoff applied in the total group was 210 g, depending on the distribution of intake. In the total sample, the resulting per-

Table 5. Percentage of 11-year-old children with fruit plus vegetable intake ≥ 400 g, by gender and country

Country	Total		Girls		Boys	
	n	%	n	%	n	%
Austria	400	24.1	212	24.3	188	23.9
Belgium	253	19.1	108	17.8	145	20.3
Denmark	394	21.2	218	23.7	176	18.7
Iceland	92	7.8	36	6.4	56	9.1
Netherlands	130	11.9	77	13.1	53	10.5
Norway	202	17.5	109	19.2	93	15.8
Portugal	453	21.4	227	20.4	226	22.5
Spain	125	9.7	45	7.5	80	11.6
Sweden	250	18.3	136	19.7	114	16.8
Total	2,299	17.6	1,168	17.9	1,131	17.3

centage of compliers (which should be 100% if the population goal was achieved) was 44.5%. Among the compliers, there were more girls than boys in all countries except for Spain. If, on the other hand, the 400 g population goal is used as a cutoff for fruit and vegetable intake, we can see that the percentage of 11-year-olds in the 9 countries that eat 400 g of fruits and vegetables per day varies between 6.4 and 24.3%, depending on gender and country (table 5).

National recommendations were in most cases higher than the WHO population goal (table 1). In some countries, fruit juice without limitation was included in the recommendation, while other countries allowed the inclusion of one portion of fruit juice per day, interpreted as 100 g. Yet other countries did not include fruit juice at all. In all countries, except for Norway, potatoes were excluded from the recommendations. Some countries used the same recommendations for adults and children. The recommendations sometimes included guidelines for interpretation of survey results; Spain, Denmark and Portugal specified that portions were supposed to be used for evaluation of intake. When taking all these factors into account, the average intake in all countries failed to reach the own nationally recommended levels in this study.

For those countries which used portions for evaluating intake, 6.0 and 5.8% of girls and boys in Denmark, 19.5 and 13.3% in Norway, 23.2 and 22.2% in Portugal and 0.8 and 1.2% in Spain reached the recommended number of portions for fruit and vegetables. Comparison of the Norwegian data with national recommendations was however difficult as potato intake was not measured in this study.

The Dutch and Belgian recommendations are expressed both in grams (for vegetables) and portions (for fruit). For the Netherlands 7.8 and 5.7%, and for Belgium 14.0 and 13.3% of girls and boys, respectively, reached both recommendations for fruit and vegetables.

For Austria 6.4 and 7.6%, for Iceland 3.4 and 4.6% and for Sweden 15.7 and 13.3% of girls and boys reached the recommended intakes, which ranged from 400 to 600 g. According to the National Food Administration in Sweden, the recommendation for fruit and vegetables for Sweden (1/2 kg) should be seen as a population goal, which means that half of the whole population should reach the recommendation.

In the above calculations, fruit juice was not counted at all. This could mean that the results were too pessimistic in many cases, since fruit juice could have contributed to a higher intake of for example folate and vitamin C than indicated by the data on fruit and vegetables.

Conclusions

The average fruit and vegetable intake did not reach WHO population goals or national recommendations in any country when fruit juice was excluded. The fruit and vegetable intake was highly variable across Europe, for total amounts and types of vegetables eaten. Vegetable intake was clearly lower than fruit intake. A large proportion of the investigated group stated a frequency of intake which was less than once a day of fruit and vegetables, respectively.

The future analysis of determinants for fruit and vegetable intake in the Pro Children cross-sectional survey will be of great importance for identifying ways to correct the inadequate intakes that were identified in this analysis.

We can also conclude that there were difficulties in the interpretation of the WHO population goal, since no clear guidelines seemed to exist regarding (1) the inclusion or exclusion of fruit juice and (2) interpretation within selected age groups. Moreover, national recommendations are highly variable and sometimes difficult to interpret.

Acknowledgements

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2001-00547 'Promoting and Sustaining Health through Increased Vegetable and Fruit Consumption among European Schoolchildren' (Pro Children). The study does not necessarily reflect the Commission's views and in no way anticipates its future policy in this area. Special thanks to all the teachers, headmasters and above all, the children who took the time to participate in this survey, to the staff and students from all 9 participating countries who have collected and entered the data, to Professor Emeritus Leif Hambraeus who advised on the interpretation of results and finally to Emma Patterson who checked the English and gave good advice.

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ORIGINAL ARTICLE

Personal, social and environmental predictors of daily fruit and vegetable intake in 11-year-old children in nine European countries

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Objective: To investigate potential personal, social and physical environmental predictors of daily fruit intake and daily vegetable intake in 11-year-old boys and girls in nine European countries.
Subjects: The total sample size was 13 305 (90.4% participation rate).
Results: Overall, 43.2% of the children reported to eat fruit every day, 46.1% reported to eat vegetables every day. Daily fruit intake and daily vegetable intake was mainly associated with knowledge of the national recommendations, positive self-efficacy, positive liking and preference, parental modeling and demand and bringing fruit to school (odds ratio between 1.40 and 2.42, $P<0.02$). These factors were associated fairly consistently with daily fruit intake across all nine European countries, implying that a rather uniform intervention strategy to promote fruit can be used across Europe. For vegetables, the pattern was, however, less consistent. Differences between countries in cooking and preparing vegetables might be responsible for this larger diversity.
Conclusions: This study showed that especially a combination of personal and social factors is related to daily fruit and vegetable intake in schoolchildren. This shows that a comprehensive multilevel intervention strategy based upon a series of individual and social correlates will be most promising in the promotion of daily fruit and vegetable intake in children.
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Keywords: health promotion; determinant; correlate; Pro children; fruit and vegetable consumption

Introduction

Epidemiological evidence suggests that regular consumption of fresh fruit and vegetables is associated with lower risks of certain types of cancer (Paolini *et al*., 2003), heart disease (Joshipura *et al*., 2001) and obesity (Pesa and Turner, 2001). Nevertheless, people in many countries, including children eat less fruit and vegetables than recommended. A number of international recommendations and population targets have been published regarding the desirable level of consumption of fruit and vegetables for adults and children (Yngve *et al*., 2005). Guidelines are expressed in portions or in grams and considerable differences in recommendations appear between countries. In addition, there is inconsistency about including or excluding for example potatoes, fruit juice, vegetable soup and tubers (Yngve *et al*., 2005). In general, all

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recommendations advise at least daily consumption of fruit and vegetables. The consumption of at least one portion of fruit and one portion of vegetables can be considered to be an absolute minimum in children and adults (Yngve *et al*., 2005). However, also with this minimum recommendation, a considerable proportion of children still do not meet the guideline. The Health Behavior in School-Aged Children (HBSC) Study investigated fruit and vegetable intake in 35 countries and found for 11-year olds 19–58% of the children reporting to eat fruit every day and 13–55% to eat vegetables every day. In most countries, the proportion of students who eat fruit and vegetables every day also decreased with increasing age (Vereecken *et al*., 2004). The promotion of daily fruit and vegetable consumption in schoolchildren is important, since food habits established in childhood may to a certain extent track into adolescence and adulthood (Birch, 1990; Lien *et al*., 2001; Mikkilä *et al*., 2004), and food habits in children may still be more flexible for change (Birch, 1990).

Intervention studies designed to promote fruit and vegetable intake in children need to be informed by knowledge of predictors of intakes (Baranowski *et al*., 1997). The consumption of fruit and vegetables among schoolchildren is a complex phenomenon in which personal, social and physical environmental factors may have mutual influences. Personal cognitive and affective factors such as proposed in social-cognitive theories (Armitage and Conner, 2000) include such factors as knowledge, attitude, liking, self-efficacy, preference and perceived barriers. Social and physical environmental factors are highlighted in so-called social–ecology models (Swinburn *et al*., 1999). Social environmental factors for children include family and friends, while physical environmental factors include availability and accessibility of healthy or unhealthy foods at home, in schools or in the neighborhood. To date, most studies investigating possible predictors of fruit and vegetable consumption in children, included only part of the possible predictors outlined above, often focusing on personal or physical environmental factors only (Klepp *et al*., 2005). No cross-national studies are available studying differences and similarities in predictors across countries in Europe. The diversity in the physical and social environments within European countries could result in variation in predictors of daily fruit and vegetable intake in children within different countries. Furthermore, although previous studies showed more fruit and vegetable intake in girls compared to boys (Yngve *et al*., 2005), it is not clear whether other predictors are important in boys than in girls.

The aim of the present study was to investigate potential personal, social and physical environmental correlates of daily fruit intake and daily vegetable intake in 11-year-old boys and girls in nine countries in Europe.

Methods

Sample

The sample was from the cross-sectional study of the Pro Children project. This project aimed at promoting and sustaining health through increased vegetable and fruit consumption among European schoolchildren, involving nine European countries (Austria, Belgium, Denmark, Iceland, the Netherlands, Norway, Portugal, Spain and Sweden). The cross-sectional survey was conducted as a pre-intervention needs assessment in these countries during October–December 2003. Pupils completed a questionnaire in the classroom. Ethical approval was obtained from all relevant ethics committees in all countries and written informed consent forms were signed by parents of all participating children.

Schools constituted the sampling unit, and from each country random samples of at least 20 schools and a minimum of 1300 11-year-old eligible children were recruited. A participation rate of 90.4% was reached in the participating schools; mean age was 11.4 years (range 8.8–13.8, s.d. = 0.48; 79% of the children were born in 1992). The final sample sizes varied from 1105 for the Netherlands to 2134 for Portugal, with a total sample size of 13 305. A detailed description of the Pro Children project, including the sampling and data collection procedure is given elsewhere (Klepp *et al*., 2005; Yngve *et al*., 2005).

Questionnaire

A self-report questionnaire was developed to measure fruit and vegetable intake, and possible correlates. The development of the questionnaire was based on theoretical models, a literature review, focus group interviews with children, individual interviews with parents and school staff and thorough pretesting (De Bourdeaudhuij *et al*., 2005; Wind *et al*., 2005). A rigorous translation – back translation protocol was used to make sure that the questions were well understood in each country and measured the same constructs. The questionnaire included 15 constructs that were analogous for fruit and for vegetable intake: (1) personal factors: knowledge (how much fruit/vegetables you should eat), attitudes (feel good, gives energy), liking (like to eat, tastes good), general self-efficacy (difficult to me, I can do it), preferences (12 fruits/vegetables like/dislike) and perceived barriers (time, hungry, squeezed, so on…), (2) perceived social–environmental factors: modeling (mother/father/best friend eats fruit/vegetables), active parental encouragement (mother/father encourages), family rules – demands (parents demand to eat fruit/vegetables) and allowances (allowed to eat as much fruit/vegetables as you like) – parental facilitation (cut fruit/vegetables for you) and bringing fruit/vegetables to school, (3) perceived physical–environmental factors: availability at home (different fruits/vegetables, fruit/vegetables that you like, if you like it will be bought), availability at school (can you get fruit/vegetables at school) and availability at friends' home (can you get fruit/vegetables at friends' home). These constructs were assessed with 1–12 items, and for each construct a composite score was calculated as the mean of the relevant item scores. Responses were given on 5-point scales ranging from (−2) fully disagree/never to (+2) fully agree/always. An overview

of the items, constructs and scaling are reported elsewhere (De Bourdeaudhuij *et al*., 2005; Sandvik *et al*., 2005). A separate study in five countries showed sufficient internal consistencies for composite scores (alphas between 0.59 and 0.89), good to very good test–retest reliability (most ICC > 0.60; all ICC > 0.50) and moderate to good predictive validity (Spearman *r* ranging from 0.16 to 0.54 for personal factors, and from 0.05 to 0.38 for physical environmental factors) compared to other studies (De Bourdeaudhuij *et al*., 2005). Usual fruit and vegetable intake was measured using a food-frequency questionnaire. Children were asked how often they usually eat fresh fruit, salad or grated vegetables, other raw vegetables and cooked vegetables. Response categories were (1) never, (2) less than 1 day per week, (3) 1 day per week, (4) 2–4 days a week, (5) 5–6 days a week, (6) every day, once a day, (7) every day, twice a day and (8) every day, more than twice a day. A separate study was executed to test the reliability and validity of these intake measures in six countries. Results showed good test–retest reliability (Spearman *r* from 0.45 to 0.77), and adequate validity comparing the food-frequency questions with 7-day food records (Spearman *r* from 0.38 to 0.53) (Haraldsdóttir *et al*., 2005).

Statistical analysis

Multilevel logistic regression analysis was used to investigate the associations of daily fruit intake and daily vegetable intake with personal, social and physical environmental variables, taking into account the nested design of children within schools and schools within countries. The fruit and vegetable frequency questions were dichotomized into 0 (no daily fruit/vegetable consumption, response category 1–5) or 1 (daily fruit/vegetable consumption, response category 6–8). The predictors were also dichotomized into 0 (negative or neutral, response category −2 to 0.49) or 1 (positive, response category >0.49) (Sandvik *et al*., 2005). Adjusted odds ratio (OR) and 98% confidence intervals (CIs) are presented for the total sample, both gender groups and all nine countries separately. All analyses were conducted in 2005 using SPSS 12.0 and in MlWin version 2.02.

Results

Daily fruit and vegetable intake

The percentage of children reporting daily fruit and vegetable intake are reported in Table 1. In the total sample, 43.2% of the children reported to eat fruit every day, 46.1% reported to eat vegetables every day. A significant gender difference was found for both outcome measures: 47.7% of the girls and only 38.9% of the boys reported to eat fruit daily (OR: 1.44, 98% CI: 1.33–1.56), while 51.8% of the girls and 40.5% of the boys reported to eat vegetables every day (OR: 1.58, 98% CI: 1.45–1.71). Significant differences were also found between the nine participating countries ($P<0.001$). For daily fruit intake, the lowest rates were found in the Nordic countries of Norway, Iceland and Sweden. The highest percentage of children reporting daily fruit intake was found in Portugal. For daily vegetable intake, low rates were again found in Norway and Iceland, but the lowest rate was found in Spain. The highest rates were found in the Netherlands, Belgium and Portugal.

Table 1 Percentage of children reporting daily fruit and daily vegetable intake

	Daily fruit intake (%)	*Daily vegetable intake (%)*
All countries ($n=13168$)	43.30	46.10
Boys ($n=6605$)	38.90	40.50
Girls ($n=6563$)	47.70	51.80
Austria ($n=1681$)	48.80	40.60
Belgium ($n=1339$)	37.30	57.80
Denmark ($n=1882$)	44.70	47.90
Iceland ($n=1169$)	35.80	37.40
Netherlands ($n=1099$)	43.10	60.90
Norway ($n=1182$)	30.20	39.40
Portugal ($n=2115$)	56.60	50.10
Spain ($n=1304$)	44.60	33.60
Sweden ($n=1397$)	36.50	46.00

Correlates of daily fruit and vegetable intake in the total sample

For daily fruit intake, 5 of the 6 personal factors yielded significance in the total sample (Table 2). Daily fruit intake was more likely to be reported by children who knew the national recommendation for fruit intake, with positive self-efficacy, with a positive liking of the taste of fruit, with a preference for many different fruits and with a positive attitude toward fruit intake. In addition, 4 of the 6 social–environmental factors yielded significance. Daily fruit intake was more likely to be reported by children who experienced positive role models, by those with parents who demand them to eat fruit every day, by children with parents who facilitate fruit intake by cutting up fruit and by those bringing fruit to school. A similar pattern was seen for boys and girls separately. Not significantly related with daily fruit intake were the three physical–environmental factors (availability at home, school, friends), active parental encouragement, the allow family rule and perceived barriers.

For daily vegetable intake, also 5 of the 6 personal factors yielded significance in the total sample. In line with the predictors found for daily fruit intake, daily vegetable intake was related to liking many different kinds of vegetables, liking the taste of vegetables, positive self-efficacy and knowing national guidelines for adequate vegetable intake. These predictors were also significant in the gender-specific analyses. In the total sample, a positive attitude toward eating vegetables was also related to eating vegetables daily. This relationship was of similar strength but not significant in the analyses for boys and girls separately.

All six social–environmental factors also yielded significance in predicting eating vegetables every day. Demands

Table 2 Odds ratios and confidence intervals of multiple binary logistic regression for total sample

	Daily fruit intake			*Daily vegetable intake*		
	Total sample (n = 13 168) OR (98% CI)	*Boys (n = 6605) OR (98% CI)*	*Girls (n = 6563) OR (98% CI)*	*Total sample (n = 11 905) OR (98% CI)*	*Boys (n = 5875) OR (98% CI)*	*Girls (n = 6030) OR (98% CI)*
Personal						
Knowledge	2.25 (2.03–2.49)	2.36 (2.04–2.74)	2.16 (1.87–2.49)	1.41 (1.26–1.58)	1.43 (1.23–1.68)	1.42 (1.21–1.67)
Attitudes	1.36 (1.14–1.63)	1.43 (1.12–1.84)	1.31 (1.01–1.69)	1.16 (1.03–1.31)	1.17 (0.98–1.39)	1.13 (0.96–1.33)
Liking	1.97 (1.52–2.55)	1.82 (1.30–2.55)	2.12 (1.44–3.13)	1.60 (1.41–1.80)	1.54 (1.29–1.83)	1.68 (1.42–1.99)
General self-efficacy	2.09 (1.79–2.43)	2.02 (1.63–2.51)	2.14 (1.73–2.64)	1.46 (1.30–1.63)	1.63 (1.39–1.91)	1.31 (1.12–1.53)
Preferences	1.74 (1.44–2.11)	1.89 (1.46–2.45)	1.57 (1.17–2.09)	1.83 (1.65–2.02)	1.98 (1.71–2.28)	1.70 (1.48–1.96)
Perceived barriers	0.88 (0.64–1.20)	0.94 (0.63–1.39)	0.78 (0.47–1.29)	0.82 (0.68–1.00)	0.82 (0.59–1.14)	0.83 (0.61–1.12)
Social–environmental						
Modeling	1.95 (1.74–2.19)	2.09 (1.77–2.46)	1.85 (1.58–2.18)	1.43 (1.29–1.60)	1.45 (1.24–1.69)	1.45 (1.24–1.69)
Active parental encouragement	0.96 (0.85–1.08)	0.95 (0.80–1.13)	0.99 (0.84–1.16)	1.26 (1.12–1.41)	1.30 (1.11–1.52)	1.23 (1.05–1.44)
Demand family rule	1.60 (1.42–1.81)	1.62 (1.37–1.92)	1.63 (1.38–1.93)	1.50 (1.34–1.68)	1.54 (1.31–1.81)	1.47 (1.25–1.73)
Allow family rule	0.85 (0.73–1.00)	0.88 (0.70–1.10)	0.83 (0.66–1.04)	1.22 (1.07–1.40)	1.11 (0.92–1.33)	1.38 (1.14–1.67)
Family facilitation	1.34 (1.20–1.51)	1.25 (1.06–1.47)	1.45 (1.23–1.70)	1.16 (1.03–1.31)	1.06 (0.89–1.25)	1.26 (1.06–1.49)
Bring fruit/vegetables to school	2.75 (2.43–3.12)	2.60 (2.17–3.11)	2.86 (2.42–3.38)	1.99 (1.68–2.36)	1.95 (1.54–2.48)	2.08 (1.63–2.67)
Physical–environmental						
Availability at home	1.22 (1.00–1.48)	1.18 (0.90–1.54)	1.28 (0.97–1.69)	1.27 (1.12–1.44)	1.26 (1.05–1.52)	1.29 (1.09–1.54)
Availability at school	1.00 (0.88–1.13)	1.01 (0.86–1.20)	1.00 (0.84–1.18)	1.08 (0.95–1.22)	1.05 (0.88–1.25)	1.12 (0.94–1.33)
Availability at friends house	1.07 (0.96–1.19)	1.15 (1.00–1.34)	1.00 (0.87–1.15)	1.00 (0.90–1.11)	0.97 (0.83–1.13)	1.03 (0.89–1.20)

Abbreviations: OR, odds ratios; CI, confidence interval.
Significant OR are underlined for ease of interpretation.

from parents to eat vegetables daily, modeling, active parental encouragement, bring vegetables to school, allowance to eat as much vegetables they like and cutting vegetables for the child were significant predictors. The association with the allow family rule and family facilitation was only significant in girls. Children who frequently have available vegetables they like at their home were more likely to report daily vegetable consumption. Not significantly related with daily vegetable intake were perceived barriers and availability at school and at friends' house.

Country-specific correlates of daily fruit and vegetable intake

Table 3 shows the results of the multilevel logistic regression analyses for daily fruit intake for the nine countries in the Pro Children study. Owing to the lower statistical power in these smaller samples, relatively high ORs did not always reach significance. In all nine countries, daily fruit intake was significantly more likely to be reported by children knowing the national guideline, with almost all ORs above 2.00. In most countries, daily fruit intake was also associated with positive self-efficacy. Positive liking and preferences scores were significant in 3–5 countries. Modeling was the social–environmental component significantly associated with daily fruit intake in all countries. Bringing fruit to school predicted daily fruit intake in all countries, but one (Spain), with ORs between 2.36 and 4.06. More demands from parents to eat fruit daily and parental facilitation were significant predictors for daily fruit intake in about half of the participating countries.

None of the availability factors was significantly associated in the separate countries, with the exception of availability at school in Norway. Not significantly related with daily fruit intake were perceived barriers, active parental encouragement and the allow family rule.

Table 4 shows that predictors were less consistent for vegetables compared to daily fruit intake. Preferences for many vegetables, positive self-efficacy toward eating vegetables, and liking the taste of vegetables were positively associated with daily vegetable intake in most countries. ORs were typically below 2.00. A better knowledge of recommendations yielded significance in five of the nine countries. More parental demand and modeling were the social–environmental components that were positively associated with daily vegetable intake in most countries. Bringing vegetables to school and active parental encouragement predicted vegetable intake in four and three countries, respectively. In Spain, none of the social–environmental factors yielded significance. Home availability of vegetables was only significant in Iceland, none of the other availability components reached significance.

Discussion

The present study is unique in its combination of a comprehensive set of possible correlates in a cross-national

Table 3 Odds ratios and confidence intervals of multiple binary logistic regressions explaining daily fruit intake by country

	Austria (n = *1678*)	*Belgium* (n = *1336*)	*Denmark* (n = *1867*)	*Iceland* (n = *1161*)	*Netherlands* (n = *1096*)	*Norway* (n = *1173*)	*Portugal* (n = *2104*)	*Spain* (n = *1291*)	*Sweden* (n = *1393*)
Personal									
Knowledge	2.60 (1.94–3.50)	1.96 (1.42–2.70)	1.57 (1.17–2.11)	2.36 (1.65–3.38)	2.17 (1.53–3.06)	2.53 (1.70–3.75)	2.70 (2.08–3.52)	2.39 (1.74–3.30)	2.54 (1.84–3.50)
Attitudes	1.60 (0.89–2.90)	1.40 (0.90–2.17)	1.32 (0.86–2.02)	2.19 (1.09–4.41)	1.14 (0.71–1.85)	2.09 (0.95–4.58)	1.00 (0.57–1.76)	1.15 (0.58–2.26)	1.15 (0.64–2.07)
Liking	1.83 (0.90–3.73)	2.25 (1.10–4.61)	2.47 (1.17–5.20)	1.02 (0.29–3.61)	1.94 (0.96–3.93)	1.51 (0.32–7.15)	2.47 (1.32–4.63)	1.76 (0.95–3.29)	2.96 (0.95–9.27)
General self-efficacy	2.14 (1.39–3.30)	1.99 (1.26–3.12)	2.15 (1.38–3.34)	1.73 (0.96–3.11)	3.26 (2.04–5.21)	1.91 (0.98–3.72)	1.57 (1.10–2.24)	2.36 (1.60–3.49)	2.69 (1.46–4.96)
Preferences	2.34 (1.14–4.57)	1.63 (0.87–3.07)	1.90 (1.16–3.12)	2.96 (1.21–7.21)	0.86 (0.52–1.44)	2.19 (0.97–4.97)	2.59 (1.57–4.25)	1.38 (0.85–2.26)	2.35 (1.11–4.96)
Perceived barriers	0.52 (0.22–1.24)	1.02 (0.33–3.19)	1.04 (0.43–2.51)	0.94 (0.19–4.74)	0.20 (0.02–1.68)	0.55 (0.17–1.72)	1.10 (0.61–1.98)	1.34 (0.63–2.83)	0.74 (0.15–3.57)
Social–environmental									
Modeling	2.14 (1.49–3.05)	2.32 (1.65–3.24)	1.86 (1.39–2.49)	1.48 (1.02–2.15)	2.09 (1.39–3.14)	2.08 (1.38–3.15)	1.95 (1.41–2.71)	2.32 (1.55–3.48)	1.53 (1.07–2.20)
Active parental encouragement	0.70 (0.51–0.95)	0.99 (0.70–1.41)	0.95 (0.69–1.31)	0.80 (0.52–1.24)	1.23 (0.85–1.78)	1.18 (0.79–1.78)	0.94 (0.66–1.34)	0.91 (0.60–1.38)	1.28 (0.89–1.83)
Demand family rule	1.33 (0.96–1.84)	1.71 (1.17–2.51)	1.90 (1.37–2.64)	1.35 (0.89–2.06)	2.49 (1.70–3.64)	1.93 (1.19–3.14)	1.73 (1.24–2.41)	1.32 (0.92–1.88)	1.24 (0.86–1.81)
Allow family rule	0.61 (0.31–1.21)	0.86 (0.55–1.36)	1.05 (0.65–1.69)	1.13 (0.59–2.19)	0.70 (0.43–1.14)	0.60 (0.34–1.08)	1.06 (0.72–1.55)	0.87 (0.58–1.32)	0.88 (0.52–1.48)
Family facilitation	1.49 (1.11–2.00)	1.91 (1.31–2.77)	1.50 (1.05–2.15)	1.01 (0.65–1.55)	1.19 (0.82–1.73)	1.37 (0.81–2.31)	1.10 (0.85–1.42)	1.64 (1.15–2.35)	1.23 (0.80–1.90)
Bring fruit to school	3.00 (2.24–4.02)	2.36 (1.56–3.57)	3.13 (2.36–4.16)	2.56 (1.76–3.71)	2.64 (1.65–4.24)	4.06 (2.70–6.08)	2.97 (1.71–5.18)	1.84 (0.90–3.76)	2.37 (1.69–3.32)
Physical–environmental									
Availability at home	1.27 (0.64–2.51)	1.11 (0.65–1.92)	1.04 (0.62–1.74)	1.64 (0.97–2.77)	1.34 (0.70–2.58)	0.90 (0.50–1.62)	0.92 (0.54–1.58)	1.45 (0.68–3.10)	1.51 (0.73–3.14)
Availability at school	0.78 (0.58–1.05)	1.07 (0.70–1.63)	0.99 (0.74–1.31)	1.16 (0.76–1.75)	0.63 (0.13–3.02)	1.65 (1.06–2.56)	0.89 (0.68–1.18)	0.92 (0.59–1.44)	1.36 (0.91–2.03)
Availability at friends	1.33 (0.98–1.80)	0.98 (0.71–1.37)	1.09 (0.82–1.44)	0.98 (0.68–1.43)	1.03 (0.72–1.47)	1.27 (0.86–1.86)	0.91 (0.71–1.15)	0.93 (0.67–1.29)	1.13 (0.82–1.58)

Abbreviations: OR, odds ratios; CI, confidence interval.
Significant OR are underlined for ease of interpretation.

Table 4 Odds ratios and confidence intervals of multiple binary logistic regressions explaining daily vegetable intake by country

	Austria (n = *1677*)	*Belgium* (n = *1335*)	*Denmark* (n = *1857*)	*Iceland* (n = *1163*)	*Netherlands* (n = *1098*)	*Norway* (n = *1174*)	*Portugal* (n = *2110*)	*Spain* (n = *1287*)	*Sweden* (n = *1383*)
Personal									
Knowledge	1.54 (1.10–2.16)	1.46 (1.01–2.11)	1.14 (0.84–1.53)	1.32 (0.90–1.93)	1.38 (0.92–2.08)	1.15 (0.75–1.75)	1.62 (1.27–2.06)	1.91 (1.18–3.08)	1.64 (1.11–2.42)
Attitudes	1.45 (1.00–2.11)	1.24 (0.90–1.71)	1.20 (0.88–1.64)	1.72 (1.06–2.69)	1.19 (0.82–1.71)	1.29 (0.83–1.99)	0.80 (0.57–1.13)	0.97 (0.65–1.45)	1.11 (0.76–1.61)
Liking	1.31 (0.90–1.91)	1.28 (0.89–1.85)	1.70 (1.21–2.38)	2.66 (1.49–4.76)	1.17 (0.79–1.75)	1.70 (1.10–2.97)	2.07 (1.55–2.75)	1.59 (1.08–2.33)	2.22 (1.49–3.31)
General self-efficacy	1.61 (1.15–2.25)	1.62 (1.13–2.31)	1.75 (1.27–2.41)	1.18 (0.73–1.89)	1.57 (1.09–2.26)	1.83 (1.19–2.81)	1.40 (1.09–1.80)	0.91 (0.64–1.29)	1.63 (1.11–2.41)
Preferences	1.92 (1.42–2.59)	1.47 (1.05–2.06)	1.90 (1.46–2.48)	2.08 (1.46–2.97)	1.91 (1.34–2.71)	2.71 (1.91–3.85)	1.51 (1.19–1.93)	2.57 (1.82–3.63)	1.62 (1.19–2.21)
Perceived barriers	0.73 (0.45–1.20)	0.87 (0.47–1.61)	1.33 (0.74–2.40)	1.13 (0.36–3.49)	1.20 (0.48–2.96)	0.59 (0.25–1.36)	0.69 (0.46–1.03)	0.88 (0.52–1.47)	0.57 (0.21–1.57)
Social–environmental									
Modeling	1.15 (0.83–1.59)	1.81 (1.31–2.51)	1.70 (1.29–2.24)	1.36 (0.93–1.99)	1.71 (1.14–2.57)	1.54 (1.06–2.21)	1.52 (1.14–2.03)	1.29 (0.90–1.86)	1.09 (0.76–1.58)
Active parental encouragement	1.17 (0.86–1.58)	1.64 (1.18–2.30)	1.06 (0.76–1.48)	0.86 (0.56–1.32)	1.31 (0.92–1.87)	1.50 (1.02–2.21)	0.99 (0.72–1.37)	1.26 (0.85–1.87)	1.70 (1.21–2.37)
Demand family rule	1.38 (0.99–1.93)	1.47 (1.04–2.09)	1.59 (1.12–2.25)	2.10 (1.38–3.19)	1.72 (1.18–2.51)	2.11 (1.35–3.30)	1.50 (1.10–2.05)	1.09 (0.74–1.59)	1.76 (1.25–2.47)
Allow family rule	1.40 (0.81–2.41)	1.36 (0.87–2.63)	1.55 (1.06–2.26)	1.37 (0.79–2.36)	0.92 (0.60–1.41)	1.25 (0.77–2.02)	1.14 (0.83–1.55)	1.06 (0.72–1.57)	1.20 (0.70–2.04)
Family facilitation	1.34 (0.98–1.82)	1.51 (0.87–2.63)	0.94 (0.67–1.33)	0.85 (0.55–1.31)	2.34 (1.22–4.50)	1.08 (0.68–1.72)	1.27 (0.99–1.63)	1.18 (0.75–1.86)	1.08 (0.77–1.52)
Bring to school	1.90 (1.22–2.96)	2.17 (0.77–6.12)	2.38 (1.77–3.19)	2.08 (1.29–3.35)	1.89 (0.62–5.82)	2.66 (1.55–4.58)	1.46 (0.75–2.85)	1.29 (0.43–3.85)	1.23 (0.63–2.39)
Physica1–environmental									
Availability at home	1.25 (0.84–1.85)	1.10 (0.78–1.55)	1.32 (0.93–1.87)	1.56 (1.02–2.39)	1.33 (0.91–1.96)	1.39 (0.90–2.13)	1.04 (0.73–1.49)	1.20 (0.75–1.92)	1.56 (0.98–2.47)
Availability at school	1.06 (0.76–1.48)	1.21 (0.85–1.73)	0.76 (0.56–1.02)	0.80 (0.51–1.26)	0.84 (0.24–3.01)	1.16 (0.69–1.95)	1.08 (0.77–1.51)	1.37 (0.86–2.19)	1.26 (0.92–1.73)
Availability at friends	1.16 (0.88–1.54)	1.11 (0.79–1.54)	0.78 (0.59–1.03)	0.90 (0.60–1.34)	0.76 (0.52–1.12)	0.96 (0.66–1.40)	1.18 (0.91–1.54)	1.01 (0.62–1.63)	1.02 (0.75–1.39)

Abbreviations: OR, odds ratios; CI, confidence interval.
Significant OR are underlined for ease of interpretation.

sample, including nine European countries. Results show that personal, social–environmental as well as physical–environmental factors are associated with likelihood of fruit and vegetable intake in children across countries. However, analyses showed that personal and social–environmental factors are stronger predictors than physical–environmental factors in this age group. Effect sizes were in general somewhat larger for fruit intake than for vegetable intake. This is in line with the study by Gibson *et al*. (1998) reporting larger explained variances for fruit intake than for vegetable intake in 9- to 11-year olds. This may be because vegetables are often part of regular meals and may therefore be less under volitional control in children, leading to weaker associations between potential determinants and intake levels (Bogers *et al*., 2004).

Knowledge of the prevailing recommendations was positively related to daily fruit and vegetable intake. This is in line with the study of Sandeno *et al*. (2000) in 4–6 graders. In the present sample, 55% (boys) to 61% (girls) knew the fruit recommendations, whereas only 23% (boys) to 24% (girls) knew the vegetable guidelines (Sandvik *et al*., 2005). The simple strategy of teaching these recommendations in elementary schools may be important to make daily intake more likely. Liking and preferences were also related to likelihood of daily intake of both fruit and vegetables, and such taste preferences have repeatedly been shown to be a good predictor of food choices (Domel *et al*., 1996; Resnicow *et al*., 1997; Lien *et al*., 2002; Neumark-Sztainer *et al*., 2003; Bere and Klepp, 2004). Repeated exposure to many different kinds of fruit and vegetables at early age might be a good strategy to improve liking (Wardle *et al*., 2003; Patrick and Nicklas, 2005). Positive self-efficacy was a third personal factor related to daily intake of fruit and vegetables. Children who were confident that they can eat fruit or vegetables daily were one and a half time more likely to eat vegetables daily and more than two times more likely to eat fruit daily. The literature is inconsistent about the relationship between self-efficacy and fruit and vegetable intake (Domel *et al*., 1996; Resnicow *et al*., 1997; Reynolds *et al*., 1999; Lien *et al*., 2002; Young *et al*., 2004), probably owing to different possible operationalizations of the self-efficacy construct. Barriers were less consistently associated with daily intakes than general self-efficacy in the present study. In line with results reported by Lien *et al*. (2002), attitudes were not strongly associated with intake. However, 75% (vegetables) to 85% (fruits) of the children in the present study reported a (very) positive attitude (Sandvik *et al*., 2005).

Our results indicate that parental influence is important for daily fruit and vegetable consumption. At age 11, parents are considered to be the most important social agent impacting upon diet (Hanson *et al*., 2005). In line with previous research, perceived modeling was a predictor of daily fruit and vegetable intake (Gibson *et al*., 1998; Cullen *et al*., 2001; Bere and Klepp, 2004; Young *et al*., 2004; Patrick and Nicklas, 2005). Next to this rather 'passive' influence of parental modeling, more active parental encouragement and facilitation was also found to be associated with daily intakes. The literature is inconsistent about the relationship between perceived parental control and children's dietary behavior (Birch and Fisher, 2000; De Bourdeaudhuij and Van Oost, 2000; Young *et al*., 2004; Wardle *et al*., 2005). In the present study, a clear positive relationship was found between parental control and daily fruit and vegetable intake, indicating that children were more likely to report daily intakes when their parents demand that they eat fruit and vegetables every day. In the same line, bringing fruit and vegetables to school were among the strongest predictors of daily fruit and vegetable intake. This was not confirmed by the US study of Sandeno *et al*. (2000), who found only weak correlations between bringing fruit and vegetables to school and intake. As the results of the focus groups (Wind *et al*., 2005) showed us that parents often put fruit and vegetables in children's lunch boxes or school bags, we labeled this factor as a social–environmental factor. Bringing fruit to school is, however, likely to be a combination of personal (habit), social (parents) and physical environmental (availability) elements. As argued by Kremers *et al*. (2003) more research is needed to clarify the role of specific food-related and more general parenting practices in predicting healthy and unhealthy food choices.

More recently, the attention for potential physical environmental predictors of health behaviors has increased, informed by so-called social–ecological models of health behavior (Klepp *et al*., 2005). For children, especially, availability of foods has received attention (Cullen *et al*., 2003; Perry *et al*., 2004). In the present study, only home availability appeared to be a significant correlate of daily vegetable consumption but not of daily fruit intake. This is only partly in line with earlier studies revealing positive associations between availability and intake of fruit and vegetables (Reynolds *et al*., 1999; Kratt *et al*., 2000; Neumark-Sztainer *et al*., 2003; Bere and Klepp, 2004; Young *et al*., 2004; Hanson *et al*., 2005). However, measures of availability were quite different between studies, reflecting considerable differences in the strength of this relationship (Hearn *et al*., 1998; Reynolds *et al*., 1999; Kratt *et al*., 2000; Cullen *et al*., 2001; Bere and Klepp, 2004; Hanson *et al*., 2005). In addition, these studies showed that correlations between parental and children's reports of availability were rather low, arguing for more concise measurement. Although it is known from other studies that interventions in the school environment can be successful in increasing fruit and vegetable intake in children (Brug and van Lenthe, 2005), school availability was not related to fruit and vegetable intake in our sample of schoolchildren. This suggests that more research is needed to examine how the school environment might impact upon children's fruit and vegetable consumption, considering not only one correlate (as in this study) but a whole range of school-level factors (for example, school policy, health education, availability of healthy/unhealthy snacks at school and in close-by shops).

Country-specific analyses revealed a consistent pattern of predictors of fruit intake across countries. However, the power of the country-specific analyses was much lower yielding fewer significant results. The consistent pattern of predictors for fruit intake across countries may imply that a rather uniform intervention strategy to promote fruit can be used across Europe. For vegetables, the pattern was, however, less consistent. It is possible that cultural differences in preparing and serving vegetables between countries are responsible for this larger diversity of predictors in vegetable intake in the European countries (Perez-Rodrigo *et al*., 2003).

There are several limitations to the present study. First, the cross-sectional nature of the study neither allows prediction nor conclusions about how much change in correlates is predictive of change in fruit or vegetable intake. A reciprocal relationship between the correlates and consumption may also be likely. Second, daily fruit and daily vegetable intake were chosen in the present study as the dependent variables in a logistic regression model. This was selected because of the inconsistency in recommendations across countries, the clarity of the statistical analyses and interpretation for this large amount of data, and the similarity with the HBSC study. However, with fruit and vegetable intakes as continuous outcomes of a multiple regression model, we could have addressed a somewhat different research question, such as the possible correlates of higher or lower levels of fruit and vegetable intake.

Important strengths of the study are its large international sample, and the use of standardized, validated instrument to measure fruit and vegetable intake and its potential psychosocial and physical environmental correlates across diverse food-related cultural settings. Country samples are representative, total sample size is large and we obtained a high participation rate.

In conclusion, this study showed that especially a combination of personal and social factors is related to daily fruit and vegetable intake in schoolchildren. This shows that a comprehensive multilevel intervention strategy based upon a series of individual and social correlates will be most promising in the promotion of daily fruit and vegetable intake in children. Further research is needed to look into the potential effect of school-level factors as intervention studies showed promising results.

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

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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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SOCIODEMOGRAPHIC DETERMINANTS OF FRUIT AND VEGETABLE INTAKE AMONG MOTHERS IN PORTUGAL

Paper IV

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ABSTRACT

Objectives:

The aims of the present study were to assess fruit and vegetable intake among mothers in Portugal and to examine its association with sociodemographic determinants.

Subjects/Methods:

A national cross-sectional survey was administered in Portugal as part of the Pro Children study. 1,853 women, mothers of 11- to 13- year old children, took part in this study.

A self-administrated questionnaire was previously developed to assess fruit and vegetable intake and to determine factors which influence its association with sociodemographic characteristics.

The data's descriptive analysis was followed by logistic regression to assess associations between daily fruit and vegetable intake and its sociodemographic determinants.

Results:

The mean intake of fruit and vegetables was 221.2g/d and 170.0g/d, respectively. Only 46% of the mothers met the recommendations established by the World Health Organization (≥ 400 g of fruit and vegetables per day). The daily fruit intake was significantly higher amongst mothers who live with spouse/partner (p=0.001); belonging to higher social class (p=0.018), and living in Centre region of the country (p=0.048) when compared to the North. For vegetables, the daily intake was significantly higher amongst mothers with higher educational level (p=0.008), and belonging to higher social class (p=0.027).

Conclusion:
This study shows that the mean intake of fruit and vegetables among mothers in Portugal is far below the international recommendations. Social class and educational level appear to influence the intake of fruit and vegetables.
Effective strategies to promote the intake of fruit and vegetables are needed, especially for those mothers belonging to lower social classes and educational levels.

Keywords: fruit; vegetables; intake; determinants; sociodemographic; mothers

INTRODUCTION

Epidemiologic data show fruit and vegetable consumption to be one of several important protective factors against non-communicable diseases like several cancers, hypertension, diabetes, heart disease and obesity (World Health Organization, 2004).
European countries and international health agencies have set recommendations for the desirable daily level of consumption of fruit and vegetables which vary between 400 to 750g (Wolf, Yngve, Elmadfa, Poortvliet, Ehrenblad, Perez-Rodrigo *et al.*, 2005).
Large discrepancies in fruit and vegetable intake have been associated with sociodemographic and psychosocial determinants, but most studies took place in the USA or the UK (Krebssmith, Heimendinger, Patterson, Subar, Kessler, & Pivonka, 1995; Van Duyn, Kristal, Dodd, Campbell, Subar, Stables *et al.*, 2001; Satia, Kristal, Patterson, Neuhouser, & Trudeau, 2002; Kamphuis, Giskes, de Bruijn, Wendel-Vos, Brug, & Van Lenthe, 2006; Shaikh, Yaroch, Nebeling, Yeh, & Resnicow, 2008). Across Europe, large discrepancies have also been found (Rodrigues & de Almeida, 2001; Agudo, Slimani, Ocke, Naska, Miller, Kroke *et al.*, 2002; Wolf, Yngve, Elmadfa, Poortvliet, Ehrenblad, Perez-Rodrigo*et al.*, 2005; Rodrigues, Naska, Trichopoulou, & De Almeida, 2007; Food and Agriculture Organization, 2009). Therefore, a better understanding of the potential determinants of fruit and vegetable intake are vital to plan and develop more effective interventions aiming to promote their consumption.

Most recommendations consider fruit and vegetables as a single food group, but recent research has shown the need to investigate their consumption separately due to their specific characteristics and health influences. Firstly the health-related effects of fruit and vegetables are different. Furthermore, the culinary uses and taste of fruit and vegetables differ clearly. Fruit is sweeter, usually eaten raw, at breakfast, as between-meals snack, or as desserts. Vegetables have different flavours, are rarely sweet, and some are bitter. Vegetables are eaten raw, as salads, and cooked as part of meals (Trudeau, Kristal, Li, & Patterson, 1998).

A recent systematic review about associations between the family environment and young people's fruit and vegetable intake demonstrated that parental intake was consistently and positively associated with young people's intake (Pearson, Biddle, & Gorely, 2009). Consequently, parents are a target group for interventions to promote fruit and vegetable intake.

The present study is part of the *Pro Children Cross-Sectional Survey*, designed to assess fruit and vegetable consumption in 11 to 13-year old European schoolchildren and their parents, to identify factors associated with the consumption patterns and to develop and test effective and culturally relevant intervention strategies for the promotion of adequate consumption levels among school-aged children and their parents (Klepp, Perez-Rodrigo, De Bourdeaudhuij, Due, Elmadfa, Haraldsdottir *et al.*, 2005).

The aims of the present paper are to describe fruit and vegetable intake patterns among mothers in Portugal and to analyse the associations between sociodemographic determinants and fruit and vegetable intake.

SUBJECTS AND METHODS

Design and sample

The *Pro Children Cross-Sectional Survey (CSS)* was carried out in nine European countries between October and December 2003.

Representative samples of at least 20 schools covering a minimum of 1,300 eligible children born in 1990-92 and their parents were drawn in each country. The study was approved by the research ethics committees within participating countries and parental written consent was obtained.

Self-administered questionnaires were developed for children and for parents and applied in all countries. The instruments were translated into national languages and tested for reliability and validity in multiple pilot-tests (De Bourdeaudhuij, Klepp, Due, Rodrigo, de Almeida, Wind *et al.*, 2005; Haraldsdottir, Thorsdottir, de Almeida, Maes, Perez Rodrigo, Elmadfa *et al.*, 2005; Kristjansdottir, Andersen, Haraldsdottir, de Almeida, & Thorsdottir, 2006).

Sixty of the 1,050 Portuguese mainland state and private schools with 5th and 6th grades (11- to 13- years old) were randomly selected and the respective headteacher contacted by letter. All schools agreed to participate but only 34 returned the questionnaires. Children's data was collected in the classroom, following teacher's instructions. All pupils took home a closed envelope with the questionnaire to be completed by one of their parents. Subsequently, the questionnaires were given to the classroom teachers, who sent them to each national research centre. A total of 3,044 questionnaires filled in by schoolchildren and 2,375 questionnaires filled in by the parents were returned, 1,853 of which from mothers (78% participation rate). In this paper only data from the mothers will be presented.

Measurement of fruit and vegetable intake

The dietary part of the questionnaire included two sections: a precoded 24 hour recall section about one week day to obtain information on type and quantity (group mean intake) of fruit and vegetables eaten and a food frequency section, to rank subjects according to their usual intake. The frequency questions about vegetables were combined and consumption of fruit and of total vegetables was recoded into daily or non-daily consumption.

In the first section participants were asked to write what they had eaten the day before. The 24-hour recall included specific pre-coded questions on natural fruit juice, fresh fruit and vegetable intake. The questions about vegetables were categorized into salad, other raw vegetables, cooked vegetables and vegetable soup. Questions on vegetables as part of composite dishes were not included. Amounts were indicated as number of pieces, slices or portions eaten, and standard weights were attributed in order to quantify intake (Haraldsdottir, Thorsdottir, de Almeida, Maes, Perez Rodrigo, Elmadfa*et al.*, 2005; Kristjansdottir, Andersen, Haraldsdottir, de Almeida, & Thorsdottir, 2006).

The food frequency included five questions about the usual intake of fresh fruit, salad, other raw vegetables, cooked vegetables and fruit juice. In order to prevent participants from including potato in the cooked vegetables group, a separate question on potato intake was included. Fruit juice was excluded from further analysis as respondents did not differentiate between natural fruit juice and soft drinks. Eight response categories were used, ranging from "Never" to "Every day, more than twice a day". The frequency of intake was converted into grams per day (using mean portions previously defined) and the total vegetable intake and combined fruit and vegetable intake were calculated. Average daily consumption was calculated multiplying the number of days when fruit/vegetable was eaten by the amount eaten, divided by seven.

Measurement of sociodemographic characteristics

Household size and composition, education level, social class and region of residence were registered to characterize the studied sample.

Educational level was measured by four categories: (1) less than 7 years, (2) 7-9 years, (3) 10-12 years and (4) more than 12 years.

To code occupational social class three kinds of job characteristics were used: educational requirements, management skills requested and control over economic assets (ownership/self-employed). This model defines a common hierarchical structure, which categorises all occupations into five social classes (I-V) and three extra groups (Group VI-VII) (Due, Lynch, Holstein, & Modvig, 2003; Holstein, Hansen, & Due, 2004) (see appendix A).

Based on the classification of the Official Portuguese Territorial Division NUT II the sample was assigned to one of the five regions of residence: North, Centre, Lisbon area, Alentejo, Algarve (Ministério do Planeamento e da Administração do Território, 1989). The last two regions were analyzed as one region due to their low sample size and close geographical location.

Data analysis

The descriptive analysis consisted on the calculation of means, standard errors, and frequencies. Logistic regression analyses were used to estimate the association between usual fruit and vegetable intake and sociodemographic characteristics. Sociodemographic variables were entered into three separate models, which used (1) daily consumption of fruit, (2)

daily consumption of vegetables and (3) a combined fruit and vegetable consumption (at least three times a day) as dependent variables. Analyses were conducted using SPSS (Statistical Package for Social Sciences) version 14.0 for Windows. A p-value < 0.05 was considered statistically significant.

RESULTS

The distribution of the sample by sociodemographic characteristics is presented in Table 1.

Table 1. Sociodemographic characteristics of the sample.

Characteristics	Number of subjects	(%)
Number of people in household		
< 4	519	28.7
4	878	48.5
> 4	414	22.9
Live with spouse/partner	1,602	88.6
Live with own child/children	1,518	83.9
Education level		
<7 years	789	43.7
7-9 years	343	19.0
10-12 years	326	18.1
>12 years	348	19.3
Social class		
Class I – II (high)	214	12.2
III	281	16.1
IV	288	16.5
V (low)	334	19.1
Group VI (economically active; insufficient information)	115	6.6
Group VII+VIII (economically inactive)	517	29.6
Region of residence		
North	534	28.8
Centre	477	25.7
Lisbon area	542	29.2
Alentejo + Algarve	300	16.2

Approximately half of the 1,853 mothers (48.5%) reported that the number of people in household was 4. The majority of this sample *lived with spouse/partner* (88.6%) and *lived with own child/children* (83.9%).

Regarding the educational level the highest percentage (43.7%) was found for mothers with less than 7 years of education.

Only 12.2% of the sample was classified into higher social classes (class I+II) and 29.6% were classified into Groups VII+VIII, which include mothers economically inactive; within this group 71.6% (n=370) reported to be housewives.

Table 2 shows the mean intake of fruit and vegetables based on the 24-hour recall. The mean intake of fruit was 221.2g/day and vegetables 170g/day. The main portion of vegetable intake came from vegetable soup (75.5g/day).

Table 2. Mean fruit and vegetable intake (F&V) in g/day and standard error *(s.e.)*, based on the 24-hour recall (n=1853).

	(g/d)	***(s.e)***
Fruit	221.2	(3.2)
Total vegetables	170.0	(2.7)
Salad	29.0	(0.8)
Raw vegetables	12.7	(0.7)
Cooked vegetables	52.8	(1.2)
Vegetable soup	75.5	(1.4)
Total F&V	391.2	(4.8)

The frequency intake of fruit and vegetables is presented in table 3. For this analysis only 1,620 mothers were included, due to an incomplete process of filling in the food frequency section of the questionnaire.

Table 3. Intake of fruit and vegetables, based on the food frequency questions (n=1,620).

	At least once everyday (%)
Fruit	73.3
Total vegetables	70.4
Salad	37.9
Raw vegetables	19.0
Cooked vegetables	13.5

A daily intake of fruit and vegetables was reported by 73% and 70% of the mothers, respectively.

Table 4 displays the associations between the frequency of daily fruit and vegetable intake (separately and combined) and the sociodemographic characteristics.

Table 4. Adjusted Odds Ratio (OR) and 95% confidence intervals (CI) for daily intake of fruit and vegetables, separated and combined by sociodemographic characteristics (n=1,620).

	Fruit			Vegetables			Fruit and Vegetables		
	OR	**95%CI**	***P value***	**OR**	**95%CI**	***P value***	**OR**	**95%CI**	***P value***
Nº. of people in household			0.242			0.651			0.445
4	1	(reference)		1	(reference)		1	(reference)	
<4	0.827	0.631-1.083	0.167	0.884	0.681-1.149	0.357	0.859	0.675-1.092	0.215
>4	0.817	0.614-1.088	0.167	0.971	0.734-1.285	0.837	0.984	0.762-1.270	0.902
Live with spouse/partner									
Yes	1	(reference)		1	(reference)		1	(reference)	
No	0.566	0.399-0.804	**0.001**	0.792	0.556-1.128	0.196	0.688	0.491-0.963	**0.030**
Live with own child/ children									
Yes	1	(reference)		1	(reference)		1	(reference)	
No	0.792	0.587-1.069	0.127	0.837	0.626-1.121	0.233	0.705	0.535-0.931	**0.014**
Education level			0.616			**0.008**			0.091
< 7 years	1	(reference)		1	(reference)		1	(reference)	
7 - 9 years	1.138	0.837-1.548	0.410	1.332	0.993-1.787	0.056	1.062	0.808-1.397	0.666
10 - 12 years	1.237	0.887-1.725	0.210	1.559	1.128-2.154	**0.007**	1.382	1.030-1.854	**0.031**
> 12 years	1.088	0.726-1.631	0.684	1.755	1.162-2.650	**0.007**	1.421	0.992-2.034	0.055
Social class			**0.018**			**0.027**			0.082
Class I + II (high)	1	(reference)		1	(reference)		1	(reference)	
Class III	0.539	0.321-0.903	**0.019**	0.622	0.362-1.070	0.087	0.644	0.417-0.995	**0.047**
Class IV	0.512	0.295-0.889	**0.017**	0.501	0.284-0.881	**0.016**	0.524	0.328-0.836	**0.007**
Class V (low)	0.750	0.432-1.302	0.307	0.557	0.319-0.973	**0.040**	0.674	0.426-1.067	0.092
Group VI (economically active; insufficient information)	0.514	0.273-0.969	**0.040**	0.365	0.194-0.686	**0.002**	0.626	0.361-1.086	0.096
Group VII+VIII (economically inactive)	0.478	0.284-0.806	**0.006**	0.454	0.265-0.778	**0.004**	0.541	0.348-0.840	**0.006**
Region of residence			0.196			0.334			0.428
North	1	(reference)		1	(reference)		1	(reference)	
Centre	1.366	1.002-1.862	**0.048**	1.063	0.787-1.437	0.690	1.206	0.919-1.582	0.177
Lisbon area	1.033	0.772-1.382	0.825	0.832	0.624-1.109	0.210	0.979	0.752-1.274	0.874
Alentejo + Algarve	1.179	0.835-1.665	0.349	0.855	0.612-1.194	0.358	1.008	0.741-1.371	0.961

Mothers' daily fruit intake was positively associated to mothers who *lived with spouse/partner* (p=0.001). The social class variable showed a significant association with daily fruit intake of mothers (p=0.018). Every class and group, excluding the class V (low), was significantly associated with lower daily fruit intake, when compared to the highest class (I+II). The variable region of residence did not show significant association to mothers' daily fruit intake. However, mothers living in the Centre region showed higher daily fruit intake when compared to the North (p=0.048).

For vegetables, the daily intake demonstrated significant associations with the variables educational level (p=0.008) and social class (p=0.027). Mothers belonging to higher education level demonstrated higher daily vegetable intake when compared to less than 7 years of education (p=0.007 for both 10-12 years and more than 12 years of education). Regarding the social class, mothers belonging to classes IV and V and groups VI and VII+VIII, showed significant associations with lower daily vegetable intake in comparison to the highest classes (I+II).

For combined intake of fruit and vegetables (table 4), the mothers' intake was positively associated with the following variables: *live with spouse/partner* (p=0.03) and *live with own children* (p=0.014). Overall the educational level, the social class and region of residence variables did not show significant association to daily fruit and vegetable combined intake. However, education level demonstrated a positive and significant association to daily fruit and vegetable combined intake amongst mothers belonging to higher educational level (10-12 years of education) (p=0.031) when compared to less than 7 years of education. In relation to the social class variable it was found a negative and significant association to daily fruit and vegetable combined intake amongst mothers belonging to Classes III, IV and Group (VII+VIII), when compared to the highest classes (I+II).

DISCUSSION

The present study shows that the mean intake levels of fruit and vegetables among mothers in Portugal are below the WHO recommendations of ≥400g/day. Only 46% of the mothers met this recommendation. However,

more than two thirds of the sample reported to be *daily consumers* of these groups of foods.

This low consumption was also found among these mothers' children. The mean fruit intake was 153g/d and mean vegetable intake was 111g/d; the frequency of daily intake was 56.5% for fruit and 50.1% for vegetables. Only 21% of the children reached the WHO recommendations (Yngve, Wolf, Poortvliet, Elmadfa, Brug, Ehrenblad *et al.*, 2005; Vea, 2007).

This study has some limitations that should be highlighted prior to further interpretation of the findings. The 24-hour recall used to assess the mean intake of fruit and vegetables was applied only on a weekday. All information given by 24-hour recall about pieces, slices or portions consumed had to be converted into standardized portions size in grams. The food frequency section of the questionnaire did not include a specific question about vegetable soup, which may lead to an underestimation of vegetable intake. This can occur because in Portugal vegetable soup is traditionally included in main meals. However, these limitations were overcome because the questionnaire applied in this study showed satisfactory validity (Haraldsdottir, Thorsdottir, de Almeida, Maes, Perez Rodrigo, Elmadfa*et al.*, 2005; Kristjansdottir, Andersen, Haraldsdottir, de Almeida, & Thorsdottir, 2006).

At the European level, Portugal has one of the highest intakes of fruit and vegetables, by children and their mothers although below recommended levels (Wolf, Yngve, Elmadfa, Poortvliet, Ehrenblad, Perez-Rodrigo*et al.*, 2005; Yngve, Wolf, Poortvliet, Elmadfa, Brug, Ehrenblad*et al.*, 2005). Low intake of fruit and vegetables in Europe raises public health concerns and demands actions for improving the situation.

In line with other studies, namely on women (Pollard, Greenwood, Kirk, & Cade, 2001; Giskes, Turrell, Patterson, & Newman, 2002a, 2002b), we found that mothers belonging to higher social classes were more likely to eat fruit and vegetables daily. However, we observed that mothers belonging to the lowest social class (Class V) showed a tendency to higher frequency of fruit daily intake when compared to their higher social class counterparts (Class III and IV). This may be due to social desirability. Previous studies have shown the belief in "fruit and vegetables" as the main characteristic of healthy eating to be more common among those in lower socio-economic and educational levels (Margetts, Martinez, Saba, Holm, & Kearney, 1997; Martinez-Gonzalez, Lopez-Azpiazu, Kearney, Kearney, Gibney, & Martinez,

1998). This contradictory result was only observed for fruit, not for vegetable intake and therefore further analysis is required to identify possible confounding factors involved.

When intake of fruit and vegetables were combined, no differences amongst social classes were found.

A recent systematic review on determinants of fruit and vegetable consumption among adults revealed higher household income and marital status to be the most important positive associations of fruit and vegetable intake (Kamphuis, Giskes, de Bruijn, Wendel-Vos, Brug, & Van Lenthe, 2006). Our results also showed a positive association of marital status "*live with spouse/partner*" with daily intake of fruit and combined intake of fruit and vegetables, in line with other authors (Devine, Wolfe, Frongillo, & Bisogni, 1999; Pollard, Greenwood, Kirk, & Cade, 2001).

The number of household inhabitants and *living with own child/children* were not associated with daily fruit and vegetable intake separately. Few studies that evaluate this, showed a mixed association (Gibney & Lee, 1993; Wandel, 1995; Devine, Wolfe, Frongillo, & Bisogni, 1999; Pollard, Greenwood, Kirk, & Cade, 2001). *Living with spouse/partner* had a positive association with the combined intake of fruit and vegetables. Our result is supported by an earlier study applied to women. (Pollard, Greenwood, Kirk, & Cade, 2001).

Educational level was positively associated with daily vegetable intake. Mothers belonging to higher educational levels were more likely to have a daily vegetable intake. This association was also observed by other, with similar results. (Trudeau, Kristal, Li, & Patterson, 1998; De Irala-Estevez, Groth, Johansson, Oltersdorf, Prattala, & Martinez-Gonzalez, 2000; Groth, Fagt, & Brondsted, 2001; Pollard, Greenwood, Kirk, & Cade, 2001; Dynesen, Haraldsdottir, Holm, & Astrup, 2003). Moreover, a nationally representative Portuguese cross sectional survey showed that highly educated women consumed more vegetables and more fruit (Moreira & Padrão, 2004). However we did not find fruit intake to be associated to educational level. A review of selected European studies, carried out by Gun Roos *et al.*(2001) showed similar results, as no clear association between educational level and fruit and vegetable intake in southern and Eastern European countries could be established. For fruit and vegetables combined, mothers belonging to higher educational level (10-12 years of education) showed higher intakes when compared to those educated at 7 or less years. Previously similar associations

with significance among adults, especially women were observed (Havas, Treiman, Langenberg, Ballesteros, Anliker, Damron *et al.*, 1998; Johansson, Thelle, Solvoll, Bjorneboe, & Drevon, 1999; Pollard, Greenwood, Kirk, & Cade, 2001).

Other investigators studied additional factors that can influence the intake of fruit and vegetables among adults. According to the review of Shaikh et al. (2008) self-efficacy, social support and knowledge about fruit and vegetable intake were stronger. When Havas et al. (1998) assessed to what extent sociodemographic and psychosocial determinants influence the intake of fruit and vegetables among women, the results showed that sociodemographic characteristics were not powerful determinants of fruit and vegetable consumption, but in relation to psychosocial determinants, self-efficacy, attitudes and perceived barriers emerged as the strong predictors. In the Pro Children Project, similar findings were found for children, in which a combination of personal and social factors, particularly knowledge of the national recommendations and parental modelling for every country influenced fruit and vegetable intake (De Bourdeaudhuij, Velde, Brug, Due, Wind, Sandvik *et al.*, 2008).

As parental intake seems to be a strong predictor of fruit and vegetable intake among children interventions should target parents' intake encouraging them to be positive role models for their youngsters.

CONCLUSION

In summary, this study shows that the mean intake of fruit and vegetables among mothers in Portugal is below the international recommendations. Social class and educational level appear to influence the intakes of fruit and vegetables. Fruit and vegetable intake was more likely to be high among mothers belonging to higher social classes, whereas the influence of educational level was only observed for vegetable intake.

These facts suggest that future interventions strategies to increase fruit and vegetable intake should be targeted to mothers belonging to lower social classes and educational levels. The use of the mass media, health and nutrition campaigns stressing the health benefits of fruit and vegetables consumption may be useful to increase fruit and vegetable consumption in

these groups. Further research should focus on the efficacy of such approaches.

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CONFLICTS OF INTEREST

The authors declare that they have no conflict of interests.

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Appendix A. Social class.

Class/Group	
Class I	Top managers in big organizations and companies; top level civil servants; top of the educational hierarchy, with at least four years of university training (e.g. *medical doctors, lawyers, administrators, professionals, executives*)
Class II	Other managers; medium level civil servants; primary school teachers; social workers
Class III	Lower level white collar workers within administrative jobs; nurses; jobs which require medium level of theoretical vocational training for specialised job functions
Class IV	Skilled manual workers, i.e. jobs which require years of practical training to acquire necessary skills (*plumber, electrician, carpenter, car mechanic, nurse assistant)*
Class V	Unskilled and semi-skilled workers (*e.g factory workers, lorry drivers, construction workers)*
Group VI	Economically active but insufficient information to code the occupation
Group VII	Economically inactive, (*e.g. housewives, retired people, people who make their living from social welfare benefits - unemployment benefit, sickness benefit, disability pension, …)*
Group VIII	Category for students who are underway for an education of at least 1 ½ years theoretical education, *(e.g. social worker, medical doctor - do not include short-term courses)*

ASSOCIATION BETWEEN THE PARENTING STYLES AND OWN FRUIT AND VEGETABLE CONSUMPTION AMONG MOTHERS OF PORTUGUESE SCHOOLCHILDREN

Paper V

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ABSTRACT

The present study aimed to evaluate the association between parenting style and own fruit and vegetable (F&V) consumption among mothers of Portuguese schoolchildren. A cross-sectional study was performed in Portugal as part of the Pro Children cross European survey. 1,601 mothers of the 11- to 13- year old schoolchildren were included in this study. A self-administered questionnaire was developed to assess F&V consumption as well as the parenting styles. F&V consumption was assessed by a validated food frequency questionnaire. Parenting styles based on two dimensions – strictness and involvement – were classified into authoritative, authoritarian, indulgent and neglectful. The higher mean intakes of fruit, vegetables and total F&V were observed for mothers classified as indulgent, whereas the lower for mothers classified as neglectful. Differences of intake among parenting styles were significant for fruit, vegetables and total F&V. When partial correlations were calculated between both the dimensions strictness and involvement (controlled one for the other) and intakes, only involvement was positively associated with fruit, vegetables and total F&V intake. Findings from this study show that F&V consumption of mothers of Portuguese schoolchildren seems to be related to their own parenting style, especially with the

dimension involvement. Future interventions to promote F&V intake should take into account these variables.

Keywords: parenting style; fruit; vegetables; consumption; mothers

INTRODUCTION

The benefits of an adequate intake of fruit and vegetables have been observed in a wide range of epidemiological studies [1, 2, 3, 4, 5]. It is well know that an adequate intake of fruit and vegetables not only promotes health but also it is important in the prevention of non-communicable diseases like cardiovascular disease, obesity and cancer, which today are the focus of prevention for public health [5, 6, 7].

Most European countries as well as international health agencies have developed recommendations for the desirable level of consumption of fruit and vegetables. The recommendations vary from 400 to 750 grams per day [8]. The World Health Organization (WHO) recommends to a population goal for fruit and vegetable consumption equal to or above 400 grams per day. Such a recommendation is considered a population average and is important for the maintenance of health [6].

The Pro Children cross-sectional survey showed that in Portugal fruit and vegetable consumption among mothers as well as their children was high in the European setting, but low compared with the recommendations of 400 grams per day. The proportion of compliers to WHO recommendations was only of 44% and 21% for mothers and children respectively [8, 9].

Determinants of fruit and vegetable intake among children, adolescents [10, 11, 12] and adults [13] have been identified by various researchers. From social-environmental determinants, parenting style has been taken into account as one of the determinants of fruit and vegetable intake among children and adolescents [14, 15, 16]. Parenting style is globally defined as the general emotional climate between parent-child interactions across a wide range of situations. Although it may be conceptualised differently, according to the

most usual theories (see Maccoby & Martin, 1983) it is classified according to the amount and quality of two underlying dimensions of parental behaviour – strictness and involvement. Strictness refers to the extent to which parents show control, maturity demands and supervision in their parenting; involvement refers to the extent to which parents show affective warmth, acceptance and supportiveness. Based on these two dimensions, a four-fold classification of parenting style is described: (1) the authoritative style (high strictness/high involvement); (2) the authoritarian style (high strictness/low involvement); (3) the indulgent style (low strictness/high involvement); and (4) the negligent style (low strictness/low involvement) [17]. Table 1 summarizes these concepts. Within these general parenting styles, parents also display more specific parenting practices, which are typically context-specific behaviours. According to Darling et al. [18] the effectiveness of specific parenting practices is moderated by the general parenting style.

Table 1. Characteristics of each parenting style (Adapted from Maccoby & Martin [17]).

		Involvement	
		High	Low
Strictness	High	Authoritative Parents are demanding and responsive at the same time. They don't impose their authority and welcome a certain amount of questioning.	Authoritarian Parents are highly demanding and directive, but not responsive. They are restrictive, punitive and do not welcome or appreciate feedback from their children.
	Low	Indulgent Parents are more responsive than demanding. They are generally kind and do not monitor their children behaviours.	Neglectful Parents are neither demanding nor responsive. They are not interested in feedback from their children.

Parenting style may influence children's food habits, namely fruit and vegetable intake, but to our best knowledge its relationship with parent's own consumption has not been investigated yet. Therefore, we hypothesize that within the family, parenting style may also be associated with parent's food intake. The study of the association between the parenting styles and own fruit and vegetable consumption is relevant independently of the role of parenting styles as moderators of the relationships between children's and mother's intakes. The knowledge on this primary association may help clarifying different processes by which parental intake may influence children's fruit and vegetable intake, namely modelling or common availability and accessibility. In this context, the aim of the present study was to evaluate the association between the parenting styles and own fruit and vegetable consumption among mothers of 11-13 year old Portuguese children. Further studies will address how parenting styles are associated with children's fruit and vegetable intake and therefore moderate that association.

METHODS

Participants

The present study is part of the Pro Children cross European survey, in which Portugal is one of 9 participating countries [19]. The survey was designed to provide information on actual consumption levels of fruit and vegetables in European schoolchildren (11- to 13- years old) and their parents and to assess potential determinants of consumption patterns.

A random national sample of 60 schools was selected from a list provided by the Portuguese Ministry of Education, which identified all state and private schools with 5th and 6th grades. All schools agreed to participate but only 34 schools returned the questionnaires. The children completed a questionnaire in the classroom with instructions and help from the teacher and took a questionnaire home to be completed by one of their parents or guardians.

From the total sample of 3,044 schoolchildren only 2,375 questionnaires were filled in by one of their parents or guardians (participation rate 78%). 1,853

were filled in by mothers or female guardians and 522 by fathers or male guardians. In the current paper, only data from mothers were included. Of the total sample of 1,853 mothers, only 1,601 were taken into account in the analysis due to incomplete answers about the food frequency questionnaire or about the parenting styles. More detailed description of the Pro Children project, including sampling and data collection procedure is given elsewhere [8,9,19].

Measures

A self-administered questionnaire was developed to assess fruit and vegetable consumption and parenting styles.

Fruit and vegetable consumption was assessed by a validated food frequency questionnaire [20]. Mothers were asked how often they usually eat fresh fruit, salad, other raw vegetables and cooked vegetables (four separated questions). Fruit juice, potatoes as well as fruit or vegetables included in meals composite dishes, were not included. The response categories included eight possibilities ranging from "never" to "more than twice a day". The frequency of intake was converted into grams per day (using mean portions previously defined) and the total vegetable intake and combined fruit and vegetable intake were calculated.

Parenting style was assessed based on previous work of Steinberg et al. [21], Lamborn et al. [22] and Avenevoli et al. [23]. Two dimensions, involvement and strictness, were measured by nine and seven items respectively. Mothers were asked about different statements with five response possibilities ranging from "completely untrue" to "completely true". The mean score of all items for each dimension was used in the analyses (range 1-5). Internal consistency was satisfactory for both scales: α=0.80 for involvement and α=0.78 for strictness.

In order to define the four parenting styles, the scales were dichotomised by median split. Mothers were subsequently categorised as authoritative (above median on both scales), authoritarian (above median for strictness, below median for involvement), indulgent (above median for involvement, below median for strictness) and neglectful (below median for both scales).

In the Pro Children project only four countries measured parenting styles (Belgium, The Netherlands, Portugal and Spain) [19, 24].

Statistical analyses

Descriptive statistical analyses consisted on the calculation of frequencies, means, standard deviations and medians. One-way ANOVA was used to compare means ranking of fruit and vegetable intake amongst the four parenting styles. Pearson's correlation coefficient was used to measure the association between involvement and strictness and the consumption of fruit, vegetables and fruit and vegetable combined. In order to overcome the effect of the association between the two dimensions, partial correlations were also calculated, controlling the associations between consumption and each dimension for the other dimension. Statistical analysis was performed with SPSS version 14.0 for Windows. A p-value of < 0.05 was considered to be statistically significant.

RESULTS

The study sample comprised 1,601 mothers of Portuguese schoolchildren. Table 2 describes the sample's mean scores, on the two dimensions, involvement and strictness, as well as the medians used to dichotomise them. A positive correlation was found between the two dimensions [r=0.652 (p<0.001)].

Table 2. Sample distribution by dimensions involvement and strictness.

Dimension	N	Mean	SD	Median
Involvement (1-5)	1,601	4.21	0.47	4.22
Strictness (1-5)	1,601	4.33	0.54	4.43

The distribution of the sample amongst the four parenting styles is shown in Table 3.

Table 3. Distribution of the sample by parenting style (N=1,601).

Parenting style	N	%
Authoritative	600	37.5
Authoritarian	214	13.4
Indulgent	196	12.2
Neglectful	591	36.9

Most mothers were found to be either authoritative or neglectful in almost equal proportions (37.5% or 36.9% respectively), whereas the remaining 25% were found to be authoritarian (13%) or indulgent (12%).

Table 4 shows the mean intake of fruit, vegetables and total fruit and vegetables for the whole sample and by parenting style. The highest mean intakes were observed for mothers classified as indulgent, whereas the lowest for mothers classified as neglectful. Differences of intake by parenting styles were significant (p<0.001) for fruit, vegetables and total fruit and vegetables.

Table 4. Mean intake of fruit, vegetables and total fruit and vegetables (F&V) of the sample by parenting style (g/day).

		Fruit		Vegetables		F&V	
Parenting style	N	Mean	SD	Mean	SD	Mean	SD
Authoritative	600	165	96	95	59	260	127
Authoritarian	214	148	91	83	54	231	124
Indulgent	196	174	89	99	56	272	116
Neglectful	591	140	94	79	55	219	124
Total	1,601	155	95	88	57	242	126
p*		<0.001		<0.001		<0.001	

*One-way ANOVA.

Both dimensions of the parenting style (strictness and involvement) showed a positive correlation with the intake of fruit, vegetables and fruit and vegetables combined as can be observed on table 5.

Table 5. Association between the dimensions of parenting style and fruit, vegetable and total fruit and vegetable intake (F&V).

Dimension		Fruit	Vegetables	F&V
Involvement	r	0.151	0.165	0.189
	p	<0.001	<0.001	<0.001
Strictness	r	0.086	0.115	0.117
	p	<0.001	<0.001	<0.001

When partial correlations are calculated between each dimension (controlled for the other) and fruit, vegetables and total fruit and vegetables intakes, only involvement shows a positive association (see table 6).

Table 6. Partial correlations between the dimensions of parenting style and fruit, vegetable and total fruit and vegetable intake (F&V).

Dimension		Fruit	Vegetables	F&V
Involvement	r	0.126	0.119	0.150
(controlled for strictness)	*p*	<0.001	<0.001	<0.001
Strictness	r	-0.017	0.010	-0.008
(controlled for involvement)	*p*	0.505	0.694	0.743

DISCUSSION

In the scope of our research we did not find any other study exploring the association between parenting style and parents' own intake of fruit and vegetables. However, we found some associated relevant studies which will be used to compare and discuss our results. Significant differences were found in fruit, vegetable and total fruit and vegetable intakes among parenting styles. In general, an indulgent parenting style was associated with higher intake, and authoritative mothers also showed mean intakes above the global

mean. Neglectful parenting style was associated with the lowest own fruit and vegetable mean intakes.

When studying the effects of parenting style on children's fruit and vegetable intake, a previous study (which included the children of mothers of the present study) showed a similar trend: children of parents with neglectful parenting style reported to eat less fruit and vegetables compared to children of parents with an authoritative and an indulgent style [24]. This association has been also found in other studies carried out by several researchers [14, 15, 16, 25]. For instance, the findings from Kremers et al. [15] showed that adolescents who were raised in authoritative and indulgent homes consumed more fruit than those raised in authoritarian and neglectful homes. When Lytle et al. [16] explored the potential predictors of fruit and vegetable consumption in adolescents they came to the following conclusion: the authoritative parenting style by a mother or female figure predicted higher fruit and vegetable consumption by adolescents. The study contribution of Pearson et al. [25] shows that significant effects for parenting style were observed for all dietary behaviours in adolescents. Adolescents who described their parents as authoritative ate more fruit per day, less unhealthy snacks per day and took breakfast on more days per week than those who described their parents as neglectful.

Additional findings in our study show that from the dimensions strictness and involvement only the involvement has a positive association with own consumption of fruit and vegetables among mothers. Involvement, as it was already said, is defined as the affective warmth between parent and child expressed by supportiveness and understanding. The high involvement is common to the authoritative and indulgent parenting styles, in which we found the higher levels of fruit and vegetable consumption.

Once parenting style shows a similar relation with children and parents own intake may support the hypothesis of modelling as predictor of intake of fruit and vegetables among children. This statement has been found in other studies as revealed by two recent reviews carried out by McClain et al. [11] and Pearson, Biddle, & Gorely [12] dealing with determinants of fruit and vegetable consumption in children and adolescents.

In the Pro Children study, when De Bourdeaudhuij et al. [26] explored the personal, social and environmental predictors of daily fruit and vegetable intake in children, parental modelling was also associated strongly and consistently with daily fruit intake across all nine European countries. However, for vegetables daily intake this trend was weaker but still consistent. Therefore this finding should be considered in future interventions; moreover it should encourage parents to have a positive role model in their children eating habits.

The main limitation of this study is that, as cross-sectional study, it cannot express causality between parenting style and intakes. However, because of the complex relationship among parenting style, children's intake and parents' intake it is of increasing relevance to explore their associations. One of the strengths of this study is the large and representative sample, so in future we intend to study the association among these three variables, in the same sample (mother and respective child).

CONCLUSION

This explorative study shows that fruit and vegetable consumption of mothers of 11- to 13- year old Portuguese schoolchildren seem to be related to their own parenting style, especially with the dimension involvement which has a positive association with intakes. It appears that parental involvement should be considered as a component of family-based nutrition interventions to promote fruit and vegetable consumption.

Furthermore, in order to develop effective interventions it is necessary to fully understand the association among parenting style and intakes of parents and their children. This influence may happen not only through parenting style but also indirectly through role modelling. Future research should address these associations.

CONFLICT OF INTERESTS

The authors declare that they have no conflict of interests.

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FRUIT AND VEGETABLES: RELATIONSHIP BETWEEN PORTUGUESE CHILDREN'S AND MOTHERS' INTAKE

Paper VI

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ABSTRACT

Objectives:

To compare the consumption of fruit and vegetables between mothers and their children and to examine the association between them.

To analyze this comparison and association according to the children's sex and the mothers' parenting styles.

To analyze the effect of mothers' consumption of fruit and vegetables and the dimensions of the parenting styles (strictness and involvement) on children's intake.

Design/Subjects/Setting:

A cross sectional study was performed in Portugal as a part of the Pro Children European survey.

Fruit and vegetable intake among mothers and their children was assessed by self-administered questionnaires using 24-hour recall (n=1,603 mother-child).

Parenting style was assessed by two dimensions, strictness and involvement, measured by nine and seven items, respectively.

Correlations of fruit and vegetable intake between mothers and their children were assessed using the Spearman coefficient correlation.

Results:

Mothers' intake of fruit, vegetables and combined fruit and vegetables were significantly higher than their children, with the exception of raw vegetables.

Significant but weak associations, were found between the mothers' and their children's intake of fruit, vegetables, and combined fruit and vegetables.

Mothers' intake of fruit and vegetables revealed a higher effect on their children's intake than the dimensions of parenting styles.

Conclusion:

Mothers' consumption of fruit and vegetables appears to influence their children's consumption.

These findings suggest that future interventions should encourage parents to be positive role models with the aim of increasing fruit and vegetable consumption. Interventions need to be focused on family related factors.

Key words: fruit; vegetables; children; mothers; intake; parenting style; strictness; involvement

INTRODUCTION

Fruit and vegetable consumption has been shown to be associated with a reduced risk of developing a great number of diseases including some forms of cancer [1-5], cardiovascular disease [6-8], and others [9, 10].

Unfortunately, despite the well-established benefits of fruit and vegetable consumption, nutritional research in different countries consistently show that many children and adults do not meet nutritional guidelines [11-16].

Moreover, some research studies have reported a linear decrease in fruit and vegetable consumption as children develop into adolescence and young adulthood [17-19]. So, an effective knowledge of the predictors of fruit and vegetable intake may help to design better programmes and healthier environments that facilitate and encourage the consumption of fruit and vegetables among these different age groups.

Several systematic reviews about potential determinants of fruit and vegetable among children and adolescents have revealed that parental intake is one of the predictors of children's and adolescents' intake [19-22]. According to the study carried out by Hart et al, [23], this predictor starts from early age among infants and toddlers.

A variety of mechanisms can explain the influence of the parental intake: exposure of the child to more fruit and vegetables through availability of fruit and vegetables at home [24-28] or/and parenting modelling of eating

behaviours, namely fruit and vegetables [24, 29]. However, more knowledge about this association, parent-child intake, should be developed especially with others variables that can influence its magnitude.

Previous studies have demonstrated that fruit and vegetable consumption among children and adolescents is influenced by both sex and parenting styles. The possible influence of these two factors in the children's consumption justifies the need to study its effect on the parent-child association in regards to fruit and vegetable intake.

The present study is part of the Pro Children cross-Europe survey, which involved nine European countries. The survey was designed to provide information on current consumption levels of fruit and vegetables in European schoolchildren (11- to 13- years old) and their parents and to assess potential determinants of consumption at the individual, social and environmental level [30].

Portuguese children and their mothers were the target groups of this research which aimed (1) to compare both mothers' and their children's fruit and vegetable intake and to examine the associations among them; (2) to analyze these comparisons and associations according to the children's sex and the mothers' parenting styles and (3) to analyze the effect of mothers' consumption of fruit and vegetables and the dimensions of the parenting styles (strictness and involvement) on children's intake.

METHODS

Sample and procedure

The *Pro Children Cross-Sectional Survey (CSS)* was carried out in nine European countries between October and December 2003. It involved national representative samples of schools in all countries (Denmark, Iceland, the Netherlands, Norway, Portugal, Spain and Sweden) with the exception of Austria and Belgium.

Schools constituted the sampling unit, and from each country random samples of at least 20 schools and a minimum of 1300, 11-year-old children were recruited. Self-administered questionnaires were developed for children and for parents and applied in all countries. The instruments were translated into

national languages and tested for reliability and validity in multiple pilot-tests [31-33]. The study was approved by the research ethics committees within participating countries and parental written consent was obtained.

Sixty of the 1,050 Portuguese mainland state and private schools with fifth and sixth grade (aged 11-13 years) were randomly selected and the respective headteacher contacted by letter. All schools agreed to participate but only 34 schools returned the questionnaires. The children completed a questionnaire in the classroom with instructions and help from the teacher and took a questionnaire home to be completed by one of their parents or guardians.

From the total sample of 3,044 schoolchildren only 2,375 questionnaires were filled in by one of their parents or guardians (participation rate 78%). 1,853 were filled in by mothers or female guardians and 522 by fathers or male guardians. In the current paper, only data from mothers and their children were included. Due to incomplete answers in both questionnaires, the final sample included 1,603 mothers and their respective children. More detailed description of the Pro Children project, including sampling and data collection procedure is given elsewhere [15, 16, 30].

Instrument

Two self-report questionnaires were developed to measure fruit and vegetable intake, and possible correlates among children and their parents.

The questionnaires included three parts: the first part consisted of a dietary intake of fruit and vegetables; the second covered different issues to study potential, social and physical-environmental factors of fruit and vegetable intake; and a third part comprised information about social-economic, demographic characteristics and parenting style. The information about parenting style was only part of the parent's questionnaire.

Sociodemographic variables

Household size and composition, education level, social class and region of residence were registered to characterize the studied sample. All these variables were obtained from the mothers' questionnaire.

In relation to the number of people in household, this variable was recoded in three categories: less than 4 people, 4 people and more than 4 people.

Composition of household included two questions, which were recoded in the following way: *Live with spouse/partner* (Yes/No) and *Live with own child/children* (Yes/No).

According to educational level the division was made in four categories: (1) less than 7 years, (2) 7-9 years, (3) 10-12 years and (4) more than 12 years.

To code occupational social class three kinds of job characteristics were used: educational requirements to perform the job, management skills requested to perform the job and control over economic assets (ownership/self-employed). This model defines a common hierarchical structure, which categorises all occupations into five social classes (I-V) and three extra groups (Group VI-VII) [34, 35].

Based on the classification of the Official Portuguese Territorial Division NUT II the sample was assigned to one of the five regions of residence: North, Centre, Lisbon area, Alentejo, Algarve (Ministério do Planeamento e da Administração do Território, 1989). The last two regions were analyzed as one region due to their low sample size and close geographical location.

Parenting style

Parenting style was assessed based on previous work of Steinberg et al.[36], Lamborn et al. [37] and Avenevoli et al.[38]. Two dimensions, involvement and strictness, were measured by nine and seven items respectively. Mothers were asked about different statements with five response possibilities ranging from "completely untrue" to "completely true". The mean score of all items for each dimension was used in the analyses (range 1-5). Internal consistency was satisfactory for both scales: α=0.80 for involvement and α=0.78 for strictness.

In order to define the four parenting styles, the scales were dichotomised by median split. Mothers were subsequently categorised as authoritative (above median on both scales), authoritarian (above median for strictness, below median for involvement), indulgent (above median for involvement, below median for strictness) and neglectful (below median for both scales).

Fruit and vegetable intake

For both, children and mothers the dietary part of the questionnaire was composed of a pre-coded 24 hour recall part and a food frequency part. The pre-coded 24-hour recall part of the questionnaire was included to give

information about both the intake of the group and the amount and types of vegetables, whereas the food frequency part ranked individuals according to levels of usual intake. The pre-coded 24-hour recall asked in detail about the consumption of salad, other raw vegetables, cooked vegetables and vegetable soup referring to three different time intervals: (1) before school; (2) school time and lunch; (3) after school, dinner and after dinner.

Amounts were indicated in terms of number of pieces, slices or portions eaten, and standard weights were attributed in order to quantify intake [32, 33]. The total vegetable intake was calculated by summarising all answers about vegetables. In this paper the intake of fruit and vegetables were assessed using the 24 hour recall part and not the food frequency part. The reason for why this decision was made was that the food frequency part did not have a specific question on vegetable soup consumption.

Statistical analysis

Descriptive statistical analyses consisted on the calculation of frequencies, means and standard deviations.

Differences of intakes were assessed by Wilcoxon's Signed Ranks test. The degree of the association was assessed using Spearman's correlation coefficient.

Linear regression models were used to predict children's intake using mothers' consumption of fruit and vegetables and the dimensions of the parenting styles (strictness and involvement).

Statistical analysis was performed with SPSS version 17.0 for Windows. A p-value < 0.05 was considered to be statistically significant.

RESULTS

Sample characteristics

Sociodemographic characteristics of the sample are shown in Table 1. The sample included 1603 mothers and their children [736 (45.9%) boys and 867(54.1%) girls]. The mean age of the children was 11.7±0.7 years. Nearly half of the mothers (44.5%) reported that the number of people in household was 4.

The education level with highest percentage (44.5%), was found for mothers with less than 7 years of education.

In relation to the social class the highest percentage occurred in Group VII+VIII which correspond to economically inactive mothers (29.3%); within this group more than two thirds reported to be housewives. In opposition to this the lowest percentage was found in Class I+II (12.8%).

Table 1. Sociodemographic characteristics of the sample (n=1,603 mother-child pairs).

Characteristics	**n**	**(%)**
Children (mean age 11.7, SD=0.7 years)		
Boys	736	45.9
Girls	867	54.1
Number of people in household (n=1,572)		
< 4	433	28.6
4	737	48.2
> 4	341	23.2
Mothers' education level (n=1,580)		
<7 years	703	44.5
7-9 years	292	18.5
10-12 years	281	17.8
>12 years	304	19.2
Mothers' social class (n= 1,523)		
Class I – II (high)	195	12.8
III	248	16.3
IV	251	16.5
V (low)	288	18.9
Group VI (economically active; insufficient information)	94	6.2
Group VII+VIII (economically inactive)	447	29.3
Region of residence (n=1,603)		
North	481	30.0
Centre	388	24.2
Lisbon area	466	29.1
Alentejo + Algarve	268	16.7

Fruit and vegetable intake

Intake of fruit, vegetables and combined fruit and vegetables of the mothers and their children by sex (24-hour recall) are presented in Table 2. Mothers reported a significantly higher intake of fruit, vegetables and combined fruit and vegetables than their children. Analyzing these intakes by child's sex, similar results were found, excepting for raw vegetables, in which the differences of intake were not significant. Furthermore, there were no sex differences in fruit and vegetable intake.

Table 2. Intake of fruit, vegetables and combined fruit and vegetables (24 hour-recall) of the mothers and their children according by sex.

	Total			Child's sex					
	Mothers	**Children**		**Mothers**	**Boys**		**Mothers**	**Girls**		*p value*
	n=1603	**n=1603**		**n=736**	**n=736**		**n=867**	**n=867**		(boys vs.
	Mean (S.D.)	Mean (S.D.)	*p value*	Mean (S.D.)	Mean (S.D.)	*p value*	Mean (S.D.)	Mean (S.D.)	*p value*	girls)
Fruit & Vegetables (g)	386.7 (190.5)	260.9 (183.3)	<0.001	383.9 (188.5)	254.2 (191.7)	<0.001	389.1 (192.2)	266.6 (175.7)	<0.001	0.707
Fruit (g)	218.5 (131.9)	150.3 (121)	<0.001	212.5 (128.7)	147.5 (131.2)	<0.001	223.5 (134.4)	152.7 (111.5)	<0.001	0.146
Total vegetables (g)	168.3 (108.9)	110.6 (103.1)	<0.001	171.4 (110.2)	106.7 (104.2)	<0.001	165.6 (107.7)	114.0 (102.1)	<0.001	0.324
Salad (g)	28.0 (30.7)	19.3 (27.9)	<0.001	27.0 (30.4)	18.5 (26.9)	<0.001	28.9 (31.1)	20.0 (28.8)	<0.001	0.232
Raw vegetables (g)	11.4 (27.2)	10.4 (31.8)	0.042	11.7 (27.1)	11.1 (33.0)	0.329	11.1 (27.3)	9.8 (30.9)	0.065	0.589
Cooked vegetables (g)	51.9 (50.1)	25.2 (40.0)	<0.001	53.1 (49.9)	22.7 (40.0)	<0.001	50.8 (50.3)	27.3 (39.9)	<0.001	0.320
Vegetable soup (g)	77.1 (61.7)	55.7 (60.6)	<0.001	79.7 (63.4)	54.3 (62.8)	<0.001	74.8 (60.1)	56.8 (58.7)	<0.001	0.152

Table 3 describes the intake of fruit, vegetables and combined fruit and vegetables of the mothers and their children according to parenting styles (24-hour recall). According to this variable, most mothers of the sample were considered to be either neglectful (n=598) or authoritative (n=592). No matter what the parenting style, the intake of fruit, vegetables and combined fruit and vegetables were significantly higher in mothers than their children, apart from raw vegetables. Among the neglectful mothers the consumption of fruit and vegetables was significantly higher even for raw vegetables.

Table 3. Intake of fruit, vegetables and combined fruit and vegetables (24 hour recall) of the mothers and their children according to parental style.

	Authoritative mothers n=592	Children n=592		Authoritarian mothers n=223	Children n=223		Indulgent mothers n=190	Children n=190		Neglectful mothers n=598	Children n=598	
	Mean (S.D.)	Mean (S.D.)	*p value*	Mean (S.D.)	Mean (S.D.)	*p value*	Mean (S.D.)	Mean (S.D.)	*p value*	Mean (S.D.)	Mean (S.D.)	*p value*
Fruit & Vegetables (g)	394.7 (188.5)	273.3 (189.7)	<0.001	372.2 (195.3)	254.7 (178.5)	<0.001	404.2 (170.3)	287.2 (194.1)	<0.001	378.8 (196.3)	242.6 (173.2)	<0.001
Fruit (g)	220.7 (130.4)	150.5 (118.5)	<0.001	207.1 (126.2)	145.1 (112.1)	<0.001	218.7 (113.1)	166.3 (126.1)	<0.001	220.4 (140.8)	146.9 (124.8)	<0.001
Total vegetables (g)	174.0 (109.2)	122.8 (110.3)	<0.001	165.1 (111.7)	109.6 (99.3)	<0.001	185.5 (104.1)	121.0 (108.7)	<0.001	158.4 (108.1)	95.8 (93.2)	<0.001
Salad (g)	30.3 (30.1)	21.0 (29.0)	<0.001	24.9 (29.5)	18.4 (30.1)	<0.01	34.3 (31.2)	28.0 (30.7)	<0.001	24.9 (31.3)	17.1 (26.0)	<0.001
Raw vegetables (g)	10.9 (26.1)	13.2 (34.9)	0.350	10.4 (27.8)	8.4 (33.1)	0.230	12.5 (26.6)	11.4 (27.2)	0.248	11.8 (28.2)	8.1 (25.9)	0.002
Cooked vegetables (g)	55.0 (53.5)	27.2 (39.5)	<0.001	54.2 (48.4)	24.3 (40.1)	<0.001	54.5 (48.3)	51.9 (50.1)	<0.001	47.0 (47.6)	23.2 (38.9)	<0.001
Vegetable soup (g)	77.8 (60.9)	61.3 (61.9)	<0.001	75.5 (62.3)	58.5 (61.4)	<0.001	84.2 (63.5)	77.1 (61.7)	<0.001	74.6 (61.5)	47.4 (56.0)	<0.001

Correlations of fruit and vegetable intake between mothers and their children

Associations of intake of fruit, vegetables and combined fruit and vegetables between mothers and their children by sex are observed in Table 4. Significant but weak associations were found for fruit, vegetables and combined fruit and vegetable intake between mothers and their children. Analyzing this association by the child's sex the same happens, except for raw vegetables in boys, where the association was not significant.

Table 4. Associations of intake of fruit, vegetables and combined fruit and vegetables between mothers and their children according to sex.

	Total		**Child's sex**			
	Mothers-Children N=1603		**Mothers-Boys** n=736		**Mothers-Girls** n=867	
	r	*p value*	*r*	*p value*	*r*	*p value*
Fruit & Vegetables (g)	0.192	<0.001	0.224	<0.001	0.161	<0.001
Fruit (g)	0.149	<0.001	0.156	<0.001	0.141	<0.001
Total vegetables (g)	0.207	<0.001	0.240	<0.001	0.180	<0.001
Salad (g)	0.226	<0.001	0.213	<0.001	0.235	<0.001
Raw vegetables (g)	0.075	0.003	0.068	0.064	0.081	0.018
Cooked vegetables (g)	0.134	<0.001	0.139	<0.001	0.134	<0.001
Vegetable soup (g)	0.232	<0.001	0.265	<0.001	0.205	<0.001

Table 5 shows associations of intake of fruit, vegetables and combined fruit and vegetables between mothers and their children according to parenting styles. Overall, associations were also found for intake of fruit, vegetables and combined fruit and vegetables. The weakest associations were found among neglectful mothers and their children, namely for fruit and combined fruit and vegetables.

Table 5. Associations of intake of fruit, vegetables and combined fruit and vegetables between mothers and their children according to parental style.

	Authorative mothers-children n=592		Authoritarian mothers-children n=223		Indulgent mothers-children n=190		Neglectful mothers-children n=598	
	r	*p value*	*r*	*p value*	*r*	*p value*	*r*	*p value*
Fruit & Vegetables (g)	0.200	<0.001	0.287	0.001	0.244	0.001	0.121	0.003
Fruit (g)	0.189	<0.001	0.194	0.004	0.150	0.038	0.093	0.023
Total vegetables (g)	0.167	<0.001	0.222	0.001	0.201	0.006	0.224	<0.001
Salad (g)	0.225	<0.001	0.130	0.052	0.140	0.054	0.268	<0.001
Raw vegetables (g)	0.037	0.372	0.066	0.330	0.109	0.135	0.108	0.008
Cooked vegetables (g)	0.100	0.015	0.244	0.001	0.072	0.322	0.140	0.001
Vegetable soup (g)	0.227	<0.001	0.300	<0.001	0.140	0.054	0.232	<0.001

Effects of mothers' intake of fruit and vegetables and dimensions of the parenting styles on children's

In order to clarify the relations between parenting styles and consumption, and assuming the influence of the mother's consumption in their children's intake, a multiple linear regression was applied.

The effect of the mothers' consumption and parenting styles dimensions on children's intake are presented in Table 6. Among the three presented variables, mothers' intake had the highest effect for all items. The dimension involvement from mothers showed a statistically significant effect on children's consumption of combined fruit and vegetables, total vegetables and vegetable soup.

Table 6. Multiple linear regression to measure the effect of mothers' consumption and parenting styles dimensions on children's intake.

	Mothers' intake		Strictness dimension		Involvement dimension	
	β	*p value*	*β*	*p value*	*β*	*p value*
Fruit & Vegetables	0.170	<0.001	-0.015	0.634	0.080	0.013
Fruit	0.118	<0.001	-0.055	0.090	0.053	0.103
Total vegetables	0.174	<0.001	0.035	0.272	0.084	0.009
Salad	0.185	<0.001	0.011	0.721	0.033	0.299
Raw vegetables	0.053	0.035	0.043	0.189	0.042	0.198
Cooked vegetables	0.125	<0.001	-0.007	0.824	0.042	0.193
Vegetable soup	0.214	<0.001	0.040	0.210	0.076	0.016

DISCUSSION

The present study compared intakes and examined associations between mothers' and children's fruit and vegetable intake. Mothers reported significant higher mean intake of fruit, vegetable and combined fruit and vegetables than their children, with the exception of raw vegetables. Similar findings have been reported by other studies among children and adolescents [39-41].

Comparing fruit and vegetable intake by sex, our study showed there were no significant differences, although girls tended to report higher consumption. Other studies have shown similar differences in consumption, with higher intake among girls for fruit and vegetables [40, 42-49]. Still in the scope of intake comparisons, our study revealed that mothers' intake of fruit, vegetables and combined fruit and vegetables were significantly higher than their children, apart from raw vegetables, regardless of the parenting style. For raw vegetables, one possible explanation for the absence of significant difference between mothers' and children's consumption could be the low intake of this type of culinary preparation among Portuguese population.

In relation to the associations, the study found a positive and significant but weak correlation in fruit, vegetables and combined fruit and vegetable intake between mothers and their children, which is in agreement with other studies [39, 40, 42, 50-53].

Some previous studies reported the association mother-child intake only for fruit and not for vegetables [54, 55] and other only for girls [27].

Overall, when we analyzed the magnitude of the association mother-child intake for all items (fruit, vegetables and combined fruit and vegetables), this magnitude is comparable to other studies developed [42, 52].

However, when we compared the magnitude of the association found for fruit and vegetables separately, the one for fruit was weaker and among vegetables the strongest association occurred in the vegetable soup. Furthermore, the strongest associations were verified among boys. Contradictory results have been found in other studies [39, 40, 50-52] in which the strongest associations were observed for fruit and not vegetables. Our findings in relation to vegetable soup, suggest that further research is required.

Associations of intake between mother's and their children, according to parenting style were also explored in this study and to our knowledge this was the first study that assessed this relationship. Findings showed associations for each parenting style, but the magnitude of the association varied among parenting styles, occurring weaker associations in the negligent style.

Associations between parenting styles and fruit and vegetable consumption among children and adolescents (not including mothers' intake) have been analysed but with unclear results. Some studies found no association between parenting style and fruit and vegetable consumption among children and adolescents [56, 57] while some evidence has shown a positive association between an authoritative parenting style and fruit and vegetable consumption in adolescents [58, 59].

In addition, in the present study we analyzed the effect of mothers' consumption of fruit and vegetables and the dimensions of the parenting styles (strictness and involvement) on children's intake. Our results showed that mothers' intake was the strongest predictor of children's intake, overlapping the effect of both dimensions of the parenting styles.

This fact suggests that future interventions, to increase the fruit and vegetable consumption among children, should take into account this target group (mothers). The determinants associated with the mothers' consumption as well as the role model factor and availability of fruit and vegetables appear to be more important than interaction between mother and child as expressed by parenting styles.

Previous studies have indicated that availability of fruit and vegetables is one of the most important environmental factors for fruit and vegetables among children [60-63] and adolescents [27, 64-66]. Also, the parental modelling as a predictor of children's and adolescents' fruit and vegetable consumption have been shown in several studies [42, 47, 54, 63, 66-69].

However, more research is needed to investigate the contribution these variables on associations of intake between mother's and their children.

The present study has some limitations that need to be considered when interpreting the findings. The data are derived from a cross-sectional survey and cause and effect can not be inferred. The dietary intake of the both, mothers and children, were assessed by 24 hour recall, which were applied only on a weekday. Despite these limitations, the questionnaires were previously validated and showed a satisfactory validity [32,33]. Another limitation was the lack of analysis of other consumption determinants, such as preference, peer influences, frequency of meals in family that can influence the association of consumption of fruit and vegetables among mothers and their children.

The strength of this study was the large and representative sample of the mothers and their children.

CONCLUSION

Mothers' intake of fruit and vegetables seems to influence their children's consumption.

Overall, this research suggests that future interventions to increase children's fruit and vegetable intake should explicitly target mothers' own intake.

Mothers especially, should provide ample opportunities in which children have repeated experiences of consuming fruit and vegetables and at the same time encourage fruit and vegetable intake in their children by acting as role models of fruit and vegetable intake.

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CONTRIBUTION OF VEGETABLE SOUP TO TOTAL VEGETABLE INTAKE AND ITS DETERMINANTS AMONG MOTHERS IN PORTUGAL

Paper VII

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ABSTRACT

Objectives:

To assess vegetable soup intake and its contribution to total vegetable intake among mothers of Portuguese schoolchildren as well as to examine the association between relative vegetable soup intake and sociodemographic characteristics.

Design/Subjects/Setting

A cross-sectional survey was carried out in Portugal as part of the Pro Children study. 1,673 women, mothers of 11- to 13-year old children, took part in this study. The vegetable intake and sociodemographic characteristics were collected with a self-administered questionnaire, in which a precoded 24-hour recall was applied. The analysed sociodemographic characteristics were the number of people and composition of household, educational level, social class and region of residence. The association between mothers who consumed vegetable soup preferentially or exclusively (i.e. ≥50% of total vegetable intake) and sociodemographic characteristics were analysed by a logistic regression model.

Results:

The mean intake of vegetable soup was 76.1g/d and its contribution to total vegetable intake was approximately 45%. The percentage of mothers that were preferential or exclusive consumers of vegetable soup was 41%.

Preferential or exclusive vegetable soup intake was less likely among mothers where the number of people in household was less than 4 (vs. 4; OR: 0.734,

95%CI: 0.577-0.934) and that did not live with their spouse/partner (OR: 0.617, 95%CI: 0.424-0.878).

Conclusion:

The contribution of vegetable soup to total vegetable intake among mothers of Portuguese schoolchildren seems to be associated with the number of people and composition of household. Future interventions, to promote vegetable soup intake should include all members of household.

Keywords: vegetable soup; vegetables; intake; consumption; determinants; sociodemographic

INTRODUCTION

Soup is "a timeless "food", it was in the past, it is in the present and it will be in the future (Feliciano *et al.*, 2003).

Broadly, soup is defined as a liquid culinary preparation mainly made of boiled water, a large variety of vegetables and starchy foods in which a little fat is added, sometimes meat, fish or eggs. It is eaten at main meals, often as a starter (Feliciano *et al.*, 2003; Flandrin and Montanari, 1998; Hornby, 2002; Peres, 1997).

Since the Middle Ages, medicine recognizes the therapeutic and medicinal virtues of soup, as well as its consumption that is recommended in several situations and pathologies. After the Industrial Revolution at the beginning of the 20th Century soup had gained a negative connotation related to the low social condition and to poverty. In the last few years of the 20th Century a fall in soup consumption was observed mainly in the developed countries. The reasons that led to this can be related to cultural and social demographic determinants namely the spread of the international fast-food chains, the appearance of pre-packed meals, lack of time and the need of cutting the link with the past (Feliciano *et al.*, 2003; Flandrin and Montanari, 1998; Ritchie, 1995).

Soup is part of the culinary Portuguese tradition. There are several types and ways of cooking soup according to the different regions of the country. For instance *green cabbage soup*, *chicken soup and fish soup* (Olleboma, 1994;

Quitério, 1987). According to a nutritional point view soups can be classified as *broth, soup* and *rich soup*. *Broth* results from the cooking of a mixture of foods, and after almost all of them are removed. Usually, this type of soup does not contain vegetables. The *rich soup* is cooked in a similar way as the *soup*, with meat, fish, egg or other foods and is served as a main meal. There is also *soup*, commonly called vegetable soup, which is very rich in several vegetables and is frequently eaten at the beginning to the main meals (Feliciano *et al.*, 2003).

Vegetable soup is one of the ways of consuming vegetables by several populations and is often linked to healthy lifestyles (Galan *et al.*, 2003; Kesse *et al.*, 2005; Padrão *et al.*, 2007).

The relationship between soup consumption and nutritional status has been studied. For instance, one study conducted in Italy, showed high levels of obesity among adults subjects not eating soups, while obesity among soup eaters was low. Moreover, soup eaters had a lower incidence of hypercholesterolemia, hypertriglyceridemia, irritable colon and hypertension (Giacosa and Filiberti, 1997).

Another study carried out by Bertrias *et al.*, (2001) among a national sample of adults living in France, observed that big consumers of soup had significantly higher intakes of carbohydrates and lower lipid intakes than in occasional or non-soup consumers. In this same sample, lower levels of obesity and a lower incidence of hypercholesterolemia were found among subjects who ate soup.

Aside from the importance of the nutritional state of populations, this culinary preparation has been the main subject of many investigations due to the feeling of fullness and weight management. Several studies have also found that eating soup before the main dish decreases hunger, increases fullness and reduces subsequent food intake. The researchers Himaya and Louis-Sylvester (1998), demonstrated that the consumption of chunky soup as the first course reduced total intake by 20%. Similar results were found in the study carried out by Flood and Rolls (2007).

Other studies found that the consumption of soup before the main course was more filling than common starters such as crackers, cheese and fruit juice (Kissileff *et al.*, 1984; Mattes, 2005; Rolls *et al.*, 1990).

Although, there are several studies that state the importance of soup, only a few speak about the determinants that lead to soup consumption.

In this context, the aims of the present study were to assess vegetable soup intake and its contribution to total vegetable intake among mothers of Portuguese schoolchildren as well as to examine association between the relative vegetable soup and sociodemographic characteristics.

METHODS

Sample and procedure

The sample is derived from the cross-sectional study of the Pro Children project. This Pro Children study, involving nine European countries (Austria, Belgium, Denmark, Iceland, the Netherlands, Norway, Portugal, Spain and Sweden) was designed to assess fruit and vegetable intake among children and their parents, as well as its potential determinants. The cross-sectional survey was conducted during October-December 2003 involving national representative samples of schools in all countries with the exception of Austria and Belgium.

Schools constituted the sampling unit, and from each country random samples of at least 20 schools and a minimum of 1,300 11-year-old eligible children were recruited.

Pupils completed a questionnaire in the classroom and later took home another questionnaire to be completed by one of their parents. The parent questionnaires were brought by the children to the classroom teachers.

The study was approved by the research ethics committees within participating countries and parental written consent was obtained.

60 schools were randomly selected for participation in the study, from a list provided by the Ministry of Education with 5^{th} and 6^{th} grades (11- to 13-years old). This list included 1,050 state and private schools. These schools were invited to participate by an initial letter sent to the headmaster. All schools agreed to participate but only 34 schools returned the questionnaires. A total of 3,044 schoolchildren, born between 1990 and 1992, and 2,375 questionnaires filled in by one of their parents were received (1,853 by mothers and 522 by fathers or guardians). Among parents the participation rate was 78%. In this paper, only data from the mothers were used. The final sample consisted of only 1,673 due to an incomplete process of completing the 24-hour recall of the questionnaire and sociodemographic characteristics.

Instrument

A self-report questionnaire was developed to measure fruit and vegetable intake, and possible correlates among children and their parents.

The questionnaire included three parts: the first part consisted of a dietary intake of fruit and vegetables; the second covered different issues to study potential, social and physical-environmental factors of daily fruit and vegetable intake; and a third part comprised information about social-economic, demographic characteristics and parental style.

Sociodemographic variables

Household size and composition, education level, social class and region of residence were registered to characterize the studied sample.

In relation to the number of people in household, this variable was recoded in three categories: less than 4 people, 4 people and more than 4 people.

Composition of household included two questions, which were recoded in the following way: *Live with spouse/partner* (Yes/No) and *Live with own child/children* (Yes/No).

Educational level was divided into categories: (1) less than 7 years, (2) 7-9 years, (3) 10-12 years and (4) more than 12 years.

To code occupational social class three kinds of job characteristics were used: educational requirements to perform the job, management skills requested to perform the job and control over economic assets (ownership/self-employed). This model defines a common hierarchical structure, which categorises all occupations into five social classes (I-V) and three extra groups (Group VI-VII) (Due *et al.*, 2003; Holstein *et al.*, 2004).

Based on the classification of the Official Portuguese Territorial Division NUT II the sample was assigned to one of the five regions of residence: *North, Centre, Lisbon area, Alentejo, Algarve* (Ministério do Planeamento e da Administração do Território, 1989). The last two regions were analyzed as one region due to their low sample size and close geographical location.

Vegetable intake

The dietary part of the questionnaire was composed of a pre-coded 24 hour recall part and a food frequency part. The pre-coded 24-hour recall part of the questionnaire was included to give information about both the intake of

the group and the amount and types of vegetables, whereas the food frequency part made it possible to rank individuals according to levels of usual intake. The pre-coded 24-hour recall asked in detail the consumption of salad, other raw vegetables, cooked vegetables and vegetable soup referring to three different time intervals: (1) before school; (2) school time and lunch; (3) after school, dinner and after dinner.

Amounts were indicated in terms of number of pieces, slices or portions eaten, and standard weights were attributed in order to quantify intake (Haraldsdottir *et al.*, 2005; Kristjansdottir *et al.*, 2006). The total vegetable intake was calculated by summarising all answers about vegetables. In this paper, the food frequency part was not used because a specific question about vegetable soup intake was not included.

Statistical analysis

The sample was divided into 5 groups according to the contribution of vegetable soup in total vegetable intake (grams): (1) non-vegetable consumers, (2) consumers of vegetables but not vegetable soup, (3) preferential consumers of other vegetables (i.e. vegetable soup <50%), (4) preferential consumers of vegetable soup (i.e. ≥50% and <100%) and (5) exclusive consumers of vegetable soup (100%).

The data's descriptive analysis was followed by a logistic regression model to investigate the associations between preferential or exclusive consumer mothers of the vegetable soup and sociodemographic variables.

Statistical significance was defined for $P<0.05$. All analyses were conducted using SPSS (Statistical Package for Social Sciences) version 14.0 for Windows.

RESULTS

Characteristics of the sample

The study sample comprised 1673 mothers of Portuguese schoolchildren. The sociodemographic characteristics of the sample are summarized in Table 1.

Table 1. Sociodemographic characteristics of the sample (N=1,673).

Characteristics	n	(%)
Number of people in household		
< 4	485	29.0
4	811	48.5
> 4	377	22.5
Live with spouse/partner	1492	89.2
Live with own child/children	1406	84.0
Education level		
<7 years	721	43.1
7-9 years	316	18.9
10-12 years	308	18.4
>12 years	328	19.6
Social class		
Class I – II (high)	208	12.4
III	278	16.6
IV	276	16.5
V (low)	316	18.9
Group VI (economically active; insufficient information)	108	6.5
Group VII+VIII (economically inactive)	487	29.1
Region of residence		
North	481	28.8
Centre	428	25.6
Lisbon area	490	29.3
Alentejo + Algarve	274	16.4

The highest frequency of mothers live in a household composed of four people (48.5%).

89.2% and 84% of this sample *live with spouse/partner and live with own child/children*, respectively.

The education level with the highest frequency among mothers was less than 7 years (43.1%).

In relation to the social class the highest frequency occurred in Group VII+VIII which correspond to economically inactive mothers; within this Group 58.4%% (n=284) reported to be housewives. On the other hand, the lowest frequency was found in class I+II (12.4%).

Vegetable intake

Table 2 shows the means and standard deviations for total vegetable and vegetable soup daily consumption.

Table 2. Mean and standard deviation (SD) of total vegetable and vegetable soup intake in g/day.

	Mean (g/d)	**SD**
Total vegetables	170.4	114.5
Vegetable soup	76.1	61.8
Vegetable soup at lunch	36.8	39.0
Vegetable soup at dinner	39.2	39.2

The mean intake of total vegetables was 170.4 g/d and of the vegetable soup was 76.1 g/d. The intake of vegetable soup was similar in both periods: lunch and dinner.

The contribution of vegetable soup intake to total vegetable intake was approximately 45%.

Vegetable soup intake and sociodemographic characteristics

Table 3 displays the distribution of the sample according to the contribution of the vegetable soup to total vegetable intake by sociodemographic characteristics.

Table 3. Relative contribution of vegetable soup intake in total vegetable intake according to sociodemographic characteristics.

	Non-vegetable consumers (%)	Consumers of vegetables but not vegetable soup (0%) (%)	Preferential consumers of other vegetables (Veg. soup <50%) (%)	Preferential consumers of vegetable soup (≥50% and <100%) (%)	Exclusive consumers of vegetable soup (100%) (%)
Total	8.4	21.9	28.6	33.5	7.5
Nº. of people in household					
<4	7.8	24.5	31.8	29.5	6.4
4	8.5	19.6	27.3	36.0	8.6
>4	8.8	23.6	27.6	33.4	6.6
Live with spouse/partner					
Yes	8.1	20.2	29.1	34.7	7.9
No	10.5	35.9	24.9	24.3	4.4
Live with own child/children					
Yes	8.1	22.0	28.6	33.9	7.3
No	9.7	21.3	28.8	31.5	6.6
Education level					
< 7 years	9.3	23.7	29.0	29.7	8.3
7 - 9 years	10.1	19.3	30.1	31.6	8.9
10 - 12 years	7.5	23.7	28.9	33.1	6.8
> 12 years	5.5	18.9	26.2	44.2	5.2
Social class					
Class I + II (high)	4.8	16.3	28.4	46.2	4.3
Class III	5.4	24.1	27.7	34.5	8.3
Class IV	10.1	20.3	24.3	37.0	8.3
Class V (low)	11.4	18.7	30.4	29.4	10.1
Group VI (economically active; insufficient information)	7.4	24.1	27.8	32.4	8.3
Group VII+VIII (economically inactive)	8.8	25.7	30.8	28.5	6.2
Region of residence					
North	7.9	17.9	31.6	32.2	10.4
Centre	7.7	20.8	29.7	35.3	6.5
Lisbon area	8.4	23.9	27.6	33.5	6.7
Alentejo + Algarve	10.2	27.4	23.7	33.2	5.5

Overall, approximately 41% of the sample were preferential or exclusive consumers of vegetable soup. On the other hand, around 30% were not consumers of soup.

44.6% of the mothers who live in a household composed of 4 individuals were preferential or exclusive consumers of vegetable soup.

Higher frequencies of mothers who live with their spouse/partner (42.6%) and live with own child/children (41.2%) had a soup contribution of more than 50% in total vegetable intake.

In relation to educational level the highest frequency of preferential or exclusive consumers of vegetable soup (49.4%) was observed for mothers with >12 years of education.

Taking into account the social class the highest frequencies of preferential or exclusive consumers of vegetable soup were found in mothers belonging to highest social classes.

Regarding the variable region of residence, it was found that from North to South the contribution of vegetable soup intake tended to decrease.

Determinants of higher contributions of vegetable soup intake

Mothers who live in a household with less than 4 people and did not live with spouse/partner were less likely to be preferential or exclusive vegetable soup consumers, whether variables were adjusted or not (Table 4).

Table 4. Non-adjusted and adjusted Odds Ratio (OR) and 95% Confidence Intervals (CI) for preferential/exclusive consumers of vegetable soup (≥50%) by sociodemographic characteristics.

	OR *Non-adjusted*	95%CI	*p value*	OR *Adjusted*	95%CI	*p value*
Nº. of people in household			**0.007**			**0.004**
<4	0.694	0.551-0.875	**0.002**	0.734	0.577-0.934	**0.012**
4	(1)	(reference)	-	(1)	(reference)	-
>4	0.829	0.647-1.062	0.138	0.865	0.672-1.114	0.262
Live with spouse/partner						
Yes	(1)	(reference)	-	(1)	(reference)	-
No	0.544	0.388-0.763	**<0.001**	0.617	0.424-0.878	**0.007**
Live with own child/ children						
Yes	(1)	(reference)	-	(1)	(reference)	-
No	0.952	0.729-1.244	0.720	1.012	0.769-1.333	0.930
Education level			**0.006**			0.228
< 7 years	(1)	(reference)	-	(1)	(reference)	-
7 - 9 years	1.111	0.848-1.455	0.446	0.697	0.491-0.988	0.042
10 - 12 years	1.085	0.825-1.425	0.560	0.770	0.529-1.122	0.173
> 12 years	1.592	1.223-2.072	**0.001**	0.737	0.512-1.062	0.100
Social class			**0.003**			0.090
Class I + II (high)	(1)	(reference)	-	(1)	(reference)	-
Class III	0.734	0.512-1.053	0.093	0.881	0.583-1.330	0.546
Class IV	0.812	0.566-1.165	0.258	1.061	0.680-1.656	0.795
Class V (low)	0.642	0.451-0.914	**0.014**	0.844	0.544-1.310	0.451
Group VI (economically active; insufficient information)	0.674	0.421-1.079	0.101	0.875	0.515-1.488	0.623
Group VII+VIII (economically inactive)	0.521	0.375-0.725	**<0.001**	0.676	0.444-1.028	0.067
Region of residence			0.712			0.652
North	(1)	(reference)	-	(1)	(reference)	-
Centre	0.968	0.743-1.260	0.808	0.950	0.726-1.243	0.707
Lisbon area	0.905	0.701-1.169	0.445	0.872	0.671-1.134	0.307
Alentejo + Algarve	0.849	0.627-1.150	0.291	0.846	0.621-1.152	0.288

Non-adjusted odds-ratios showed that mothers belonging to higher educational level (>12 years vs. < 7 years) were more likely to be preferential or exclusive vegetable soup consumers. Furthermore, mothers within lower social classes (Class V and Group VII+VIII vs. Class I+II) were less likely to be preferential or exclusive vegetable soup consumers. After adjusting for all variables, the relations of educational level and social class with preferential or exclusive vegetable soup consumption was not significant (Table 4).

The region of residence did not show significant association with mothers who were either preferential or exclusive consumers of vegetable soup (Table 4).

DISCUSSION

The results from this study demonstrate that the contribution of vegetable soup in total vegetable intake among mothers of Portuguese schoolchildren was high.

Comparing Portugal to other European countries that were part of the Project Pro Children, Portugal was the one that presented the highest consumption and contribution of vegetable soup to total vegetable intake, followed by Belgium. On the other had, Portugal showed lower consumption of salad and raw vegetables, while a higher consumption was found in Sweden, Denmark and Iceland (Wolf *et al.*, 2005).

The habit of consuming soup among Portuguese population has been shown in other studies. For instance, data from the *EpiPorto* project carried out between 1999 and 2003, which included 2415 Portuguese subjects residents in Porto aged ≥18 years, showed that vegetable soup was daily consumed (1-3 times per day) by 58.8% of women and 54.9% of men (Lopes *et al.*, 2006).

Recently the study with national representative sample, carried out by Portuguese Society of Nutrition Sciences, showed that 61.4% of women and 54.9% of men consumed soup in previous 24–hour recall (data not yet published).

However, this and other healthy food habits of the Portuguese population have undergone changes, especially negative ones. According to several researchers, Portugal is gradually moving away from the traditional Mediterranean diet to a more Westernized type (Rodrigues et al. 2001, Marques Vidal P 2006).

Based on Portuguese household food survey from 1989 to 1995, Rodrigues and de Almeida (2001) demonstrated that the availability of complex carbohydrates and olive oil fell, whereas the availability of protein-supplying food groups increased.

In addition, Marques-Vidal *et al.*(2006), assessed the trends of food intake in Portugal through three cross sectional studies 1987, 1995-1996 and 1998-1999, and showed that the consumption of traditional foodstuffs such as fish and soup declined, whereas the consumption of fat-containing foods for instance meat and milk increased gradually.

Possible explanations for this trend include the lack of time, or even the replacement of the traditional meal by smaller and lighter meals (Mestdag, 2005; Poulain, 2002).

In the present study, it was possible to observe that the mothers that live in a household of 4 individual, live with their partner and their children and have a higher level of education as well as belonging to a higher social class were the ones whose vegetable soup intake most likely contributed to more than 50% of total vegetable intake.

However, after adjusting for all variables it could be verified that only the number of people and composition of the household were the best predictors of a higher contribution of vegetable soup intake.

Previous research, developed by Moreira and Padrão (2004) showed a positive association between education level and the consumption of vegetable soup among Portuguese population. In both genders, the vegetable soup as well as vegetables, fruit, milk and fish consumption was higher for those with higher levels of education (>12 years compared to those with ≤4 years), after adjusting for age, Body Mass Index, physical activity and income. The same outcome is not verified in the income variable in which low and high groups were or tended to be similar in regard to several food groups consumption. However, this study did not take into consideration the variables related to the number and composition of the household, which in our study, as mentioned before, were the best predictors of a higher contribution of vegetable soup intake.

Other studies about the association between the vegetable soup consumption and sociodemographic characteristics were not in Portugal or anywhere else. Although, many studies were carried out among adult populations, which reported the relationship between sociodemographic variables and total

vegetable consumption (Devine *et al.*, 1999; Dynesen *et al.*, 2003; Giskes *et al.*, 2002a, b; Laaksonen *et al.*, 2003; Pollard *et al.*, 2001; Trudeau *et al.*, 1998; Wandel, 1995).

Among these studies the predictors of a higher reported level of vegetable intake, were found for higher household income (Giskes *et al.*, 2002a, b; Laaksonen *et al.*, 2003; Wandel, 1995) being married (Devine *et al.*, 1999; Pollard *et al.*, 2001; Trudeau *et al.*, 1998), belonging to a higher socio-economic status/occupation (Dynesen *et al.*, 2003; Pollard *et al.*, 2001) and higher educational level (Pollard *et al.*, 2001; Trudeau *et al.*, 1998).

When we analysed, in this sample, the association between sociodemographic variables and total vegetable consumption (including raw vegetables, salad, cooked vegetables and vegetable soup) it was possible to observe that the predictors were educational level and social class and not the number and composition of household: the daily vegetable intake was significantly higher among mothers with a higher educational level and belonging to higher social class (data not showed in results).

These outcomes seem to demonstrate that there are differences among sociodemographic determinants when is analyzed the total vegetable intake as whole or vegetable soup intake. So, a comparison can not be made with other studies.

In our study, it looks like that the higher contribution of vegetable soup intake is associated with motivation inside the household, within the family environmental. Furthermore, when we analyzed the vegetable soup intake between these mothers and their children, a positive association, rather weak, was verified. Moreover, among other ways of consuming vegetables, the soup was the one that showed the strongest association (data not showed in results). These data reinforce the importance of family in vegetable soup intake.

As already mentioned in this article, vegetable soup intake has been associated with the filling of fullness and therefore recommended for the prevention of obesity (Flood and Rolls, 2007; Himaya and Louis-Sylvestre, 1998; Rolls *et al.*, 1990; Rolls *et al.*, 2005).

In Portugal, overweight and obesity rates are high. The study developed by *Carmo et al.* (2008) with a national representative sample and data from 2003-05, demonstrated that more than half of the Portuguese population (53.6%) over 18 years old were overweight or obese. Among women,

overweight and obesity were 34.4% and 13.4%, respectively. More recent data comparing previous findings, showed a fall in both situations among women: 27.8% of overweight and 10.4% of obesity. This decrease was not verified among men where obesity increased from 45.2% to 53.3% (Poínhos *et al.*, 2009).

When faced with this situation it is essential to promote vegetable soup consumption among people in Portugal.

Although there are many virtues of vegetable soup, we can not ignore the high level of salt frequently used in the Portuguese soup cooking. One study that analysed the salt content in soups, served in 39 Portuguese canteens, showed that soup contributed with 30% of the amount of salt consumed in the meal (composed of soup + main plate + dessert), and the mean amount of salt per portion of soup was approximately 2.4g (Mano *et al.*, 1989).

Also, the *EpiPorto* project demonstrated that mean intake estimate of sodium in its sample was of 3600.8mg/day, equivalent to 9.2g/day of salt. Additional results from this study showed that vegetable soup was one of the main groups of food that contributed to the highest intake of sodium with 15.8% (Lopes *et al.*, 2006).

A more precise study about the salt intake was developed by Polonia *et al*, (2006) with 426 Portuguese subjects belonging to four different adult populations living in northern Portugal. This study evaluated salt intake levels based on assessment of 24-hour urinary sodium excretion. The mean 24-hour urinary sodium excretion was 202.3 (±64.1) nmol Na/day, corresponding to an estimated daily salt intake of 12.3g well above from that recommended by the World Health Organization (<5g/day) (Polonia *et al.*, 2006; World Health Organization, 2003).

Taking into account that the high prevalence of hypertension and stroke in Portugal may be related to excessive salt consumption (Carrageta *et al.*, 1994) and the main cause of death in Portugal, in 2006, was caused by circulatory system diseases, so it seems crucial to establish and extend recommendations on how to cook soup and other components of the meal among Portuguese population (Instituto Nacional de Estatística, 2008).

There are some limitations to the present study that need to be expressed. Firstly, the findings are based on cross-sectional data and a causal relationship can not be inferred between the sociodemographic determinants and vegetable soup intake. Secondly, the questionnaire only assessed the

consumption of the day before the interview, so the reported intake may not be representative of the average intake. Despite these limitations, the questionnaire was previously validated and showed a a satisfactory validity (Kristjansdottir *et al.*, 2006).
The strength of this study is the large and representative sample, with a high participation rate.

CONCLUSION

The findings of this study suggest that the contribution of vegetable soup to total vegetable intake is associated to the number of people and composition of household, among mothers of Portuguese schoolchildren. Future interventions to promote vegetable soup intake should focus the nuclear family.

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5 Conclusions

In this chapter, the main findings of the present investigation are highlighted and implications for future practice and research are presented.

5.1 Main findings

- Portuguese schoolchildren had one of the highest fruit and vegetable consumption (264 g per day) amongst European schoolchildren, even if the majority (78.6%) of the participants did not meet the WHO population goal of ≥ 400 g daily;
- the best predictors of daily fruit and vegetable consumption in Portuguese schoolchildren were knowledge, liking, self-efficacy, preferences, modelling, demand family rule and to bring fruit to school;
- overall, boys reported less frequent consumption than girls; schoolchildren from the Lisbon area reported the lowest and less frequent consumption of fruit while in the Algarve similar results were found for vegetables;
- the majority of the mothers (54%) of Portuguese schoolchildren did not meet the WHO population goal for fruit and vegetables consumption;
- fruit and vegetable consumption was more likely to be high among mothers belonging to higher social classes, while higher educational level was associated with higher vegetable intake;
- fruit and vegetable consumption of mothers of Portuguese schoolchildren seems to be positively associated with the dimension involvement of their own parenting style;
- significant associations were found between mothers' and their children's consumption of fruit and vegetables, regardless of parenting style and the child's gender;
- mothers' consumption of fruit and vegetables revealed a higher effect on their children's consumption than the various dimensions of parenting style;

- vegetable soup was the main contributor to total vegetable consumption among schoolchildren and their mothers;
- the contribution of vegetable soup to total vegetable consumption among mothers of Portuguese schoolchildren seems to be associated with the size and composition of the household.

5.2 Methodological issues

The present research findings should be considered in light of several limitations, as follows:

- fruit and vegetables are perceived to be healthy and socially acceptable foods, which may lead to a tendency to give socially desirable answers. This may cause non-uniformity in over-reporting of consumption and positive reporting towards consumption determinants;
- as a consequence of the cross-sectional survey design, a relationship of cause and effect can not be established;
- the 24-hour recall assessed the fruit and vegetable consumption on one weekday, and therefore can not be seen as representative for usual consumption including day-to-day variation as well as seasonal differences leading to differences in availability; and
- the difficulties in estimating portion sizes.

However, the validity and reliability of the data collection tools, previously assessed, the large and representative sample with a high participation rate as well as the quality control of data processing and analysis constitute strong points of our research.

5.3 Implications for future practice and research

Data from this thesis highlight the importance of interventions to promote fruit and particularly vegetable intake among the Portuguese population, namely children and their mothers. Among children, especially boys, it is crucial to increase fruit and vegetable consumption. Moreover, it seems important to intervene in some regions namely the Lisbon area and the Algarve.
After identifying the fruit and vegetable consumption predictors among children and using these predictors as determinants of consumption, it is essential to promote a comprehensive, multilevel intervention strategy among schoolchildren taking into account personal and social determinants, including parental intake.

Within the personal determinants, the intervention should focus on the knowledge of the recommended daily intake of fruit and vegetables, liking and preferences for fruit and vegetables and self-efficacy.

Schools present excellent opportunities for developing personal determinants among children: classroom curricula provides information about knowledge and benefits of fruit and vegetables but could also provide schoolchildren with the skills for choosing, preparing and tasting fruit and vegetables therefore encouraging consumption.

In relation to social determinants, modelling, demand family rule, and bringing fruit to school are areas of concern. This means that family is vital for fruit and vegetable consumption among children.

So, future interventions within the family, especially among mothers, should provide the tools to increase knowledge about adequate fruit and vegetable consumption, to increase awareness of parents as role models for their children as well as to highlight the importance of preparation and cooking family meals together.

In the case of women, our findings suggest that interventions should target those belonging to low social and economical level.

Other ways of promoting fruit and vegetable in children and in adults, and therefore increasing their consumption should be explored. Mass media may constitute an important resource to reach out to these target population groups through TV programmes, commercials and national campaigns, and should include all members of the family.

Longitudinal studies about consumption and determinants of fruit and vegetables among children and their parents are needed to examine the effects of the various determinants. In the meantime, the present findings constitute a solid contribution to the design of effective interventions to improve the intake of these protective foods amongst the Portuguese population.

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