The development, implementation and evaluation of a school-based intervention to promote fruit and vegetable intake among 10-13 year-old European schoolchildren

Marianne Wind

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The development, implementation and evaluation of a school-based intervention to promote fruit and vegetable intake among 10-13 year-old European schoolchildren

De ontwikkeling, implementatie en evaluatie van een interventie ter bevordering van de inname van groenten en fruit door 10-13 jarige basisschoolleerlingen in Europa

Proefschrift

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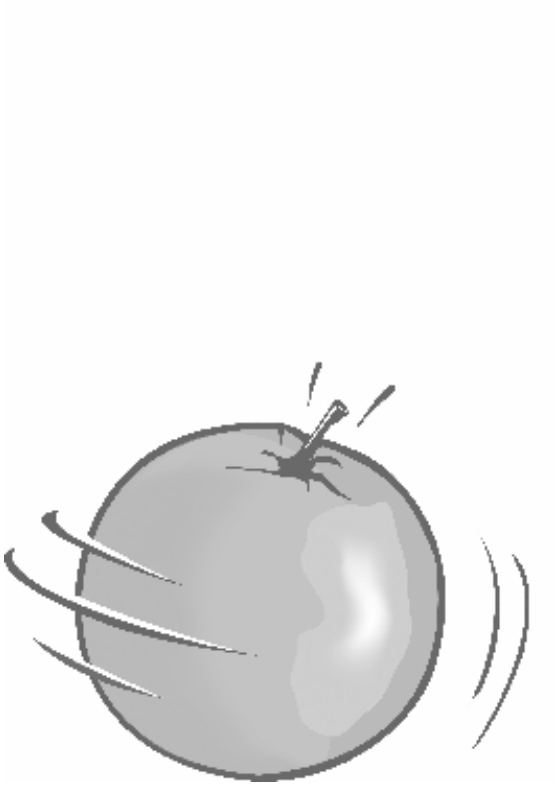
General introduction



This thesis reports on a number of studies into the development, implementation and evaluation of a school-based intervention to promote the intake of fruit and vegetables among European schoolchildren. These studies were part of the European Pro Children project ('Promoting and Sustaining Health through Increased Vegetable and Fruit Consumption among European Schoolchildren'), which was carried out between 2002 and 2006. This introductory chapter describes the background, conceptualization and design of the Pro Children project, and presents an overview of the individual studies that are part of this thesis. This chapter is partly based on a paper of Klepp and colleagues (2005) in which an overview of, and the rationale behind the Pro Children study is given.

Background

There is an international consensus that a high intake of fruit and vegetable promotes health by contributing to preventing severe public health problems such as cardiovascular diseases, obesity and several cancers (WHO, 2003; Hung et al., 2004; Paolini et al., 2003; Maynard et al., 2003). Across Europe, there is great heterogeneity in the consumption patterns of fruit and vegetables both between regions and countries, and within countries. Large population groups, particularly in northern Europe, eat far less than the recommended amount of fruit and vegetables (Dafne, 1998). The WHO population goal for fruit and vegetable intake is 400 grams per day (WHO, 3002). In southern Europe, it is of great concern that the previously seen variety, as well as the overall intake of vegetables, seems to be diminishing (Aranceta et al., 2003). The fact that the large majority of children (aged 1–15 years old) are reported not to eat fruit or vegetables every day indicates that this segment of the population consumes far less than recommended (WHO, 2004). Diet and nutrition play an important role during childhood and adolescent development, especially between 10-14 years of age when most children have their pubertal growth spurt and gain more food choice autonomy (Story et al., 2002). Moreover, these children are at an age when food preferences and habits may still be modifiable (Birch, 1999). Promoting the consumption of fruit and vegetables among children is an important health-related policy objective (WHO, 2003; European Council, 2001). Interventions aimed at children may therefore have a lifelong impact (Kelder et al., 1994; Lien et al., 2001). The large majority of children can effectively be

reached through schools, which is an appropriate arena for health promotion. In addition, parents of schoolchildren constitute an important target group, as they importantly define most of their children's eating environment. Parents themselves constitute a large and important segment of the general population, and previous nutrition education research indicates that parents can be reached through their children (Perry et al., 1989).

In order to design effective interventions to increase the amount of fruit and vegetables eaten by children and adolescents, the mediators or determinants of consumption patterns need to be identified, as well as acceptable intervention strategies that can effectively change such mediators (Baranowski et al., 1999). While there is an international body of research on this topic (primarily from the US), such information has until recently largely been lacking for European child and adolescent population groups (Blanchette & Brug, 2005; Knai et al., 2006). Since children's food environments, especially school-food environments differ substantially between the US and Europe original resreach for for European schoolchildren population was needed (Klepp et al., 2005). Within the Pro Children project, a comprehensive literature review was conducted. Although this review identified 31 published European studies investigating factors associated with fruit and/or vegetable intake among children and adolescents most of these studies were focussed on a limited range of potential mediators (Rasmussen et al., 2006). Klepp et al. (2005) identified 14 published European intervention studies designed to promote healthy eating habits among children and adolescents (Bere et al., 2005a; Eriksen et al., 2002; Friel et al., 1999; Hølund, 1990; Klepp & Wilhelmsen, 1993; Klepp et al., 1994; Lowe et al., 2004; Manios et al., 1999; Manios et al., 1999; Moon et al., 1999; Parker & Fox, 2001; Pérez-Rodrigo & Aranceta, 1997; Puska et al., 1982; Sahota et al., 2001), of which only 3 were designed specifically to increase fruit and vegetable consumption (Bere et al., 2005a; Eriksen et al., 2002; Lowe et al., 2004).

Planned health education

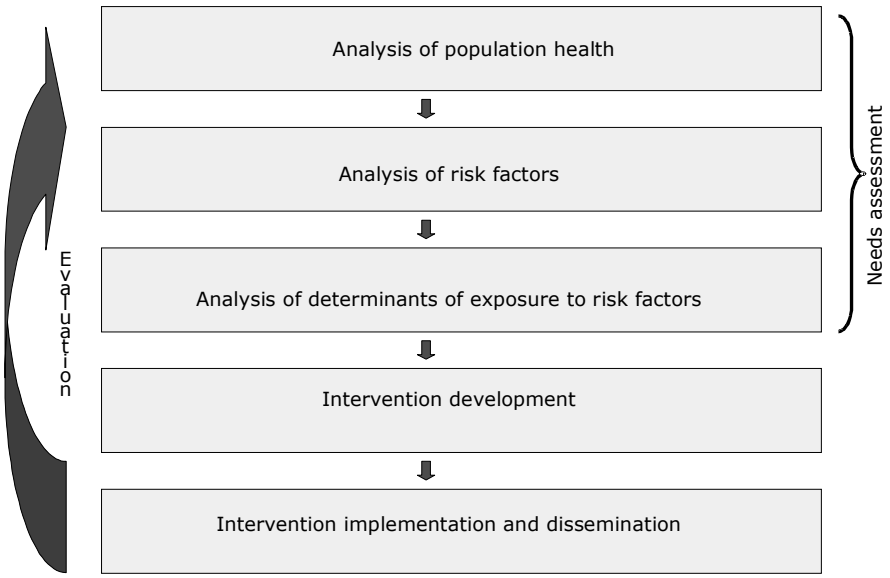


Figure 1 A model for Planned Promotion of Population Health (Brug et al., 2005)

Since the publication of the Precede-Proceed model (Green & Kreuter, 1999) and similar planning models (Brug et al., 2005), as well as the Intervention Mapping Protocol (Bartholomew et al., 2001), the importance of careful theory-based and systematic intervention planning has been recognized. According to such planning models (Figure 1), the first step in health promotion planning is the identification of health problems that are serious and/or prevalent. In the second step the behavioural risk factors for the health problems need to be identified. Subsequently the personal, social and environmental mediators or determinants of these risk factors are identified. These determinants should then be translated into interventions, which should be implemented and disseminated, so that the target population is reached as good as possible. Each step should be based on careful evaluation.

As was explained in the preceeding paragraphs sufficient intake of fruit and vegetables is associated with health benefits, and schoolchildren's intake of fruit and vegetables is far below recommendations, although good cross-European data on intake levels were lacking. As was already mentioned, original research conducted in Europe identiefying psychosocial and environmental factors associated with fruit and vegetable intake among children and adolescents is still lacking (Rasmussen et al., 2006; Blanchette & Brug, 2005; Knai et al., 2006). The main focus of the Pro Children studies described in this thesis was therefore aimed at the last three steps of the planning model (Figure 1), but additionally within the broader Pro Children project also data on fruit and vegetable intake was obtained.

The larger Pro Children project consisted of two main parts. In the first part of the Pro Children project cross-sectional data were collected to provide data on actual consumption levels of vegetables and fruits in European schoolchildren and their parents, and for the analysis of determinants of exposure to risk factors, i.e. to explore potential determinants of consumption patterns among the children. These data were collected through cross-sectional surveys which were conducted in all nine countries participating in the larger Pro Children project, i.e. in Austria, Belgium, Denmark, Iceland, the Netherlands, Norway, Portugal, Spain and Sweden. In the second part of the Pro Children project, interventions were systematically developed, implemented and evaluated in group-randomised field studies, and this part was restricted to Spain, Norway and the Netherlands.

Assessing Consumption and Determinants

Comprehensive survey instruments assessing fruit and vegetable consumption and psychosocial factors associated with these consumption patterns were developed for both schoolchildren and their parents. Both food frequency items and a 24-hour recall assessment were included in the survey instrument in order to assess fruit and vegetable intake at an individual level as well as at a group level (de Bourdeaudhuij et al., 2005; Haraldsdóttir et al., 2005).

Related to the assessment of determinants systematic literature searches reviewing quantitative and qualitative studies was conducted (Rasmussen et al., in 2006). In addition to this literature study, focus group interviews (Wind et al., 2005 (Chapter 1)) were conducted among schoolchildren. Both the literature studies and the focus group studies were used

as an input for developing questionnaires. Next to the literature review and the focus group interviews, behaviour theory was an important input for the questionnaire development. In line with state-of-the-art health promotion that uses a problem-driven approach (Brug et al., 2005), constructs from different behavioural theories were included in the Pro Children project, to ensure inclusion of potential determinants at the individual, social and environmental level. The development of the theoretical framework for the questionnaire was mainly inspired by Flay's Theory of Triadic Influences (Flay & Petriatis, 1994) and extended with constructs from the 'attitude, social influences, self-efficacy (ASE) model' (de Vries et al. 1988; Kok et al., 1996), and Bandura's Social Cognitive Theory (Bandura, 1997). Flay's Theory of Triadic Influences emphasizes that more distal determinants of fruit and vegetable consumption can be found in the cultural, physical and social environment, and that these in turn influence more proximal personal influences of attitude, social influences and self-efficacy. The value of the ASE-model above the more famous but similar Theory of Planned Behaviour (Ajzen, 1999) is that the ASE-model distinguishes different social influences, of which social support (i.e. active encouragement to engage in healthful behaviour) and the modelling behaviour of significant others were incorporated in the theoretical framework for the Pro Children study. Modelling is also an important concept in Bandura's Social Cognitive Theory, as is the self-efficacy concept, which stresses that confidence in one's abilities to engage in certain behaviour is an important determinant of that behaviour (Bandura, 1997).

The environment, such as home and school availability and accessibility of fruit and vegetables, may more directly influence intake. The role of the environment may be of special relevance for children and adolescents, since they may have only limited food choice autonomy (French et al., 2001). Therefore, special attention was given to inclusion of environmental factors in the theoretical framework used for the Pro Children project.

In the final Pro Children model, four levels of determinants were distinguished. First the most distal demographic determinants, second the physical environmental determinants, third the social environmental determinants and fourth the most proximal personal determinants of fruit and vegetable consumption (Klepp et al., 2005). This framework guided the development of the research instruments (Figure 2).

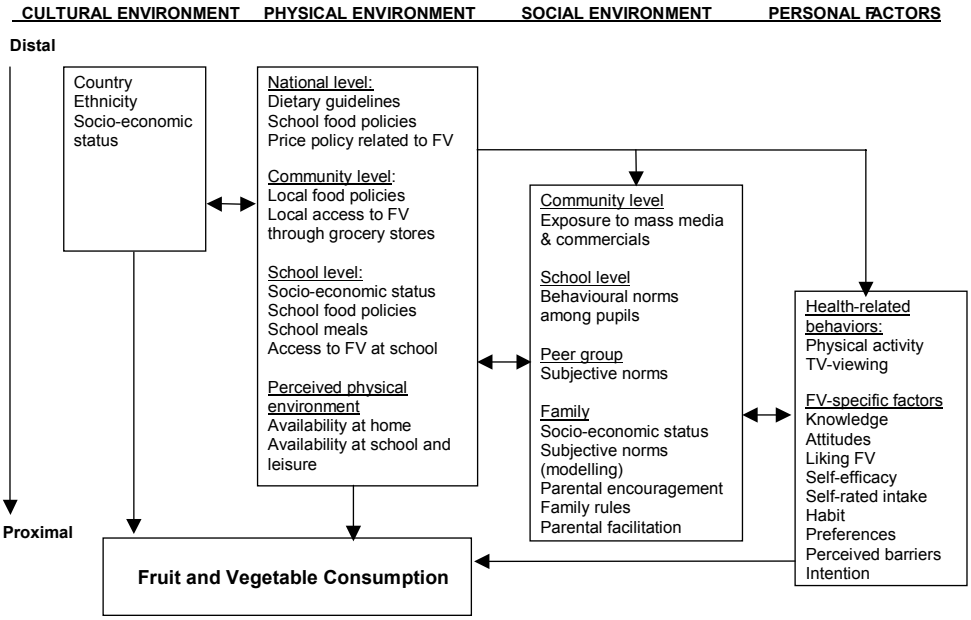


Figure 2 The Pro Children theoretical framework applied to schoolchildren's fruit and vegetable (FV) intake (Klepp et al., 2005)

Validity and reliability of the questionnaire

Three different studies among 10 and 11 year-old schoolchildren were conducted to test the validity and test-retest reliability of both the constructs measuring the frequency of fruit and vegetable intake as well as possible related personal, social and environmental correlates (Haraldsdóttir et al., 2005; De Bourdeaudhuij et al., 2005).

The validity of the food frequency questions was tested in one study in four countries (Denmark, Iceland, Norway, Portugal; n=43-60 per country), using a 7-day food record as a reference method. Reliability of the food frequency questions (7-12 days apart) was tested in another study in six countries (Belgium, Denmark, Iceland, Norway, Portugal, Spain; n=60-74 per country). Both the validity and the reproducibility of the food frequency questions as to ranking of the subjects were regarded to be satisfactory (Haraldsdóttir et al., 2005). Spearman rank correlations for the frequency of fruit and vegetable intake and the 7-day food record ranged from 0.40 to 0.53. About 25 to 50% were classified into the same quartile and 70 to 88% into the

same or adjacent quartile of intake for both instruments. The test-retest Spearman rank correlations ranged from 0.47 to 0.84. Moreover, the food frequency questionnaire was valid for ranking individuals according to their customary intake. However, the average intake, based on the 24-hour recall part, tended to overestimate the actual intake, and the 24-hour recall questions were adapted accordingly (Haraldsdóttir et al., 2005).

A process similar to the intake part of the questionnaire was performed in order to pilot and test the questions assessing factors seen as important determinants of intake according to the Pro Children conceptual framework. A total of 326 children from five European countries (Norway, Spain, Denmark, Portugal, Belgium) participated in the reliability study of the correlates part of the questionnaire, with a one-week interval. Cronbach's alpha values were moderate to high (range 0.52 to 0.89) with the exception of the general self-efficacy scale, which had a value below 0.50 for both fruit (α =0.42) and vegetables (α =0.49).

The test–retest reliability was good to very good (intra-class correlation coefficient >0.60) for 12 of the 15 constructs measuring fruit correlates, and for 12 of the 15 vegetable constructs. For the remaining constructs acceptable intraclass correlations (range from 0.50 to 0.59) were found. The test–retest reliability was comparable across the five participating countries. Only in Portugal some significantly lower intra-class correlation coefficients were found for self-efficacy related to fruit and vegetables compared with the other countries.

It was concluded that the questionnaire was of acceptable reliability and validity for assessing personal, social and environmental correlates of fruit and vegetable intake in 10 to 11 year-old schoolchildren (De Bourdeaudhuij et al., 2005; Haraldsdóttir et al., 2005).

The final questionnaire was used for cross-sectional surveys aiming to measure fruit and vegetable intake and their determinants in children across Europe. Cross-sectional surveys of 11 year-old schoolchildren and their parents were conducted in all nine countries during October and November 2003 among 13.037 schoolchildren. National representative samples of schools were used in each country with the exception of Austria (for Austria, the sample was representative for the eastern region which includes 42% of the Austrian population), and of Belgium (for Belgium, the sample was representative for Flanders, the Dutch-speaking part of Belgium).

Development, implementation and evaluation of Pro Children Intervention Strategies

The focus group studies (Wind et al., 2005 (Chapter 1)) and the literature review (Rasmussen et al., 2006) also formed the basis for the development of the intervention, which was implemented in Norway, the Netherlands and Spain. In order to design theoretically similar interventions in all three countries, an adapted Intervention Mapping protocol (Figure 3; Bartholomew et al., 2001) was applied (Pérez-Rodrigo et al., 2005, Chapter 3).

Intervention Mapping is a stepwise approach to ensure a systematic evidence-based and theory-driven development and implementation of health promotion interventions. Intervention Mapping is especially suitable for steps four and five of the planning model depicted in Figure 1. Health promotion planning models provide guidance on selecting important and changeable personal, social, and environmental determinants related to fruit and vegetable intake, but are less specific regarding how changes should be induced, i.e. how the insights in behavioural risk factors and behavioural determinants should be translated into effective interventions. Intervention Mapping guides the selection of specified intervention goals, the choice of intervention strategies, and the development of intervention tools. It also prepares the adoption, implementation and evaluation of the intervention. Matrices are constructed to facilitate that process. Selected important and changeable personal, social, and environmental determinants and performance objectives are cross-linked to specify the most proximal learning and environmental change objectives. For personal determinants, learning objectives intend to answer the question 'What does the target group need to learn with regard to a specific determinant in order to accomplish the performance objective?' Similarly considering determinants at the family and school level, change objectives need to answer the question: 'What needs to change in the environment to enable the target group to reach the performance objective?' Subsequently, educational strategies, addressing these specific programme objectives, are identified and developed.

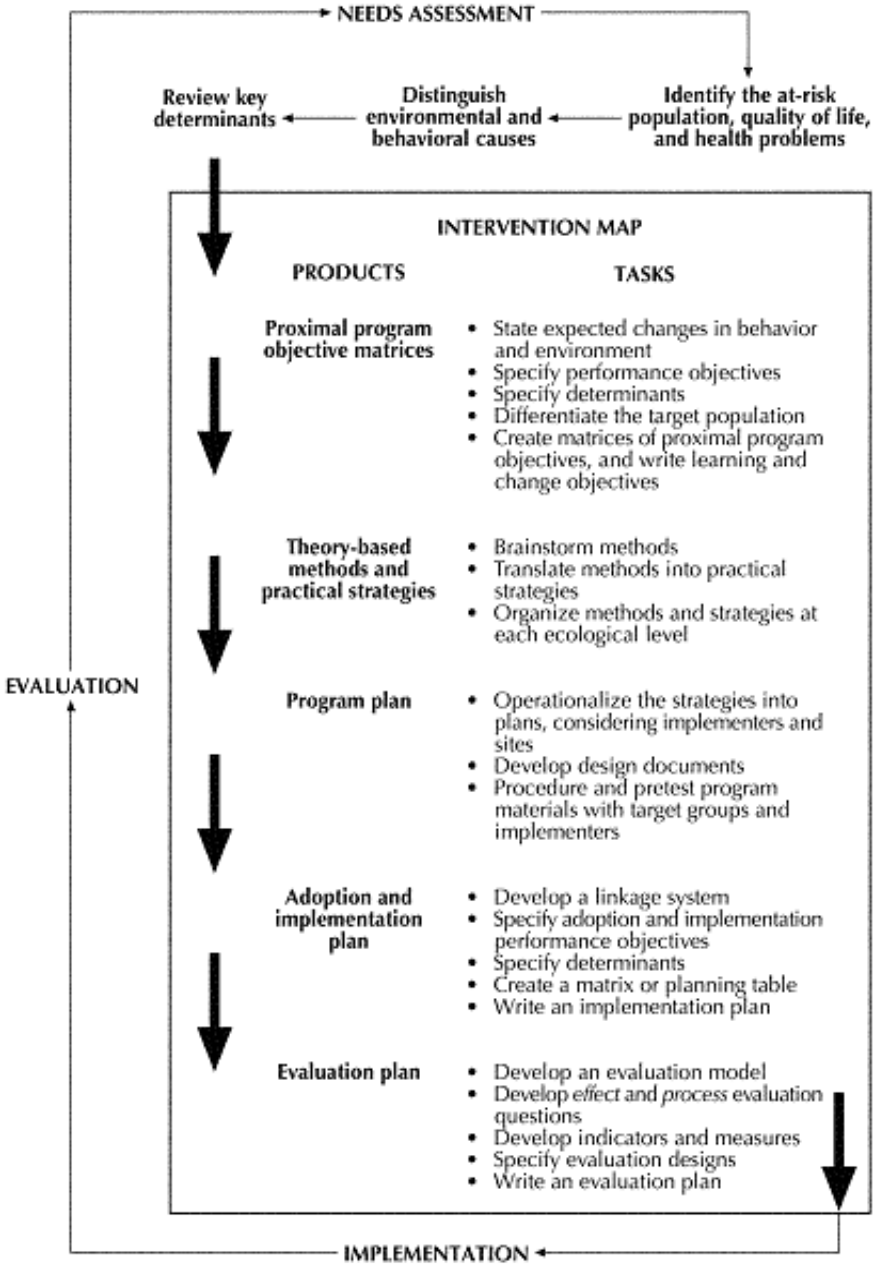


Figure 3 **The Intervention Mapping protocol (Bartholomew et al., 2001)**

The Pro Children intervention was built on the current state-of-the-art within the healthy nutrition promotion tradition. Several elements have been identified as successful key elements of an intervention. Interventions should focus on specific eating behaviours; should be guided by behavioural theory; devote adequate time and intensity; and preferably include changes in the school environment, personalized feedback and parental involvement; and the use of multimedia or web-based tools may be considered (Contento et al., 1995; Hoelscher et al., 2002; Klepp et al., 2005; Blanchette & Brug, 2005; Knai et al., 2006). French & Stables (2003) and van der Horst et al. (in press) reviewed the available literature on the school food environment and concluded that environmental change interventions in schools show potential for positively affecting fruit and vegetable consumption among youth. Thus, it was recommended that environmental strategies be identified to increase the availability of fruit and vegetables and to support their choice by schoolchildren.

The Pro Children intervention

Within the Pro Children project a multi-component intervention was developed that incorporated most of these elements (Pérez-Rodrigo et al., 2005, Chapter 3). The *school curriculum* consisted of worksheets and a web-based computer-tailored feedback tool (Brug et al., 2003). *Parents* were encouraged to be involved in the project by means of their children's homework assignments, parental newsletters and a parent version of the web-based computer-tailored tool that enabled them to get personalized feedback on their own fruit and vegetable intake levels. The school curriculum and educational materials regarding parental involvement were theoretical similar in all three countries, but were adapted to be culturally relevant. During the intervention period, schools were *provided with fruit and ready-to-eat vegetables* that could be consumed during school hours. In Norway a national fruit and vegetable subscription programme already existed (www.skolefrukt.no) and therefore children from both the intervention group and the control group were invited to participate in the subscription programme. In the participating schools, children that subscribe to the programme receive a piece of fruit or a carrot during lunch or during a fruit break each schoolday for which the parents pay a fee. In the Netherlands, children from the intervention schools received a piece of fruit, a carrot or a tomato for free during fruit breaks on two schooldays per week. Additionally, in Spain, children from the intervention schools received fruit for

free during the first two months of the intervention period. Intervention schools further explicitly asked the children to bring fruit from home on schooldays; a special fruit break was implemented in all intervention schools on between one to five schooldays per week. In Spain, where children are able to eat school lunches, fruit was part of the school lunch at both the intervention schools and control schools during one to four schooldays per week, while fruit was part of the school lunch during two or three schooldays per week. The intensive intervention, (as described above) lasted for one school year targeting fifth graders in the Netherlands and Spain (10 to 11-year-olds) and sixth graders in Norway (11 to 12-year-olds). During the subsequent school year, booster activities took place, which mainly consisted of continuation of the distribution of fruit and vegetables.

Evaluation studies

The Pro Children intervention was implemented and evaluated in all three participating countries, i.e. in the Bilbao region, Spain; in Rotterdam, the Netherlands; and in the Buskerud County of Norway.

The evaluation of the Pro Children intervention consisted of two parts. First, an effect study was conducted to assess changes in intake as well as relevant determinants of intake. Second, a process study was conducted investigating several aspects of the implementation of the intervention. Effects of the intervention were examined in a group-randomised trial among 2106 schoolchildren from 62 schools. Schools were randomly allocated to an intervention group or to a delayed intervention group (comparison group). Surveys among all participating children and their parents were conducted prior to the initiation of the intervention (September 2003; month 0), immediately after the end of the intensive intervention (at month 8) and at the end of the subsequent school year (month 20). The primary objective of the Pro Children intervention study was to increase fruit and vegetable intake by 20% in the intervention schools compared to control schools. Secondary targets were improvements in key determinants of schoolchildren's fruit and vegetable intake.

In addition to the outcome evaluation, an extensive process evaluation was conducted as part of the Pro Children intervention study. The process evaluation included monitoring of the intervention delivery and perceived satisfaction and evaluation of the intervention by schoolchildren, their parents, and schoolteachers. A thorough understanding of how the intervention was

implemented and perceived by the involved participants is critical in order to guide the interpretation of observed outcome data, including relating outcome to intervention exposure (quantity and quality). Such information was expected to be critical with respect to successful revisions and potential large-scale dissemination of the final Pro Children intervention programme.

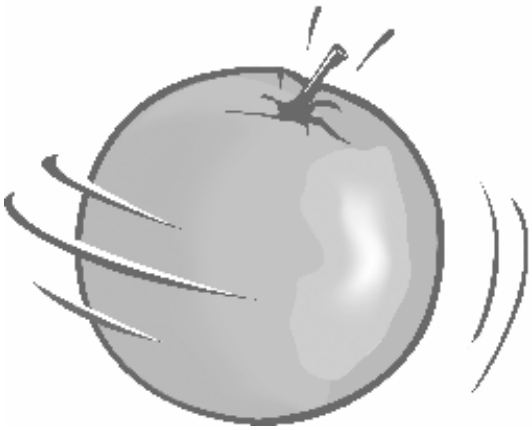
Overview of this thesis

The first part of this thesis describes determinants of fruit and vegetable intake among Belgian-Flemish and Dutch 11-year-old schoolchildren, i.e. the Dutch-speaking countries within the Pro Children project. Chapter 1 presents the results of the qualitative focus group interviews among 92 schoolchildren. Chapter 2 describes the results of the quantitative cross-sectional surveys, again only for Belgian-Flanders and the Netherlands.

In the second part of the thesis the development of the Pro Children intervention, guided by the Intervention Mapping protocol is presented in Chapter 3.

The third part of the thesis deals with both the effect and process evaluation of the intensive intervention in Norway, Spain and the Netherlands. Chapter 4 presents the short-term effects immediately after the implementation of the intensive intervention, while the long-term effects (one year after the implementation of the intensive intervention) are described in Chapter 5. In Chapter 6 associations between four intervention characteristics (i.e. quantity and quality of the implementation of the school curriculum, parental involvement, changes in weekly frequency of intervention-induced distribution of fruit and vegetables, and the children's appreciation of the intervention) and changes in intake on the short-term are assessed in children who were exposed to the Pro Children intervention. Finally, Chapter 7 provides a summary of the main findings of this thesis, and recommendations for further research and practice.

Part 1



Determinants of schoolchildren's fruit and vegetable intake

Chapter 1

A qualitative exploration of determinants of fruit and vegetable intake among 10 and 11 year-old schoolchildren in the Low Countries

Abstract

For the development of fruit and vegetable promotion interventions, insight is needed into determinants of health behaviour. This study presents results of focus group interviews held with 10 to 11 year-old schoolchildren from Ghent (Belgium-Flanders) and Rotterdam (the Netherlands) to explore personal beliefs and motivations and environmental factors related to schoolchildren's fruit and vegetable intake, to inform the Pro Children intervention development. Twelve focus groups were held with 92 schoolchildren. The interviews were recorded and transcribed and NVivo was used to analyse the transcripts.

Positive health beliefs, taste preferences, lack of knowledge and practical barriers were identified as personal factors related to fruit and vegetable intake. Home and school availability of fruits and vegetables, as well as parenting practices were identified as important environmental factors. A fruit and vegetable promotion intervention should aim to increase fruit and vegetable accessibility and should include educational and motivational activities tailored to these personal and environmental factors. These indications should be further evaluated in quantitative research among representative samples.

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Introduction

The 'Pro Children' study aims to systematically develop and test evidence- and theory-based strategies to promote adequate consumption levels of fruit and vegetable among primary schoolchildren across Europe (Klepp et al., 2005). Intervention development and evaluation of the Pro Children study was therefore informed by the Intervention Mapping protocol (Bartholomew et al., 2001). According to Intervention Mapping as well as other health promotion planning models like the Precede-Proceed model (Green & Kreuter, 1999), a first essential step in intervention development is to gain insight into important and changeable determinants of the target behaviour. Such knowledge about behavioural determinants helps to identify specific learning and performance objectives for the intervention, and interventions should be tailored to these determinants to improve the chance for effects (Bartholomew et al., 2001; Green & Kreuter, 1999). To explore and describe determinants of health behaviour, several methods are appropriate, such as problem-driven and theory-driven literature searches and original qualitative and quantitative research (Bartholomew et al., 2001). If a certain issue has already extensively been researched, exploring the relevant literature may be sufficient to identify the most relevant determinants. However, hardly any studies on important and changeable determinants of fruit and vegetable intake in 10- to 11-year-old children have been conducted in most European countries, including Belgium and the Netherlands (Gibson et al., 1998; Bere & Klepp, 2004; Roos et al., 2001; Pérez-Rodrigo et al., 2003; Martens et al., 2005a; Osler et al., 1993). In such cases, explorative, qualitative methods are most appropriate to start a determinants study. An example of a useful qualitative research method is the focus group interview, which is an effective technique to investigate eating behaviour (Cullen et al., 2000; Baranowski et al., 1993; Bauer et al., 2004)

We applied focus group interviews among fifth and sixth-grade primary schoolchildren in Ghent (Belgium-Flanders) and Rotterdam (the Netherlands) as part of the stepwise development of the Pro Children Project. The purpose of this study was to identify personal beliefs and motivations as well as possible environmental factors that are related to schoolchildren's fruit and vegetable intake. Special attention was given to differences in potential determinants according to gender, ethnicity and country.

Methods

A focus group is a small group of people who, led by a moderator, discuss several topics concerning a specific subject in which a research team is interested. To ensure that all participants will join in, the group should not be larger than eight to ten participants (Morgan & Krueger, 1998; Vaugh et al., 1996). When younger children are involved, groups should preferably be somewhat smaller, since children may be less familiar with expressing their opinion in a group setting. The moderator's task is to encourage the exchange of ideas and opinions, to ensure that the interview discussions stay focused on the interview topic, but to intervene as little as possible (Morgan & Krueger, 1998; Vaugh et al., 1996). As suggested by Morgan & Krueger (1998) and others (Baranowski et al., 1993; Vaugh et al., 1996; Kidd & Parshall, 2000; Morrison-Beedy et al., 2001), we composed an interview guide to facilitate the focus groups. Development of the guide was based on findings from literature reviews (Baranowski et al., 2003) and recent original qualitative studies (Cullen et al., 2000; Baranowski et al., 1993; Bauer et al., 2004) investigating determinants of schoolchildren's fruit and vegetable intake in countries outside Europe. The guide was reviewed by different experts on nutrition and health education from the Pro Children consortium and further enriched based on their comments.

Ethical approval for the Pro Children study was obtained from medical ethical committees in both countries, and schools provided informed consent and full cooperation. Before the start of the interviews, the children were told that their names would remain anonymous.

During the interviews, questions to explore determinants of fruit and vegetable consumption were asked separately, since it was expected that schoolchildren, in line with adults (Brug et al., 1995) may have different motivations for eating fruit and vegetables. Many psychosocial theories, such as the Health Belief Model and the Theory of Planned Behaviour (see for example Glanz et al. (2002) and Conner and Norman (1996) for good overviews) are often applied to investigate health behaviour and the individual behavioural determinants, such as attitudes, subjective norms, perceived control, personal risk perceptions and motivation to change behaviour. Recently, more attention has been paid to social ecological models that emphasize the importance of ecological determinants (i.e. the physical or social environment) (Baranowski et al., 2003).

Earlier research indicated that personal factors may account for only a small percentage of the variability in children's fruit and vegetable intake (Baranowski et al., 1999) and several studies have shown the importance of environmental determinants in shaping eating habits of schoolchildren (Bere & Klepp, 2004; Story et al., 2002; Kratt et al., 2000). Therefore, possible personal factors (such as attitudes, outcome expectations, perceived barriers, taste preferences, estimation of own intake, skills and knowledge), as well as possible environmental factors (such as availability and accessibility, peer and parental influences) were discussed during the interviews. Because eating behaviour is complex and difficult to explain and change, Baranowski et al. (1997; 1999) suggested to explain situational fruit and vegetable intake, and not fruit and vegetable intake in general. Because schoolchildren spend a large proportion of the day at school and at home, we included separate questions to identify personal and environmental factors of fruit and vegetable intake in the school and home situation.

Participants

Twelve focus group interviews were conducted with a total of 92 schoolchildren living in Belgium-Flanders or the Netherlands. In both countries, a convenience sample of schools was selected. In *the Netherlands,* eight focus group interviews were carried out at three different schools in the city of Rotterdam. In total, 60 schoolchildren were interviewed (29 boys and 31 girls). Of the eight groups, two groups consisted only of boys, one only of girls and the remaining groups were of mixed gender. Most groups consisted of seven or eight schoolchildren (range five tot ten children) and all were 10 or 11 years old. Reflecting the cultural diversity of the inhabitants of Rotterdam, almost all schoolchildren who participated in the first five interviews were from cultural and ethnic minority groups and had at least one parent who was born in a foreign country (i.e. Turkey, Morocco, Surinam, Pakistan, Yugoslavia, Bosnia, the Netherlands Antilles, the Dominican Republic and Ghana). For this reason, three more focus group interviews were conducted at a third school. With the exception of one child, all the children at this school had both parents born in the Netherlands.

In *Belgium-Flanders,* four focus group interviews were performed in the city of Ghent. In total, 32 schoolchildren took part in the interviews (16 boys and 16 girls). One group consisted only of boys, one only of girls and the remaining groups were of mixed gender. All groups consisted of eight

schoolchildren and all were 10 or 11 years old. Only four schoolchildren had parents born in a foreign country (i.e. Spain, Turkey and Morocco). Both in Belgium-Flanders and the Netherlands, all schoolchildren were fifth and sixth graders.

Procedure

Because of small differences in language and dialect between Belgium-Flanders and the Netherlands, a native speaker researcher led the interviews in each country. In both countries, an assistant was present to take notes, to notice non-verbal behaviour during the interviews and to monitor the process. To make the schoolchildren feel more comfortable, they first had to introduce themselves and name their favourite kind of fruit and vegetable. After discussing all possible determinants of schoolchildren's fruit and vegetable intake, a piece of fruit and a can of fruit juice were handed out to the schoolchildren as a reward for participation. Each interview took about 45–60 min and was tape-recorded.

Analyses

After each interview, the moderator and assistant discussed the interview and relevant non-verbal behaviour. After all the interviews had been conducted, transcripts were made. M.W. did the first analyses of the transcripts using NVivo (version 1.3). Possible determinants were analysed separately for fruit and vegetable intake. For both fruit and vegetable intake, a further initial distinction was made between personal factors, factors related to the school environment and factors related to the home environment. This distinction was based on the literature study that formed the basis for the interview guide. Furthermore, during analyses special attention was given to differences in potential determinants according to gender, ethnicity or country. K.B. did a secondary analysis of all transcripts and results. If the researchers had made different interpretations, J.B. was asked to judge the data and the interpretation was discussed until consensus was reached.

Results

The results are presented according to the aforementioned distinction between personal and environmental determinants. In the description of the results, we include quotes from the interviews in parentheses to illustrate certain factors.

Personal Factors

Health Beliefs

Expecting positive health outcomes from, or prescribing positive attributes to eating fruit and vegetable was mentioned most often as a reason to eat fruit and vegetable. Most participants knew fruit and vegetable are healthy and contain vitamins, and they are supposed to 'make you strong' ('I eat fruit and vegetable because it is good for your body. It contains vitamin C.').

Taste Preferences

Besides health aspects, taste preferences were often mentioned as a factor related to eating fruit and vegetable. Many participants said they did (not) eat fruit and vegetable simply because they (did not) like them. Most participants seemed to prefer fruit to vegetables. Some vegetables were considered too bitter ('I don't like vegetables, they are often too bitter. Only grown-up's like that.'). Vegetable juices were also less popular than fruit juices, because they were considered less tasty. Only a few participants said they sometimes drunk tomato juice or carrot juice, while fruit juices were very popular among the participants.

Knowledge

To assess knowledge of fruit and vegetable, we asked participants to mention examples of fruit, fruit juices and vegetables. It seemed that children from ethnic minorities were more familiar with 'exotic' fruits and vegetables like mango, pineapple or squash.

Knowledge about fruit juices was often incorrect, especially in the Netherlands. Several of the participants thought that all kinds of soft drinks, lemonades, fruit yoghurt, milk shakes or even fruit tea could be defined as fruit juice.

We also asked whether children were familiar with the national guidelines for recommended intake. Dutch participants seemed to be more aware of the recommended daily intake for fruit compared to the Flemish participants. In both Belgium-Flanders and the Netherlands, most participants were not familiar with national guidelines for vegetable intake ('I think two tablespoons of vegetables each day is enough.').

Awareness

When asking participants whether they thought they ate enough fruit and vegetable themselves, almost all participants thought they did. However, when asking them whether they ate fruit and vegetable every day, hardly anybody actually said that they did so.

Personal Barriers

Several personal barriers were mentioned. Many participants said it was not common to eat fruit and vegetable during leisure time activities, because they forgot to take them with them, they just wanted to play, or they were too busy to remember to eat fruit ('My mother often forgets to put fruit in my bag, sometimes I remember. But I often forget to do that too'.). Fruit getting squashed in the (school) bag was also mentioned as a reason for not eating fruit ('I don't take fruit with me in my bag. I throw my bag around and then it gets squashed.'). Participants seemed to be quite choosy when it comes to eating fruit. Besides taste, the appearance of fruit was considered important. Some participants said they did not want to eat fruit when, for example, it contained seeds, when it was too hard, too sweet, too sour or too bitter ('When I eat an apple, I only eat the middle of it, I do not like the peel.'). Finally, many participants mentioned that sweets were competitors for eating fruit and vegetable ('I am allowed to take candies or cookies with me. I prefer those.').

Factors Related to the School Environment

Availability

About half of the participants ate lunch at school; the other half went home for lunch, at least on most schooldays. In the Flemish schools, children could get soup and/or a hot meal at school, whereas in the Netherlands this was uncommon. School food was usually not available at Dutch schools. Dutch children who stayed at school during the lunch break had to bring their lunches from home. Although in both countries parents often prepared their children's lunchboxes, most children also had a say when it comes to preparing the lunch. In both countries, many children said they usually did not take fruit with them to school; bringing vegetables to school was even less common.

Peer Influences

Although many participants seemed to be convinced that other children did not influence their fruit and vegetable intake, some indirect influence by peers could be detected. Peer influence may be especially strong on behaviours that may compete with fruit and vegetable intake, such as eating candies ('I do feel like eating candy when I see somebody eating sweets, but I do not feel the urge to eat an apple when I see somebody eating an apple.').

Social Norms

Eating fruit at school was perceived as 'normal' by most children. Participants who did not eat fruit at school themselves did not find it strange that other children ate fruit at school. Only when it comes to birthdays or other celebrations, social norms tended to steer children away from eating fruit ('When it is somebody's birthday, you do not serve fruit.'; 'Nobody likes that, children want to eat candy when it is a party.'). Serving vegetables was considered to be a rather unusual and certainly not a preferred thing to do at such occasions ('You eat vegetables during dinner, not at school.'). However, among participants from minority groups, it seemed to be more common to eat raw vegetables during school hours ('Sometimes my mother prepares a sandwich with lettuce and tomato for me to take to school.').

School Food Policies

Most participating children were not aware of school food policies, such as rules about foods that cannot be used for birthday treats at school. When school food policies were known, the children indicated that neither they nor their parents complied with these rules. Influences from teachers were perceived as marginal. According to the participating children, their teachers rarely encouraged them to eat fruit and vegetable during breaks or when celebrating birthdays.

Factors Related to the Home Environment

Family Influences

Children reported that their parents seemed to have a lot of influence on their fruit and vegetable intake. According to the participants, their parents often decided whether and what vegetables would be served for dinner and what their child would eat at school ('At my father's place, we just have to eat what he prepares.').

Children shared the opinion that their parents were responsible for buying fruits and vegetables. But, according to most participants, the parents took into account their preference when purchasing fruits and vegetables.

Some children went shopping themselves instead of asking for the kind of fruits or vegetables they wanted. When children went shopping on their own, they did not use their pocket money, since that was reserved for sweets, games and such.

These interviews gave the impression that children from ethnic minority groups went shopping on their own more often and seemed to be more inclined to buy fruit themselves ('When I feel like eating grapes, I just go to the supermarket myself.'). Nevertheless, most of these children also preferred to spend their money for other purposes than eating fruit or vegetables.

Availability and Accessibility

Dutch participants reported that vegetables were often not available at home, whereas according to the Flemish participants vegetables were often available. Fruit seemed to be unavailable during part of the week both in the Netherlands and in Belgium-Flanders ('Every Saturday my parents go to the market, so on Friday sometimes there is no fruit left.'). When fruit was available at home, it was often stored in a visible place such as on a fruit bowl on the table. According to participants from ethnic minorities, it was more common to put a fruit bowl on the table when other family members were visiting them.

Most Dutch participants were allowed to take fruit themselves whenever they wanted. Only when participants tended to eat 'too much fruit', parents sometimes interfered. In Belgium-Flanders, participants more often had to ask whether they could take fruit ('When I am at my father's place I have to ask, when I am at my mother's I can just take it myself.'). Taking and eating vegetables without asking was uncommon for participants in both countries.

Vegetables were typically eaten at dinner in both the Netherlands and Belgium-Flanders where it is common to eat one hot meal per day that traditionally includes vegetables (De Bourdeaudhuij, 1997a). Therefore, not having vegetables for dinner was often mentioned as an important reason for not eating vegetables during that day. Eating vegetables during other meals or in between meals seemed to be quite unusual. Only a few participants, mainly from minority groups, said they sometimes ate a piece of cucumber, carrot or a tomato as a snack in between meals.

Eating fruit throughout the day was more common ('I eat fruit when I feel like it.'). Nevertheless, most participants did not eat fruit at school, but rather at home after school, since they did not want to take fruit to school because it tends to get squashed in the schoolbag. Orange juice typically belonged to breakfast according to some participants, and is thus not something to drink during the rest of the day ('Every morning I drink a glass of orange juice. That always is part of my breakfast.').

Some participants said they more often ate fruit during the weekends than on schooldays, because they had more time and there was more fresh fruit available at home than at school. Others ate less fruit over the weekends because they were too busy doing other things and did not remember to eat fruit.

Vegetables were less often part of the dinner during weekends, because it was more common to eat take-away food or eat out then ('During the week we eat something like broccoli, but during the weekend we eat French fries.').

Food Rules

Since many of the participants appreciated vegetables less than fruit, some parents applied rules, such as demanding that their child eat some vegetables. However, the children often got away with it, because several participants reported that they were allowed to dish up their own vegetables and would take small helpings ('I have to eat all my veggies, but I can dish up my own plate. It doesn't matter how much I take.'). A few participants mentioned they had to at least taste the vegetables. In some families, children were punished when not eating their vegetables (e.g. no dessert, no television) or they got rewarded when finishing them. This seemed to stimulate the participants to finish their dinner ('When we eat something I don't like, I have to finish it, otherwise I am not allowed to leave the table. So I finish my plate.').

Encouragement

According to the participating children, some parents actively encouraged them to eat fruit and vegetable, either by saying they have to eat fruit and vegetable or by preparing fruit as a snack and vegetables for dinner ('My mother says it is healthy.'). Eating vegetables in between meals was more unusual than eating fruit as a snack, and therefore parents seemed to pay less attention to eating vegetables. However, many participants did not experience parental encourage-

ment to eat fruit either.

Especially when participants do not like fruit, it seemed fruit should be made as accessible as possible ('When my mother does not tell me, it sometimes happens that I do not eat fruit for a week.').

In Belgium-Flanders, participants said they were often not allowed to cut vegetables themselves or to help preparing dinner, but they could prepare fruit (e.g. fruit salad, fruit shake). In the Netherlands, on the other hand, many participants were allowed to and liked to prepare fruit as well as vegetable dishes. The participants especially liked to prepare fruit salads or mixed fruit juices, desserts or fruitcake. The Dutch interviews also gave the impression that participants from minorities prepared dinner themselves more often.

Discussion

The results from this study suggest the relevance of personal determinants related to schoolchildren's fruit and vegetable intake. Taste preferences for specific kinds of fruit and vegetable and having a positive health belief related to eating fruit and vegetable were mentioned most often. Other personal factors that seem to influence intake were perceived barriers, i.e. forgetting to eat fruit and vegetable, a stronger preference for competing foods such as sweets, being choosy when it comes to fruit and inadequate knowledge of recommended daily intake levels. Not knowing the recommended daily intake levels might lead to an overestimation of own fruit and vegetable intake. Although we conducted part of our focus group interviews in separate gender groups, we did not uncover indications of strong differences in determinants between boys and girls.

From quantitative studies it is known that many children aged 10–13 years do not meet the recommendations for fruit and vegetable intake (Vereecken & Maes, 2000), while other studies have shown that adolescents (Kremers et al., 2003) as well as adults (Bogers et al., 2004) overestimate the adequacy of their intake levels. Our study provides some indication that this also applies to younger children.

In both the school and home environment, availability of fruit and vegetable seems to influence intake of these foods by schoolchildren. At Belgian-Flemish and Dutch primary schools, there is no or hardly any food available. In Belgium-Flanders, fruit is available only in 14% of the primary schools (Vereecken et al., 2005). In both countries, most schoolchildren who eat

lunch at school bring their own lunchbox that is often prepared by their parents. Yet, parents seem to take their child's preferences into account when preparing their lunchbox. Unfortunately, parents often forget to give their child fruit or vegetables when going to school, or the schoolchildren themselves prefer to take other food with them.

Children do not seem to be aware of any enforced school food policies. They are allowed to bring other food items, such as cakes, cookies, bread or candies with them to school; because of this, many participants do not eat fruit at school. In the Netherlands, formulating a school health policy is obligatory, but the school itself can determine the content of the policy by deciding which health topics will be addressed (Pijpers et al., 1999) In Belgium-Flanders, most primary schools have written rules, but only to restrict intake of savoury snacks and sweet snacks (Vereecken et al., 2004).

At school, social norms and peer influences only seem to play a role when treats are provided at birthdays. Based on what the children say, in this age group parents influence schoolchildren's intake of fruit and vegetable more than peers do. Parents are often responsible for buying and preparing fruit and vegetable and for making them more available and accessible at home. In some families, parents are also quite active in encouraging their children to eat fruit and vegetable by preparing these for their children or by applying food rules.

Preferences, health beliefs and home and parental practices were also identified as the major influences in earlier qualitative and quantitative studies. Baranowski et al. (1993) identified home availability and affect as major influences on fruit and vegetable intake. In that study, affect was described as combining two factors: preferences and expectancies (knowing that it is good for you). Baranowski et al. (1993) identified skills as a third main determinant. In our study, we did not obtain detailed information on specific skills, such as asking parents to buy or prepare special kinds of fruits and vegetables. However, the interviews did indicate that 'asking skills' could be a relevant factor for children in order to encourage their parents to make fruits and vegetables more readily available. Bauer et al. (2004) also indicated the importance of addressing environmental factors to promote healthy eating habits in adolescents.

Focus groups enable the collection of extensive and valuable information in a relatively short period of time. Group interactions and observing non-verbal communication helps researchers to stimulate discussions and to uncover in-

depth data (Morgan & Krueger, 1998). However, focus groups do not provide hard evidence on the relative importance of potential behavioural determinants, nor do they provide a representative picture of important behavioural influences. Furthermore, some children may not be used to such discussions and dominant or shy children could hinder the process of the focus groups or bias the outcomes (Vaugh et al., 1996).

Nevertheless, qualitative data as derived from focus groups can provide useful information when designing a school-based intervention. Asking schoolchildren themselves to describe their views and thoughts in their own words enables intervention developers to target the intervention to the needs of schoolchildren. Young people's views should be the starting point for any future efforts to promote healthy eating (Shepherd et al., 2001).

Due to small language differences between Belgium-Flanders and the Netherlands, two moderators guided the interviews. Differences in experience and interviewing style may have affected the flow and content of the interviews (Kidd & Parshall, 2000). However, both moderators communicated regularly and used a well-structured interview guide. Although this interview guide may have reduced a possible moderator bias, it also somewhat restricted the openness of the discussion among the children, which may have prevented more unexpected determinants from being detected. However, focus groups are most effective when these are at least somewhat structured and when specific questions are formulated (Baranowski et al., 1993; Morgan & Krueger, 1998; Morrison-Beedy et al., 2001) We conducted a standard analysis procedure, with one researcher doing the primary analyses and a second researcher doing the checking of transcripts and a second analysis, in order to optimise the reliability and validity of the outcomes (Kidd & Parshall, 2000; Morrison-Beedy et al., 2001)

As a consequence of selecting schools at random in only two cities, the results of this study might not be generally representative. Fruit and vegetable intake between boys and girls does differ (Vereecken & Maes, 2000; Voedingscentrum, 1998); however, we did not uncover strong differences in potential determinants between boys and girls. We found only small differences between participants from both countries and ethnic minority groups. Therefore, quantitative survey research, preferably with a longitudinal design, as well as evaluations of interventions that address these factors are needed to further verify the relationship between the personal and environmental determinants we explored and schoolchildren's fruit and vegetable intake (Baranowski et al.,

1999). Such research methods would allow more solid conclusions to be drawn regarding differences in determinants according to gender, ethnicity or country. This is indeed what is being carried out within the Pro Children study, with a cross-national survey among more than 13.000 European schoolchildren and their parents and intervention studies in 3 European countries (Klepp et al., 2005). To conduct such a quantitative study and to evaluate effects of the intervention, valid and reliable assessment instruments are crucial. The results of this study have therefore also been used as input for the development of a questionnaire to assess schoolchildren's fruit and vegetable intake and its determinants (De Bourdeaudhuij et al., 2005).

To increase the likelihood of behaviour change, an intervention should be tailored to mediators (Baranowski et al., 1997; 1999). Nowadays, the health promotion literature emphasizes the inclusion of environmental changes in interventions in order to make 'the healthy choice, the easy choice', especially related to obesity prevention (Booth et al., 2001) and fruit and vegetable intake in youth (French & Stables, 2003). Our findings indicate the need to design an intervention that is tailored to personal as well as environmental determinants. Similar to other studies, our study also showed that taste preferences (Bere & Klepp, 2004; Cullen et al., 2003) and increasing availability in the home (Kratt et al., 2000; Cullen et al., 2003) are important determinants that should be addressed.

The present study indicates that fruit and vegetable promotion in children should focus on improving availability of fruits and vegetables and on improving fruit- and vegetable-related health beliefs and references. To improve home availability parents should be involved since they have primary responsibility for buying and preparing fruit and vegetable. This could either be done directly by means of an intervention or indirectly by teaching children specific asking skills. Baranowski et al. (1997) suggest developing separate interventions aimed at behaviour change in separate situations. The present study suggests that vegetable promotion for 10 to 11-year-old children in the Low Countries should primarily be aimed at parents in order to improve vegetable availability at home and to encourage them to promote vegetable preferences.

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Chapter 2

Correlates of fruit and vegetable consumption among 11 year-old Belgian-Flemish and Dutch Schoolchildren

Abstract

The objective was to determine factors associated with the consumption of fruit and vegetables among 11-year-old schoolchildren in Belgium-Flanders and the Netherlands. In total 2468 schoolchildren from 98 randomly selected schools participated in a cross-sectional survey. Frequency of fruit and vegetable intake and potential personal, social and environmental correlates were measured by means of self-administered school-based written questionnaires. Hierarchical multiple regression analyses were conducted to assess potential correlates of schoolchildren's fruit and vegetable consumption. Separate analyses for boys and girls were conducted. Bringing fruit to school, modelling behaviour of parents and friends, parents demanding that their child eats fruit, knowledge about recommended daily intake levels, liking fruit and self-efficacy to eat fruit were the strongest correlates of fruit intake. For vegetables gender, parental demand, parents facilitating to eat vegetables by cutting them for their child, modelling behaviour of parents and friends and preferences for vegetables emerged as strongest correlates. No substantial differences in significant correlates were found according to gender. The percentage of explained variance was 33.7% for fruit and 28.4% for vegetable intake. Interventions need to be focused on personal (taste preferences), social (parental influences) and environmental factors (availability).

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Introduction

In many European countries fruit and vegetable intake among children and adolescents is lower than recommended. Mean intake of fruit and vegetables among 11 year-old schoolchildren in nine European countries was 141 grams of fruit and 86 grams of vegetables, which is 57% of the recommended daily intake levels of the World Cancer Research Fund (Yngve et al., 2005; WHO, 2003). In some countries fruit and vegetable intake levels have decreased in the last decades, especially in children. Between 1993/1994 and 1997/1998 the reported frequency of fruit and vegetable intake decreased in about two thirds of the 29 European countries that participated in the Health Behaviour in School-Aged Children (HBSC) study (Vereecken & Maes, 2000). Evidence from the Dutch National Food Consumption Surveys shows that this decrease was especially apparent in the Netherlands (Voedingscentrum, 1998).

Epidemiological evidence for an association of adequate intake of fruits and vegetables with decreased risk for cardiovascular diseases including obesity, hypertension and type 2 diabetes mellitus is convincing (Van Duyn & Pivonka, 2000). Although a recent study suggests a less important role of fruit and vegetable intake in relation to the prevention of cancer (Hung et al., 2004), improving the intake of fruit and vegetables remains an important public health challenge.

Some studies suggest that eating habits of children are maintained into adulthood (Kelder et al., 1994; Lien et al., 2001; Mikillä et al., 2004). Moreover, it has been suggested that food preferences may be easier to modify during childhood than during adulthood (Birch, 1999). Thus, children are an important target group for interventions aimed at increasing fruit and vegetable intake.

The Pro Children study was designed to promote intake of fruit and vegetables among European schoolchildren. The main objective of the Pro Children study was to develop, implement and evaluate intervention strategies to promote intake of fruit and vegetables in European schoolchildren (Klepp et al., 2005). In order to design such effective intervention strategies, insight into possible mediators or correlates of fruit and vegetable intake of schoolchildren is needed (Baranowski et al., 1997; Reynolds et al., 2002). A recent review showed that few studies have investigated comprehensive models of possible correlates of fruit and vegetable intake of European schoolchildren and adolescents, including Belgium-Flanders and the Netherlands. Most studies were

conducted in the US (Bere & Klepp, 2004; Gibson et al., 1998; Lien et al., 2002; Martens et al., 2005a; Osler et al., 1993; Pérez-Rodrigo et al., 2003; Roos et al., 2001) and availability and accessibility, parental behaviour, peer influences, television viewing/advertisement and access to school snack, taste preferences, outcome expectations, self-efficacy and skills, and knowledge were most often examined as possible determinants of intake (Blanchette & Brug, 2005). To ensure inclusion of potential and relevant determinants of fruit and vegetable intake, a problem-driven and theory-driven approach was chosen. The development of the theoretical framework for the questionnaire was mainly inspired by Flay's Theory of Triadic Influences (Flay & Petriatis, 1994) and extended with constructs from the 'attitude, social influences, self-efficacy (ASE) model' (Kok et al., 1996), and Bandura's Social Cognitive Theory (Bandura, 1997). Flay's Theory of Triadic Influences emphasizes that more distal determinants of fruit and vegetable consumption can be found in the cultural, the physical and the social environment, and that these in turn influence more proximal personal influences of attitude, social influences and self-efficacy. The ASE-model distinguishes different social influences, of which social support (i.e. active encouragement to engage in healthful behaviour) and modelling behaviour of significant others were incorporated in the theoretical framework. According to Flay's Theory perceived behaviour of others (modelling) is viewed as a distal social-environmental determinant of behaviour. Modelling is also an important concept in Bandura's Social Cognitive Theory, as is the self-efficacy concept, which stresses that behaviour is a result of interaction between the environment or situation and the person and the person's behaviour (Bandura, 1997). The role of the environment is also more recognized in the social ecological perspectives on behaviour, as shown by French and colleagues (2001). Especially for children, environmental factors such as fruit and vegetable availability may more directly influence their intake. Therefore, environmental determinants of behaviour were also included in theoretical framework used for the Pro Children study. In the final Pro Children model (Figure 2, page 7) four levels of determinants were distinguished. First the most distal demographic determinants, second physical environmental determinants, third the social environmental determinants and fourth the most proximal personal determinants of fruit and vegetable consumption (Klepp et al., 2005).

Insight into important and changeable correlates is needed in order to tailor interventions. The aim of the present study was to quantitatively test

personal, social and physical environmental correlates of 11-year-old schoolchildren's fruit and vegetable intake. As a first step to gain insight into possible relevant determinants of children's fruit and vegetable intake qualitative studies were held (Wind et al., 2005). The results of this qualitative exploration were combined with the results of a systematic review (Rasmussen et al., 2006) to inform the development of questionnaires to quantitatively assess possible determinants of intakes (De Bourdeaudhuij et al., 2005). In an earlier paper Sandvik and colleagues (Sandvik et al., 2005) presented descriptive statistics on the possible determinants that were included in the Pro Children cross-sectional survey study and differences in these variables between the nine Pro Children countries.

In the present study for the first time, the strength of the associations between the presumed correlates and intake levels of children in both countries were tested, to study if these variables are indeed related to fruit and vegetable intakes. To our knowledge this is the first study among primary schoolchildren testing associations of a broad range of potential determinants of children's fruit and vegetable intake and to verify results found in the qualitative study among children in both Dutch-speaking countries within the Pro Children study. Additionally, special attention was paid to differences in potential correlates according to gender.

Methods

Design and sample

Data were collected by means of a self-administered written questionnaire among 11-year-old schoolchildren during October and November 2003. Children completed their questionnaire in the classroom during school hours and were supervised by the teachers, who had received instructions from the research centres (Klepp et al., 2005). To achieve representative samples, schools were randomly selected in both countries. In total 2468 schoolchildren from 98 schools (49 in both countries) participated in this study. Participation rate among the schools was 45.2% and the response rate among children in participating schools was 82.6%.

Schools were approached by telephone, and school officials who indicated that they did not want to participate were asked for a reason for non-participation. Already participating in other research projects was mentioned

most often as reason not to participate in this project. In the Netherlands, lack of time was mentioned as a second important reason not to participate.

Twenty child questionnaires were excluded from the analyses, because of missing gender (n=9), no consent from parents (n=4), the questionnaire was considered not to be reliable (n=2) or the questionnaire was returned but not completed (n=5). Ethical approval for the Pro Children study was obtained from the medical ethical committees in both countries, and schools provided informed consent and full cooperation. Responses were treated anonymously and respondents were told that their responses were confidential.

The mean age of the population was 11.6 years (range 10.3 to 13.8; SD=0.48). Participants were equally divided by gender and country. Demographic characteristics of the sample are given in Table 2.1.1.

Table2.1.1 Demographic characteristics of the survey sample (%)

Study sample (n=2448)		%	Mean (SD)
Demographics			
Country			
	Belgium-Flanders	54.9	
	The Netherlands	45.1	
Gender			
	Boys	50.6	
	Girls	49.4	
Age (years)			
	<11	6.9	11.6(0.48)
	11	78.0	
	>11	15.1	
Family status			
	Two-parent family	89.1	
	One-parent family	10.9	
Parents' country of origin			
	Both parents born in Belgium/the Netherlands	83.0	
	At least one parent born in another country	17.0	

Measures

The development of the questionnaire was based on three steps. First, a systematic review of previous studies on correlates of fruit and vegetable intake (Rasmussen et al., 2006) and second, qualitative focus group research (Wind et al., 2005) to further explore possible relevant determinants were conducted. Subsequently, three different studies were conducted to test the validity and test-retest reliability of both the constructs measuring frequency of fruit and

vegetable intake as well as possible related personal, social and environmental correlates. All studies were conducted among 10 to11 year-old schoolchildren, prior to the cross-sectional survey described in this paper, in 4-6 of the Pro Children countries (De Bourdeaudhuij et al., 2005; Haraldsdóttir et al., 2005).

Fruit intake was assessed by one food frequency question: 'How often do you usually eat fresh fruit'. Vegetable intake was measured by three food frequency questions: 'How often do you usually eat salad and grated vegetables', 'How often do you usually eat other raw vegetables', and 'How often do you usually eat cooked vegetables". All four questions had eight response alternatives ranging from 'never' (0) to 'every day, more than twice per day' (7). Mean total frequency of vegetable intake per day was calculated by the sum of frequency of intake of salad/grated, raw and cooked vegetables.

Potential correlates of fruit and vegetable intake were measured within the domain of demographic factors (country, gender, age, family status and parents' country of origin), personal factors (knowledge about recommended daily intake levels, attitude 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), social factors (modelling behaviour of friends and parents, active parental encouragement, whether parents facilitate intake of fruit and vegetables by cutting them for their child (parental facilitation), and whether parents demand their child to eat fruit and vegetables (parental demand) or allow their child to eat as much fruit and vegetables as they want to (parental allowance), and perceived environmental factors (perceived availability of fruit and vegetables at home, and perceived availability of fruit and vegetables in other settings i.e. at school, at their friends' home, and at the (sports)club). All factors, except knowledge, were assessed using a bipolar five-point scale: fully disagree (-2) to fully agree (+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).

As mentioned above, prior to this study, two separate studies were conducted to assess the validity and the reproducibility of the food frequency questions. The validity study was conducted in a population of children from four

of the Pro Children countries (Denmark, Norway, Iceland, Portugal), and showed that Spearman rank correlations for frequency of fruit and vegetable intake as assessed by the Pro Children food frequency questions and a 7-day food record ranged between 0.40-0.53. Between 25-50% were classified into the same quartile and 70-88% into the same or adjacent quartile of intake. The reliability study was conducted in a population of children from six of the Pro Children countries (Denmark, Norway, Iceland, Belgium, Portugal, Spain) and showed that test-retest Spearman rank correlations were between 0.47-0.84. Validity and reproducibility as to ranking of the subjects were regarded to be satisfactory (Haraldsdóttir et al., 2005).

In a third study, the reliability and validity of the constructs measuring personal, social and environmental correlates were assessed in a population of children from five of the Pro Children countries (Denmark, Norway, Belgium, Portugal, Spain). Intraclass correlations in the test-retest reliability analyses of these correlates were 0.58-0.85 (De Bourdeaudhuij et al., 2005). Test–retest reliability was comparable across the five participating countries. Cronbach's alpha values were moderate to high (range 0.52 to 0.89) with the exception of the general self-efficacy scale, which had a value below 0.50 for both fruit (α =0.42) and vegetables (α =0.49) (De Bourdeaudhuij et al., 2005).

Based on the data from the present study conducted in Belgium and the Netherlands, we again assessed Cronbach alphas for the same constructs. For the personal and social correlates, including self-efficacy, Cronbach alphas ranged from 0.54 to 0.86, indicating similar or even better internal consistency as compared to the reliability study. However, in the present study, Cronbach alphas for the environmental factors were considered to be too low (range 0.28 to 0.41). Since availability of fruits and vegetables was assessed in four different settings, we therefore included four separate item scores in the analyses. An English version of the questionnaire can be found at www.prochildren.org. Mean scores on determinants and intake of fruit and vegetabes at baseline are given in Table 2.1.2.

Table 2.1.2 Mean scores (and SD) on determinants and intake of fruit and vegetables at baseline.

	Fruit		**Vegetables**	
	mean	SD	mean	SD
Physical environment				
Availability at home*	1.23	0.60	0.87	0.73
Availability at school*	-1.29	1.23	-1.36	1.26
Bring to school*	-0.59	1.24	-1.50	0.85
Availability at friends' place*	0.48	1.24	-0.17	1.33
Availability at club*	-0.95	1.29	-1.33	1.11
Social environment				
Modelling*	0.57	0.81	0.82	0.80
Active parental encouragement*	0.25	1.17	0.44	1.18
Parental facilitation*	-0.06	1.15	-0.82	1.11
Parental demand*	0.07	1.22	0.46	1.19
Parental allowance*	1.47	0.90	1.27	0.99
Personal				
Knowledge**	0.46	0.50	0.22	0.42
Attitude*	0.91	0.82	0.60	0.94
General self-efficacy*	1.00	0.96	0.77	1.02
Liking*	1.24	0.79	0.59	1.02
Preferences*	1.14	0.64	0.60	0.82
Perceived barriers*	-1.40	0.68	-1.25	0.84
Intention*	0.90	1.11	0.38	1.20
Intake frequency	0.88	0.75	1.32	0.88

*(-2=fully disagree; +2=fully agree); **(0= does not know recommended daily intake level, 1=knows recommended daily intake level)

Statistical analyses

All data collected in the cross-sectional surveys were entered and cleaned in the national centres according to a standardized protocol (www.prochildren.org). Further data processing and quality control was carried out in the Pro Children Data Management Centre at the University of Vienna. In order to compute scales, more than 50% of the scale items had to be answered. In total ten children who had not filled in the intake question for fruit, and seven children who had not answered the food frequency questions for vegetables, were excluded from the analysis. As a consequence there was a slight variation in the number of schoolchildren that were included in the different analyses.

Spearman correlations between all variables were computed to show the unadjusted relation between each variable and intake and to gain insight into possible multicollinearity. An intercorrelation of 0.60 was allowed as a maximum correlation between two independent variables. Further, t-tests were conducted to test for a significant difference in fruit and vegetable intake between boys and

girls. To determine the explained variance of schoolchildren's fruit and vegetable intake, hierarchical multiple linear regression analyses were performed. A square root transformation was used on the vegetable intake variable to approach a normal distribution. Two sets of multiple regression analyses were conducted for fruit and vegetable frequency, respectively. In both regression models demographic variables were entered as a first block, since these variables were considered to be more distal, non-modifiable potential determinants. According to the theoretical model (Figure 2, page 7), subsequently blocks of physical environmental (block 2), social (block 3) and personal correlates (block 4) were entered in the model (Klepp et al., 2005). Sub-group analyses were conducted to assess differences in potential correlates for boys and girls separately. Overall a significance level of 0.05 was used. Standardized betas were used in order to compare the adjusted associations of the different potential correlates with intake.

Perceived availability of fruit and vegetables at the (sports)club was not included in either model, since more than 350 children reported that they did not attend any leisure time activity at a (sports)club. Statistical analyses were performed using the Statistical Package for Social Sciences 11.0 (SPSS).

Results

Intercorrelations

Intercorrelations between all independent variables were below 0.60. Most of the independent variables were significantly correlated to schoolchildren's fruit and vegetable intake (Table 2.2). All variables were positively correlated to fruit and vegetable intake, except perceived barriers to eat fruit and vegetables and perceived availability of fruit at school.

Table 2.2 Spearman correlation's between all potential correlates and

		1	2	3	4	5	6	7	8	9	10
	Physical environment										
1	Availability at home	1	.023	**.175**	**.206**	**.106**	**.210**	**.219**	**.264**	**.191**	**.225**
2	Availability at school	-.004	1	.030	.023	**.115**	-.030	.042*	.023	**-.074**	.029
3	Bring to school	**.190**	**.053**	1	**.137**	**.071**	**.204**	**.156**	**.214**	**.210**	.018
4	Availability at friends' place	**.248**	**.147**	**.234**	1	**.157**	**.255**	**.161**	**.164**	**.126**	.154
5	Availability at club	**.134**	**.191**	**.229**	**.203**	1	**.084**	**.079**	**.139**	.029	**.062**
	Social environment										
6	Modeling	**.326**	-.041*	**.136**	**.188**	.048*	1	**.379**	**.251**	**.424**	**.081**
7	Active parental encouragement	**.218**	.023	**.131**	**.176**	**.075**	**.401**	1	**.266**	**.460**	**.131**
8	Parental facilitation	**.294**	**.063**	**.340**	**.249**	**.264**	**.126**	**.163**	1	**.276**	**.097**
9	Parental demand	**.248**	**-.078**	**.129**	**.129**	-.005	**.493**	**.485**	**.139**	1	.053*
10	Parental allowance	**.351**	.039	**.081**	**.194**	.057*	**.250**	**.175**	**.150**	**.183**	1
	Personal										
11	Knowledge	**.078**	-.012	**.053**	.045*	**.063**	**.136**	**.062**	**.068**	**.080**	**.075**
12	Attitude	**.276**	.015	**.169**	**.123**	**.100**	**.302**	**.285**	**.220**	**.238**	**.132**
13	General self-efficacy	**.387**	-.010	**.170**	**.125**	.055*	**.346**	**.138**	**.159**	**.259**	**.201**
14	Liking	**.397**	.012	**.218**	**.138**	**.102**	**.355**	**.169**	**.223**	**.230**	**.141**
15	Preferences	**.348**	.041*	**.215**	**.131**	**.077**	**.220**	**.127**	**.194**	**.158**	**.111**
16	Perceived barriers	**-.292**	**.115**	**-.084**	**-.057**	.035	**-.251**	**-.098**	**-.081**	**-.215**	**-.135**
	Demographics										
17	Country	-.043*	**.396**	.031	**.145**	**.097**	**-.193**	.011	.018	**-.238**	-.007
18	Gender	.048*	-.007	**.104**	**.122**	**-.080**	**.074**	.031	.028	**.103**	.034
19	Age	.048*	**-.061**	.024	-.028	**.061**	**.058**	.002	**.090**	**.053**	.032
20	Family status	.002	.000	.027	.005	.040	**-.075**	.015	.033	**-.046**	.003
21	Parents' country of origin	**-.069**	.015	**-.064**	-.034	**-.090**	.025	**-.045**	**-.192**	.004	**-.047**
22	Intention	**.382**	.005	**.234**	**.159**	**.103**	**.434**	**.268**	**.230**	**.324**	**.209**
23	Intake frequency	**.309**	.038	**.243**	**.169**	**.081**	**.311**	**.226**	**.250**	**.315**	**.181**

Bottom left: vegetables; Top right: fruit

intake frequency

11	12	13	14	15	16	17	18	19	20	21	22	23
.050*	**.137**	**.255**	**.260**	**.220**	**-.240**	-.008	.032	.003	-.016	-.010	**.241**	**.208**
-.027	.002	-.004	.022	**.090**	**.061**	**.396**	-.008	**-.111**	-.004	.002	.035	.011
.113	**.207**	**.251**	**.311**	**.285**	**-.250**	.050*	**.199**	-.037	.034	**-.065**	**.289**	**.350**
.069	**.077**	**.122**	**.099**	**.084**	**-.140**	-.020	**.139**	-.009	-.005	-.028	**.152**	**.126**
.037	**.081**	.036	.050*	.030	-.008	**.073**	-.049*	**.064**	.049*	**-.131**	.048*	.043
.152	**.247**	**.204**	**.272**	**.154**	**-.197**	**-.198**	**.110**	**.057**	-.033	**-.062**	**.336**	**.337**
.127	**.221**	.027	**.148**	**.100**	**-.071**	**.055**	.008	.025	.050*	**-.115**	**.219**	**.182**
.081	**.191**	**.178**	**.228**	**.173**	**-.152**	-.013	.034	.026	-.005	**-.103**	**.226**	**.230**
.140	**.199**	**.161**	**.219**	**.095**	**-.171**	**-.239**	**.090**	.048*	.000	**-.083**	**.267**	**.290**
.054	.010	.035	.004	.023	-.034	.043*	-.020	.007	.013	**-.056**	.022	.041*
1	**.140**	**.107**	**.128**	**.073**	**-.082**	-.036	**.053**	.033	-.011	-.039	**.136**	**.266**
.150	1	**.245**	**.437**	**.242**	**-.229**	-.002	.005	.020	.030	**-.065**	**.452**	**.255**
.120	**.309**	1	**.509**	**.317**	**-.391**	**-.061**	**.078**	-.029	-.019	-.014	**.449**	**.368**
.170	**.503**	**.577**	1	**.487**	**-.414**	-.040*	**.108**	-.022	-.010	-.041*	**.677**	**.418**
.125	**.291**	**.416**	**.577**	1	**-.252**	**.110**	**.083**	-.033	.023	**-.058**	**.357**	**.245**
-.081	**-.258**	**-.415**	**-.373**	**-.283**	1	**.193**	**-.148**	.027	.008	-.023	**-.376**	**-.293**
.006	.005	**-.069**	-.012	**.088**	**.229**	1	**-.079**	**-.280**	-.018	.005	-.047*	-.031
-.067	-.011	**.066**	**.058**	.039	**-.146**	**-.079**	1	-.016	.017	.004	**.140**	**.137**
.074	.020	-.013	.019	-.021	.007	**-.280**	-.016	1	**.089**	**-.161**	-.035	.001
.052*	.015	.024	.013	.026	-.012	-.018	.017	**.089**	1	**-.106**	-.004	-.033
-.022	-.050*	.019	.040	.025	-.039	.005	.004	**-.161**	-.106	1	-.030	**-.074**
.170	**.475**	**.552**	**.708**	**.487**	**-.348**	-.029	**.066**	-.001	-.004	.028	1	**.414**
.128	**.238**	**.328**	**.376**	**.369**	**-.251**	.005	**.177**	-.007	-.016	.024	**.371**	1

Bold correlation is significant at the 0.01 level (2-tailed)
* correlation is significant at the 0.05 level (2-tailed)

Intake of fruit and vegetables

About 60% of the children reported to eat fruit less than once a day; mean frequency of fruit intake was 0.88 times per day (median=0.79, SD=0.75). Thirty-six percent of the children reported eating vegetables less than once a day; mean frequency of vegetable intake was 1.32 times per day (median=1.25, SD=0.88). Girls ate fruit significantly more often ($t=17.1$; $p<0.01$) than boys. The frequency of vegetable intake did not differ significantly between boys and girls ($t=0.8$; $p>0.05$).

Correlates of fruit and vegetable intake

The results of the hierarchical multiple regression analyses for fruit are shown in Table 2.3.1 and for vegetables in Table 2.3.2. Adding each block resulted in an increased percentage of explained variance. Demographic variables explained only 3% of the variance of both fruit and vegetable intake. Adding the block of physical environmental variables contributed 13% to the explained variance for fruit and 12% for the vegetable intake. Inclusion of social environmental variables added an extra 8% to the explained variance for both fruit and vegetable intake. Personal variables added another 10% to the explained variance in fruit intake and 5% of the vegetable intake.
The final model accounted for 33.7% for variance in schoolchildren's fruit intake and 28.4% for vegetable intake

Fruit

Schoolchildren who reported to eat fruit more frequently, more often brought fruit with them to school, perceived their mother, father and best friend to eat fruit every day, perceived their parents demanding them to eat fruit, were more familiar with the recommended daily intake level for fruit, liked fruit better and had higher self-efficacy. Country, gender, parent's country of origin, family status, parental facilitation and perceived barriers also contributed to the explained variance. Children who were Flemish, girls, from families where both parents were born in the research country, from two-parent families, with parents who facilitated intake, and who perceived fewer barriers, had higher frequency of fruit intake. Among girls the explained variance of fruit intake was 32.2%, while the explained variance for boys was 32.5%. Qualitative comparison of correlations in boys and girls did not reveal substantial differences compared to the correlates presented in Table 2.3.1. The only difference in significant correlates was that in girls parental facilitation was not

significantly (ß=0.03) associated with fruit intake, while it was in boys (ß=0.06).

Vegetables

Schoolchildren who reported to eat vegetables more frequently were more likely to be girls, perceived a stronger demand from their parents to eat vegetables, reported that their parents more often facilitated them to eat vegetables by cutting vegetables for them, perceived more modelling behaviour of their parents and friends, and had a higher preference for vegetables. Perceived home availability, bringing vegetables to school, knowledge about recommended daily intake levels, liking vegetables, self-efficacy to eat vegetables, and perceived barriers also contributed to the explained variance. Children who perceived vegetables to be more available at home, who more often brought vegetables with them to school, who knew the recommended daily intake levels for vegetables, who liked vegetables better, who perceived higher self-efficacy to eat vegetables, and who perceived fewer barriers, had a higher frequency of vegetable intake.

For girls the explained variance was 23.8%, for boys it was 29.2%. In separate subgroup analyses for boys and girls the same correlates were significant as in the whole group, except for parents' country of origin, which was significantly (ß=0.06) associated with vegetable intake in boys, while it was not in girls (ß=0.02), nor in boys and girls combined (ß=0.03).

Table 2.3 Stepwise multiple regression analyses with reported frequency and demographic (STEP 1), physical environmental (STEP 2), factors.

2.3.1 Fruit (n=2157)

	No. of items	Step 1 Adjusted R^2=0.03		Step 2 Adjusted R^2=0.16		Step 3 Adjusted R^2=0.24		Step 4 Adjusted R^2=0.34	
BLOCK OF VARIABLES Variable		beta	p-value	beta	p-value	beta	p-value	beta	p-value
DEMOGRAPHICS									
Country*	1	-0.03	0.13	-0.06	<0.01	0.03	0.16	0.05	<0.01
Gender**	1	0.15	0.00	0.07	0.00	0.06	0.00	0.05	<0.01
Age (range: 10.3-13.8)	1	-0.01	0.66	0.00	0.94	0.00	0.94	0.01	0.60
Parent's country of origin***	1	-0.09	0.00	-0.07	0.00	-0.04	0.03	-0.04	0.02
Family status ****	1	-0.05	0.02	-0.06	0.00	-0.04	0.03	-0.04	<0.05
PHYSICAL ENVIRONMENT									
Availability at home†	1			0.13	0.00	0.07	0.00	0.01	0.60
Availability at school†	1			0.03	0.20	0.01	0.52	0.01	0.48
Bring to school†	1			0.31	0.00	0.24	0.00	0.16	0.00
Availability at friends†	1			0.05	0.01	0.00	0.95	-0.01	0.64
SOCIAL ENVIRONMENT									
Modelling†	3					0.21	0.00	0.14	0.00
Active encouragement†	2					-0.04	0.10	-0.02	0.27
Parental facilitation†	1					0.08	0.00	0.04	0.03
Parental demand†	1					0.15	0.00	0.12	0.00
Parental allowance†	1					-0.01	0.57	-0.01	0.80
PERSONAL									
Knowledge‡	1							0.17	0.00
Attitude†	2							0.01	0.60
General self-efficacy†	2							0.12	0.00
Liking†	2							0.18	0.00
Preferences†	12							-0.02	0.47
Perceived barriers†	4							-0.07	<0.01

*0=the Netherlands; 1=Belgium-Flanders; **0=boys; 1=girls; ***0=both parents born in Belgium/the Netherlands, 1=at least one parent born in other country than Belgium/the Netherlands; ****0=two-parent family, 1=one-parent family; † -2=fully disagree, +2=fully agree; ‡0= does not know recommended daily intake level, 1=knows recommended daily intake level

of fruit intake (2.3.1) and vegetable intake (2.3.2) as dependent variables socioenvironmental (STEP 3), and personal factors (STEP 4) as independent

2.3.2 Vegetables (n=2158)

	No. of items	Step 1 Adjusted R^2=0.03		Step 2 Adjusted R^2=0.15		Step 3 Adjusted R^2=0.23		Step 4 Adjusted R^2=0.28	
BLOCK OF VARIABLES Variable		beta	p-value	beta	p-value	beta	p-value	beta	p-value
DEMOGRAPHICS									
Country*	1	-0.02	0.51	-0.03	0.16	0.05	0.05	0.03	0.26
Gender**	1	0.16	0.00	0.13	0.00	0.12	0.00	0.12	0.00
Age (range: 10.3-13.8)	1	0.03	0.24	0.01	0.50	0.01	0.71	0.01	0.53
Parent's country of origin***	1	0.00	0.94	0.03	0.13	0.04	0.04	0.02	0.23
Family status ****	1	0.00	0.91	-0.01	0.78	0.02	0.43	-0.01	0.77
PHYSICAL ENVIRONMENT									
Availability at home†	1			0.28	0.00	0.17	0.00	0.07	<0.01
Availability at school†	1			0.03	0.21	0.02	0.43	0.02	0.29
Bring to school†	1			0.17	0.00	0.11	0.00	0.08	0.00
Availability at friends†	1			0.04	0.06	-0.02	0.46	-0.01	0.63
SOCIAL ENVIRONMENT									
Modelling†	3					0.17	0.00	0.10	0.00
Active encouragement†	2					0.00	0.89	0.02	0.40
Parental facilitation†	1					0.13	0.00	0.11	0.00
Parental demand†	1					0.15	0.00	0.13	0.00
Parental allowance†	1					0.02	0.28	0.02	0.24
PERSONAL									
Knowledge‡	1							0.08	0.00
Attitude†	2							<0.01	0.78
General self-efficacy†	2							0.07	0.01
Liking†	2							0.07	<0.01
Preferences†	12							0.14	0.00
Perceived barriers†	4							-0.05	0.02

*0=the Netherlands; 1=Belgium-Flanders,;**0=boys; 1=girls; ***0=both parents born in Belgium/the Netherlands, 1=at least one parent born in other country than Belgium/the Netherlands; **** 0=two-parent family, 1=one-parent family; † -2=fully disagree, +2=fully agree; ‡0= does not know recommended daily intake level, 1=knows recommended daily intake level 1=knows recommended daily intake level

Discussion

The aim of the present study was to identify personal, social and environmental correlates of schoolchildren's fruit and vegetable intake in two European countries. Our study is rather unique in its inclusion of a broad range of possible correlates from social cognition as well as social-ecological perspectives, thus including potential determinants at the personal, social and environmental level. With this approach we were able to explain about 30% of the variance in fruit and vegetable intake. This is in line with some of the few studies that also included such a broad range of possible correlates (Bere & Klepp, 2004; Lytle et al., 2003). In studies focusing on a smaller range of specific correlates, the variance in children's nutrition behaviour could be explained by preferences (10%) and home availability (10%) (Baranowski et al., 1999).

In the present study, the strongest correlates for both fruit and vegetable intake were taste preferences and parental influences, either by perceived modelling behaviour or parental demand to eat fruit and vegetables. Parental facilitation and home availability also added to the explained variance of vegetable intake, while availability at school (by bringing fruit from home) contributed to the explained variance of fruit intake.

Previous studies, including a recent review on determinants of fruit and vegetable consumption among 6-12 year-old children (Blanchette & Brug, 2005) revealed that preferences (Bere & Klepp, 2004; Gibson et al., 1998; Domel et al., 1996; Neumark-Sztainer et al., 2003; Resnicow et al., 1997), and physical environmental factors (availability/accessibility) (i.e. Bere & Klepp, 2004; Neumark-Sztainer et al., 2003; Young et al., 2004; Cullen et al., 2003; Hearn et al., 1998; Kratt et al., 2000; Reynolds et al., 1999a) are the more important correlates of fruit and vegetable intake, with some evidence that parental intake, knowledge of intake recommendations and skills are positively associated with intake (Blanchette & Brug, 2005). Perceived modelling behaviour from parents (Young et al., 2004) and family food rules (De Bourdeaudhuij, 1997b) have been found to be positively associated with intake as well. Our results are thus much in line with these previous studies, and with a qualitative study conducted among Dutch and Belgian-Flemish schoolchildren (Wind et al., 2005), in which taste preferences, availability at home and at school and parental practices were also identified as important determinants of fruit and vegetable intake. Although our study further confirmed that

preferences and availability are important, our study also indicates that there is a broader range of social environmental and personal factors that are associated with intake levels that should be taken into account in fruit and vegetable promotion.

Girls reported to eat fruit and vegetables more often than boys. However, when conducting separate analyses for boys and girls, there were only small differences in the correlates of fruit and vegetable intake between boys and girls. Since country of origin was significant in boys for vegetables further research should look into determinants of fruit and vegetable intake in different ethnic groups. Among boys parental facilitation was a significant correlate of fruit intake while it was not among girls. Therefore parents should maybe be especially encouraged to cut up fruit for their sons.

In our study, perceived availability did contribute significantly to the explained variance of intake. After adding social and personal factors into the model, effect sizes for availability at home and at friends' homes decreased. These decreased effect sizes for availability, and the significant correlations between availability and some of the personal and social factors, is a first indication that social and personal factors mediate the relationship between availability and fruit and vegetable intake, and is in line with the Pro Children theoretical framework. For example, the greater the availability of fruit and vegetables at home or at friends' homes might lead to more exposure and/or to role modelling behaviour of parents and friends which, in turn, leads to higher fruit and vegetable consumption. Full mediation analyses should explore this further. However, since our data are cross-sectional, no proof for such causal inferences could be obtained. Kratt and colleagues (2000) and Young and colleagues (2004) studied the role of availability in more detail. They addressed the possible modifying effect of availability on the relationship between modelling and fruit and vegetable intake. The association between children's knowledge and perceived parental modelling and fruit and vegetable intake was stronger when availability was higher, and suggested that availability could be a moderator for the relation between knowledge and intake (Kratt et al., 2000; Young et al., 2004). More research is needed to explore the interrelationships between personal and environmental factors.

Our study indicated a positive association between parental demand and children's fruit and vegetable intake, which was in line with a study by De Bourdeaudhuij (1997b) among Belgian-Flemish adolescents. However, other

studies have not confirmed this (Fisher et al., 2002; Wardle et al., 2005). In none of these studies causal relationships could be established. Since there is a growing body of evidence supporting the importance of family and social influences in the development of children's eating patterns (Patrick & Nicklas, 2005) more qualitative and longitudinal research is needed to gain a better understanding of parental practices and their influence on children's intake.

Because representative samples were selected, the results should have good external validity for the Netherlands and the Dutch-speaking part of Belgium. The sample size and processing and quality control of the data (Klepp et al., 2005) may be additional strengths of this study, as well as the theory-based and evidence-based selection of possible correlates based on a literature review, qualitative research, and three validity and reliability studies prior to this study (De Bourdeaudhuij et al., 2005; Haraldsdóttir et al., 2005; Wind et al., 2005; Rasmussen et al., 2006).

This study has some limitations. First, we could not adjust for possible confounding of social desirable answers given by the children, as tendency to give social desirable answers was not assessed. Second, some constructs were measured using only one or two items. This was done so that the children would be able to complete the entire questionnaire within a one-lesson period of 45 minutes. Fortunately, most of these self-reported measures showed good test-retest and construct reliability (De Bourdeaudhuij et al., 2005). Third, the statistical analysis has some limitations. More sophisticated analyses such as mediation analyses or testing interaction terms should be considered in further research. However, the aim of this exploratory study was to assess a broad range of possible determinants of schoolchildren's fruit and vegetable intake and to get an idea of the strongest correlates. In further research the most relevant correlates as identified in the present study should be assessed with multi-item scales and mediation and moderation between different constructs should be tested (Kremers et al., 2005).

To increase children's fruit and vegetable intake, insight into potentially important and changeable mediators is needed when developing effective strategies (Bartholomew et al., 2001; Brug et al., 2005). The present study has contributed to such insight. Our study indicates that fruit and vegetable promotion in Belgian-Flanders and the Netherlands should address physical environmental, social environmental, as well as personal factors, and should especially focus encouraging children and parents that children bring fruit and

vegetables to school, to encourage parents to more strongly demand that their children eat fruit and vegetables, to encourage parents to cut up vegetables for their child, to encourage parents to be a good role model for their child, and to encourage parents and possibly schools to explore which fruits and vegetables the children like and encourage preferences for other fruits and vegetables.

French and Stables (2003) who reviewed the literature on the school food environment concluded that multi-component interventions tailored at fruit and vegetable intake, that include behavioural focused curricula as well as changes in the environment (availability) and a parental component, have a positive impact on fruit and vegetable intake, but mainly fruit intake. Findings from the present study support the implementation of interventions with a focus on personal (taste preferences), social (parental influences) and environmental factors (home and school availability).

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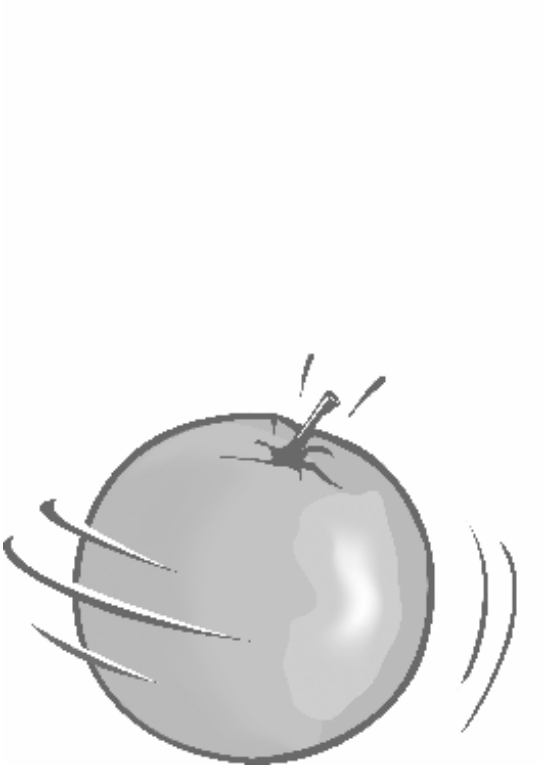
Part 2



Development of the Pro Children intervention

Chapter 3

The Pro Children Intervention: Applying the Intervention Mapping Protocol to develop a school-based fruit and vegetable promotion programme

Abstract

The importance of careful theory based intervention planning is recognized for fruit and vegetable promotion. This paper describes the application of the Intervention Mapping (IM) protocol to develop the Pro Children intervention to promote consumption of fruit and vegetable among 10 to 13-year-old schoolchildren. Based on a needs assessment, promotion of intake of fruit and vegetable was split into performance objectives and related personal, social and environmental determinants. Crossing the performance objectives with related important and changeable determinants resulted in a matrix of learning and change objectives for which appropriate educational strategies were identified. Theoretically similar but culturally relevant interventions were designed, implemented and evaluated in Norway, the Netherlands and Spain during two school years. Programme activities included provision of fruits and vegetables in the schools, guided classroom activities, computer-tailored feedback and advice for children, and activities to be completed at home with the family. Additionally, optional intervention components for community reinforcement included incorporation of mass media, school health services or grocery stores. School project committees were supported. The Pro Children intervention was carefully developed based on the IM protocol that resulted in a comprehensive school-based fruit and vegetable promotion programme, but culturally sensible and locally relevant.

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Introduction

As shown by available evidence, fruit and vegetable intake is too low among European schoolchildren (WHO, 2004; Yngve et al., 2005). School-based health promotion strategies fostering healthy eating practices have the potential to improve health and well-being during childhood and later stages in life (Lien et al., 2001; Klepp et al., 2005). The Pro Children consortium aimed to initiate, develop, implement and evaluate school-based fruit and vegetable promotion actions among primary schoolchildren aged 10–13 years in different European countries (Klepp et al., 2005). This consortium especially aimed to develop an evidence-based and theory-driven intervention package that is applicable in different European countries.

Since the publication of the Precede-Proceed model by Green and Kreuter (Green & Kreuter, 1999) and other similar health promotion planning models (McKenzie & Smeltzer, 2001), the importance of careful theory-based intervention planning is recognized. According to such planning models (Figure 1, page 4), the first phase (A) in health promotion planning is the identification of health problems that are serious and/or prevalent. In the second phase (B), the behavioural risk factors for the health problems need to be identified. Phase C is to investigate the individual and environmental mediators or determinants of these risk behaviours. These determinants should then be translated into interventions (phase D) that can be implemented and disseminated (phase E).

Within the aforementioned planning models, the road map to *what* needs to be changed is well laid out. Phases A–C lead to evidence-based indications about which health problems need to be addressed, which health behaviours need to be changed, as well as which behavioural determinants need to be influenced. Health promotion planning models thus give good guidance on selecting specific change objectives, but are less specific in *how* change should be induced, i.e. how the objectives should be translated into effective interventions. Intervention Mapping (IM) (Bartholomew et al., 2001; Kok et al., 2004; Brug et al., 2005) was especially developed for this purpose. Furthermore, IM recognizes the importance of social ecological models of behaviour change, thus highlighting individual motivational factors as well as environmental opportunities as important mediators of health behaviour. Earlier studies show that dietary habits of children may be largely dependent on such environmental factors (Cullen et al., 2003). IM was therefore selected as the

framework to develop fruit and vegetable promotion interventions for schoolchildren.

In this paper, we will first introduce the IM protocol and subsequently describe how we applied the IM protocol to the development of the Pro Children intervention.

Intervention Mapping

IM is a stepwise approach to ensure a systematic evidence-based and theory-driven development and implementation of health promotion interventions. IM structures the initiation, development and implementation of such interventions based on established theories and empirical data. IM guides the selection of specified intervention goals, the choice of intervention strategies and the development of intervention tools. It also prepares the adoption, implementation and evaluation of the intervention. IM is thus a specification of phases D and E of the planning model depicted in Figure 1 (page 4). It assumes that phases A–C have been carefully conducted and refers to these phases as the 'needs assessment'. To complete this needs assessment, IM proposes to use a combination of qualitative and quantitative research methods, starting with reviewing the literature on relevant evidence and theories. Since the body of evidence on health and behaviour is in general much stronger than for behavioural determinants, it is often especially necessary to conduct additional research to further explore the determinants of target behaviours (Brug et al., 2005; Baranowski et al., 2003). IM proposes to use social ecological models that recognize the importance of individual, social and environmental factors as important determinants of health behaviours.

IM then recognizes five steps, from the definition of specific intervention objectives to the development of an evaluation plan (Figure 3, page 10). IM assumes a temporal order from step one to step five, but certainly allows and encourages a more iterative process, i.e. going back to an earlier step if this seems necessary.

At step one of IM, proximal programme goals are specified based on the needs assessment. These goals are referred to as performance objectives: the specific behaviours people in the target group need to participate in, or the specific changes to be achieved in the environment as a result of the programme. Important and changeable determinants of these performance objectives should be selected. Combinations of selected determinants and

performance objectives are then used to specify the most proximal learning and environmental change objectives. Matrices are constructed to facilitate that process. For personal determinants, learning objectives intend to answer the question 'What does the target group need to learn with regard to a specific determinant in order to accomplish the performance objective?' In the same way, considering determinants at the family and school level, change objectives need to answer: 'What needs to change in the environment to enable the target group to reach the performance objective?'

At step two, a list of theory-based and evidence-based intervention methods is generated that matches the learning objectives. Subsequently these theoretical methods are translated into practical intervention strategies. Step three is the design of the actual programme. This requires organizing the strategies into a deliverable programme, considering the target groups and the settings.

Furthermore, the actual educational materials have to be selected, produced and pre-tested. At step four, the plan for the implementation of the programme is developed which should highlight the anticipated prerequisites for successful programme adoption and dissemination. Adoption and diffusion of an intervention programme is, of course, crucial for its success and it often requires tailoring the programme to the end-users and intermediaries. For school-based interventions, this means interaction with pupils, teachers and other school staff, as well as parents (French & Stables, 2003). Finally, at step five, IM focuses on developing a plan for monitoring the process of implementation and evaluation of the programme's efficacy. It is relevant to have in mind this process from the very early phases of programme development, since the proximal programme objectives inspire the evaluation of programme effects. IM has been described in more detail elsewhere (Bartholomew et al., 2001).

Mapping the Pro Children Intervention

Since the Pro Children Project aimed to develop a school-based intervention applicable across Europe, IM was used to identify intervention methods and strategies valid in different countries, but leaving open the opportunity to further tailor these methods to each separate country's specific relevant features. The needs assessment and steps one and two were therefore done for all Pro Children countries together, while steps three and four were partly country-specific. Within the present project, these later steps were fully completed for

three Pro Children countries in which the Pro Children intervention was tested: Spain, Norway and the Netherlands (Klepp et al., 2005).

The Needs Assessment

Fruit and vegetable consumption is generally regarded as a health-promoting behaviour (Van Duyn & Pivonka, 2000; Hung et al., 2004), but intake of this food group is lower than recommended for many European schoolchildren (Yngve et al., 2005). We therefore started with the identification of important and changeable determinants of fruit and vegetable intakes in children across Europe. This phase was accomplished by means of a literature review of determinant studies, an exploration of important behavioural determinant theories and focus group interviews with children in six Pro Children countries (Klepp et al., 2005; Wind et al., 2005).

The literature review revealed that determinant studies for fruit and vegetable intakes in schoolchildren have been mostly based on Bandura's Social Cognitive Theory (Bandura, 1997) and social-ecological models (Baranowski et al., 2003). These studies indicate that a mixture of environmental and individual factors predict consumption in children, with taste preferences ('liking') and fruit and vegetable availability as possibly the most important determinants, while beliefs about health outcomes were regarded as less important. Parents were identified as important mediators, since they may influence availability as well as act as role models.

The main determinants were categorized as individual, social and environmental factors (Table 3.1). For all three of the intervention countries, availability of fruit and vegetable, preferences and taste were expected to be the most important determinants. A general awareness of the importance of fruit and vegetable intake, recommended daily intake levels and own intake levels were also regarded as important across countries. For Spain, the needs assessment indicated that peer influences played a role regarding fruit consumption while parental modelling behaviour and family food rules influenced vegetable consumption. Skills for preparing fruit and vegetable and asking for fruit and vegetable, and awareness of own fruit and vegetable intake were relevant as well. In the Netherlands, the focus groups revealed that practical barriers and parenting practices were identified as relevant additional determinants (Wind et al., 2005). In Norway, the focus groups additionally revealed that children were concerned about hygiene, quality and food safety

issues, especially related to fruit and vegetables available at schools. Time constraint during breakfast and the lunch break was perceived as a barrier as well.

Table 3.1 Identified changeable important determinants of fruit and vegetable consumption in Pro Children intervention

Personal determinants	Social determinants	Environmental determinants
Awareness of importance of fruit and vegetable intake for health and well-being	Parental facilitation and direct encouragement	Availability and accessibility of fruit and vegetable at home
Positive taste preferences for different fruits and vegetables	Parental modelling behaviour	Availability and accessibility of fruit and vegetable in the school
Awareness of own fruit and vegetable intake	Peer modelling behaviour	A fruit and vegetable promotion school environment
Awareness of recommended daily intake levels	Teacher support	Neighbourhood support
Self-efficacy and skills for asking for fruit and vegetable		
Self-efficacy and skills for preparing fruit and vegetable		
Self-efficacy and skills for obtaining fruit and vegetable		
Self-efficacy and skills for keeping fruit and vegetable fresh		
Familiarity with different fruits and vegetables		

Step 1: Define Proximal Programme Objectives

Selection of Performance Objectives

The general behaviour 'children eat more fruits and vegetables' was further specified into the following individual performance objectives: to assess the adequacy of one's own current fruit and vegetable intake; to become familiar with a variety of fruits and vegetables; to develop skills to ask for fruit and vegetable; to develop skills to obtain fruit and vegetable; to develop skills to

keep fruit and vegetable fresh; to develop skills to prepare fruit and vegetable. Performance objectives regarding social influences and environmental conditions to be changed were specified as: parents stimulate their children to eat more fruit and vegetable; parents eat fruit and vegetable with their children to act as role models; children taste and eat fruit and vegetable along with peers at school; fruit and vegetable are made better available and accessible for children at home and school.

Selection of Changeable and Important Determinants of Performance Objectives
The potential correlates and determinants of the specified performance objectives were selected based on the literature review, the focus group interviews (Wind et al., 2005), as well as a concise review of theoretical models that are currently used to describe and explain nutrition behaviours.

Personal determinants included awareness of recommended daily intake levels and own intake, skills and self-efficacy for obtaining, preparing, asking for and keeping fruit and vegetable, self-evaluation and fruit and vegetable taste preferences. At the social level, determinants considered were peer influences, parental influences as well as social support. Finally, at the environmental level, determinants considered were availability and accessibility of fruit and vegetable at home and at school, social support and school-based social networks.

Identification of the Target Populations
In the Pro Children project, the target group was already quite narrowly defined, i.e. 10 to 13-year-oldschoolchildren. These children were identified as the ultimate target population for the intervention. Parents and school staff were further target populations since the selection of determinants revealed that these intermediaries were needed to improve the children's fruit and vegetable environment (French & Stables, 2003).

Define Learning and Change Objectives
The completion of step one was done in a modified way: a two-day workshop was organized at one of the Pro Children centres for all Pro Children staff involved in the intervention development and implementation in January 2003. A matrix was developed by combining the performance objectives and relevant determinants (Tables 3.2, 3.3)

Table 3.2 **Matrix of learning objectives for schoolchildren in Pro Children intervention arranged by determinants: personal determinants**

Performance objectives	Personal determinants				
	awareness	skills	self-effiicacy	self-evaluation	preferences/taste
To assess adequacy of one's own current fruit and vegetable intake	Children are aware of importance of F&V intake for health and well-being	Children can complete a computer based F&V test		Children complete a computer based F&V test	
	Children are aware of recommended intake levels	Children can read and understand a feedback report		Children read and understand a tailored feedback report	
	Children know what is a portion of F and a portion of V	Children develop skills to identify what is a portion of F and a portion of V		Children set goals for increased consumption	Children taste a variety of F&V at home
					Children taste a variety of F&V at school
	Children know what a fruit juice is and what is not				Children taste a variety of fruit juices at school
	Children are aware of own intake			Children experience success in eating more F&V per day	
To become familiar with a variety of fruit and vegetables	Children are aware of what influences their F&V preferences	Children are able to describe taste and other characteristics of F&V	Children feel confident they can try F&V they have not tasted before	Children set goals for increased consumption	Children become familiar with a variety of F&V and try kinds not tested before

Table 3.2 **Matrix of learning objectives for schoolchildren in Pro Children intervention arranged by determinants: personal determinants**

Performance objectives	Personal determinants awareness	skills	self-effficacy	self-evaluation	preferences/taste
To ask for fruit and vegetable in different settings		Children develop skills to ask for F&V at home Children develop skills to ask for F&V in a variety of settings	Children feel confident they can ask for F&V at home	Children set goals for increased consumption	
To be able to btain fruit and vegetable in different situations	Children identify different places where they can get F&V Children identify a variety of F&V	Children develop skills to get/ buy F&V Children are involved in buying F&V	Children feel confident they can get F&V at home	Children set goals for increased consumption	Children taste ´new´ F&V
To be able to keep fruit and vegetable fresh and attractive	Children are aware how F&V are best preserved Children identify F&V safety issues	Children develop skills to get, keep and prepare F&V considering food safety	Children feel confident they can keep safely F&V		
To be able to prepare fruit and vegetable	Children are aware that F&V can be prepared in many different ways	Children develop skills to prepare F&V	Children feel confident they can prepare F&V with some help at home		Children are exposed to different preparations based on F&V at home and at school

F&V=fruit and vegetable

Table 3.3 **Matrix of change objectives for external determinants in Pro Children intervention**

	Social and environmental determinants				
Performance objectives	peer influences	parental influences	availability and accessibilty	neighbourhood support	a F&V promotion school environment
To assess adequacy of one's own current fruit and vegetable intake	Children complete a computer based F&V test at school with their peers	Children read CT feed-back report with their parents Parents complete, read and under-stand CT feedback		Local media report on F&V facts and issues	
To become familiar with a variety of fruit and vegetables	Children taste a variety of F&V and fruit juices with their peers Peers act as role models eating and tasting F&V together	Children taste a variety of F&V with their parents Parents act as role models for children eating F&V with them	Parents increase availability and accessibility of F&V at home Schools cooperate to increase availability of F&V in school		School Project Committes/ School Health program and other health related bodies support increased availability F&V at school
To ask for F&V in different settings		Parents stimulate their children to eat more F&V	Children find F&V school and at home		School Health Program reinforces children's demand of F&V
To be able to obtain F&V in different situations	Children share shopping experiences	Children buy F&V with their parents		Grocery stores highlight importance of F&V	
To be able to keep fruit and vegetable fresh and attractive	Children share experiences in keeping F&V	Children keep F&V at home with their parents			
To be able to prepare fruit and vegetable	Children share experiences in preparing F&V	Children prepare F&V at home with their parents	Increases avail-ability and access of F&V at home		

F&V=fruit and vegetable; CT=Computer tailoring

Step 2: Select Suitable Theoretical Methods and Practical Strategies

Subsequently, we had brainstorm sessions to select suitable methods and strategies to reach the learning objectives that were regarded as realistic within the Pro Children context. The selection of useful theoretical methods included information transfer, role modelling, skill building, skill transfer, self-assessment and feedback, problem solving, goal setting, active learning, incentives, social support, guided practice and reinforcement (Kok et al., 2004; Hoelscher et al., 2002; Contento et al., 1995; Cullen et al., 2004; Wechsler et al., 2000; Perry et al., 2004).

Evidence for the effectiveness of school-based nutrition education programmes also suggests that the following features contribute to successful nutrition education: the use of theory-driven educational strategies directly relevant to a behavioural focus; devotion of adequate time and intensity to the intervention; family involvement, particularly in programmes for younger children; incorporation of self-evaluation or self-assessment and feedback in interventions for older children; interventions in the school environment and interventions in the larger community which can enhance school nutrition and health education (Hoelscher et al., 2002; Contento et al., 1995). Schools provide a well-established setting for implementing health promotion interventions aimed at children and their important others (Wechsler et al., 2000; Perry et al., 2004; Pérez-Rodrigo & Aranceta, 2003; Reynolds et al., 1999b).

At a very early stage of the intervention development, we conducted a feasibility study in order to identify similarities and differences among intervention sites, strengths and weaknesses in school systems and the potential of available resources. The feasibility study explored the school systems and other potential organizations or settings relevant for the intervention; the way nutrition education is considered in schools in each intervention site, how much effort is dedicated to that, which teacher or any other person is responsible for nutrition education in schools; whether it is considered as a separate subject in the curriculum; possible school food service and other possibilities children may find in the school to get food; existing school food policies or norms regarding the provision of food or access to food in schools; possibilities to organize out-of-the classroom activities in schools; continuing education for teachers; existing school health committees or potential for creating them; availability of computer facilities and Internet access in schools. All this information was collected from

existing documents and personal interviews with heads of schools, curriculum developers and other school staff in each country.

Step 3: Design a Programme Plan

A further brainstorm session was held to identify existing intervention tools and activities in the three intervention countries that fitted the methods and learning objectives and that were applicable given the time, setting and financial restraints of the Pro Children Project. Next we decided on necessary adjustments of existing tools, for example in order to make tools developed in one country applicable in the other Pro Children intervention countries. Subsequently, we considered the cells in the matrices (Tables 3.2, 3.3) that were not yet covered by an existing intervention tool, to explore if new tools could be developed for those cells. Finally, theoretically similar but culturally relevant interventions were developed to be implemented and evaluated in Norway, the Netherlands and Spain during two school years. The programme is meant to be applicable in all Pro Children countries with few adaptations. The Pro Children programme was arranged into three different components: (a) *classroom component,* namely school based educational material for children consisting of a set of worksheets with guided activities for the classroom and out-of-the classroom and was partly based on existing educational materials (Martens, 2005b); a computer-tailored instrument developed to be used by children at school and a teachers' manual; (b) *school component (school environment),* with provision of fruit and vegetable in the schools as the main element, either as free in-school distribution, a subscription programme, or as part of school meals; building of school project committees as a supportive structure was encouraged as a means of stimulating participation of all school members in the project; parents, pupils, teachers, school food service personnel, school health people and other interested members in the community were invited to be members of the school project committee; (c) *family component,* consisting of active parent involvement in the children's homework worksheets. Parents were informed about these homework tasks by specially designed letters. Additionally, an existing Internet-based computer-tailored tool (Oenema et al., 2005) to provide parents with personalized feedback on the intake levels and perceived barriers was adjusted and used in the present project, and five newsletters for parents were developed that included a variety of information on fruit and vegetable, announcements about ongoing activities in

the Pro Children programme and tips for parents to encourage their children to eat more fruit and vegetable. The three intervention sites shared a common outline for each newsletter, but added country-relevant information. The computer-tailored tool and the newsletters were also available via the Pro Children website (www.prochildren.org). Additionally, this website was used as a communication and exchange tool with participating schools.

Each intervention site added one optional component, either involvement of the media, school health services or grocery stores (Story et al., 2002). The objectives of these additional components were to encourage community participation in the Pro Children Project and to stimulate a social environment supportive to children eating more fruit and vegetable. In the Netherlands, the media was used to raise project awareness and active commitment to the project. In Spain, school health services were used to foster school food policies; counsel students on eating fruit and vegetable in the course of routine health screening exams; providing advise to families on eating an adequate amount of fruit and vegetable and reminding them about their supportive role during routine interviews. In Norway, grocery stores were used to provide basic information on fruit and vegetable to consumers and thus contributing to raising awareness.

Professional advice from designers guided the final layout of all educational materials. Designers also depicted a logo and a Pro Children poster. All educational materials, including the logo, poster, worksheets, computer tailoring and school manual, were pre-tested in the context of personal interviews with parents, teachers and school staff and by means of focus groups with children. Additionally, the main educational materials were pre-tested in classrooms. The goal of the pretesting was to find out whether the materials were attractive, personally relevant, easy enough to understand and easy to use. Table 3.4 shows the selected strategies related to learning objectives and modifiable determinants.

Table 3.4 **Selected educational strategies related to learning objectives and modifiable determinants in the Pro Children intervention**

Learning objectives	Determinants						
	availability	awareness	preferences /taste	peer influences	parental influences	skills	
						prepare	ask/obtain
Children are aware of importance of F&V for health and well being		EW*					
Children know recommendation		CT** EW					
Children know what a fruit juice is and what is not		EW on label reading	Taste-testing activity at school				
F&V is an issue for children		EW CT		Web-based international discussion forum			
Children find F&V at school	School fruit (fruit break)			Eat F&V together in class	Parents give F&V to children to bring to school		
Children find F&V at home		Newsletter for parents			Newsletter for parents	Preparing F&V at home EW	CT-encourage-ment to ask for F&V
Children are exposed to different F&V	School fruit (fruit break)		Fruit taste-testing activity at school	Peer leading activity	V-taste testinggame at home with parents		

Table 3.4 **Selected educational strategies related to learning objectives and modifiable determinants in Pro Children intervention**

Learning objectives	Determinants						
	availability	awareness	preferences /taste	peer influences	parental influences	skills	
						prepare	ask/obtain
Children are involved in buying F&V	Children buy F&V with parents						Quality and safety EW
Children taste ´new´ F&V			Fruit taste-testing game	Eating F together in class	Vegetable taste testing game at home with parents	Recipe competition Preparing F&V at home EW	
Make child aware of what inluences their preferences		Peer leading activity EW	EW	Group discussion Web-based discussion forum EW			
Children are aware of own intake		CT EW					
Children know how to prepare F&V		Newsletter for parents			Prepare F&V at home	EW	
Children set goals for increased consumption		CT EW			Parental support		EW
Parents are aware of own behaviour		Newsletter for parents			Self test CT		

* EW=Education Worksheet guided activity; ** CT=Computer tailored feedback

Step 4: Adoption and Implementation Plan
A plan for implementation and adoption of the programme was designed including implementation objectives, methods and strategies. Adequate time, intensity of the intervention, resources, as well as the provision of suitable materials and teacher training opportunities are essential for successful implementation. The involvement of teachers and children in the development phase improved the chances for adoption and implementation, and the pretesting of the materials allowed for further improvement. Additionally, we used teacher-training sessions supplemented with comprehensive teacher and school manuals to promote adequate adoption and effective implementation of the programme.

Step 5: Monitoring and Evaluation Plan
From the very early stages in programme development, formative, process and outcome evaluation plans were designed. Formative evaluation was used to guard IM steps three and four. The process evaluation protocol guided the investigation of the degree of programme implementation across the three intervention sites. The protocol included monitoring of the intervention delivery and perceived satisfaction and evaluation of the programme by key actors. Process evaluation was based on observations, face-to-face interviews with school staff, focus groups with children, and self-administered questionnaires for children, staff and parents. Additionally, teachers were asked to keep a logbook when performing each activity in the classroom. The information collected in the process evaluation was used to identify facilitating factors and barriers for implementation to enable further improvement before broader dissemination.

The outcome evaluation plan was intended to guide the assessment of the effects of the Pro Children intervention on fruit and vegetable intakes, performance objectives and determinants (Klepp et al., 2005).

Discussion

Although applying the IM protocol to develop the Pro Children intervention required time and effort, it helped us to carefully consider each decision in the intervention development and implementation preparation. It further strongly encouraged using evidence-based and theory driven intervention methods, strategies and materials. Furthermore, IM helped us to systematically get input from different actors, such as programme developers, users and the target

population, thus ensuring participation and involvement of key actors in all developmental stages of the programme. As a result, the programme was tailored to the specific needs and characteristics of participants as well as to available resources and skills of the main actors.

IM was also useful for planning the evaluation, since we used our inventory of performance and learning objectives to specify intermediary outcome indicators and to develop the survey instruments. We thus included outcome indicators at the behaviour and determinant levels, and at the individual and environmental levels.

Since application of IM completely according to the instruction given by the originators (Bartholomew et al., 2001) takes more time than was available within the Pro Children time frame, we used a modified version of the IM protocol to speed up the process. We combined steps one and two when developing matrices, although the process of formulating explicit learning and change objectives was included, and we restricted the amount and complexity of matrices that guide decision-making according to IM.

Using IM means that an intervention is not well laid out at the start of a project. This means that funding agencies need to decide on such projects without detailed information on the intervention contents, but should instead rely on the description of the development process. In the Pro Children example, we should acknowledge the courage of the project reviewers and the European Commission to approve and grant the project despite the absence of a clear-cut intervention plan, having confidence in the IM-driven careful intervention development plan.

Among the other potential strengths of the Pro Children intervention, we would like to stress that it was aimed at both the individual and the environmental level, including suggestions for organizational change such as building school project committees and changes in school policies like creating the fruit break. The Pro Children intervention encouraged active participation in learning processes and family support. Some of the learning methods make use of new technologies, such as computer-tailored tools and the website, which also served as a practical tool for cross-topic teaching experiences, involving English teachers, technology teachers and/or the usual classroom teacher. In conclusion, the Pro Children intervention was carefully developed based on the IM protocol that resulted in a comprehensive school-based fruit and vegetable promotion programme. This programme, which uses a common standard

intervention programme but at the same time allows fine-tuning to country-specific needs, is now available in four different languages, i.e. Norwegian, Dutch, Spanish and Basque. It has been implemented and is tested in three European countries.

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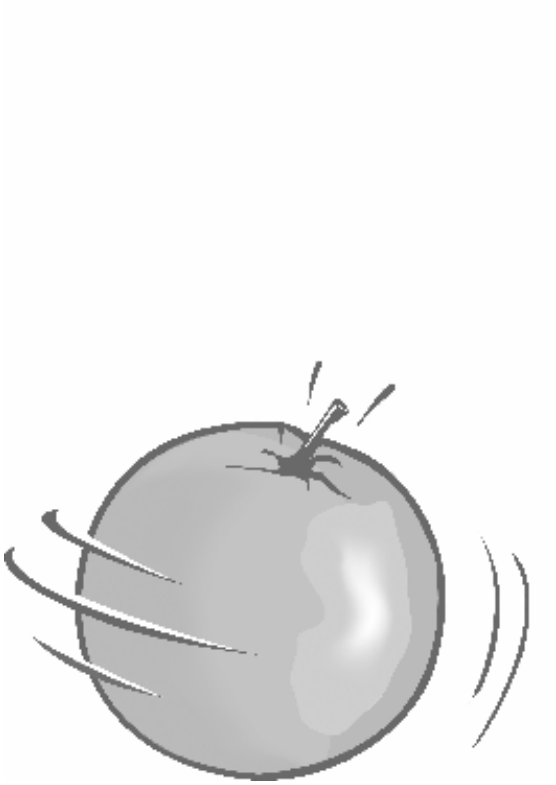
Part 3



Implementation and evaluation of the Pro Children intervention

Chapter 4

Short-term effects of a comprehensive fruit and vegetable promoting school-based intervention in three European countries

Abstract

This study assessed the effects of a school-based intervention to promote primary schoolchildren's fruit and vegetable (F&V) intake. The intervention combined a fruit and vegetable curriculum with efforts to improve F&V availability at schools and at home. The effects of the intervention were examined in a group (school)-randomised trial among 1601 children from 62 schools in Norway, the Netherlands and Spain. F&V intake, potential personal and environmental determinants and habit strength were assessed by means of validated self-administered school-based written questionnaires prior (September 2003), and immediately after the intervention (May 2004). Data were analysed using multivariate multileveling linear and logistic regression analyses. A significant intervention effect was found for usual fruit and vegetable intake frequency, fruit portions on the day prior to data collection, and knowledge of recommended daily intake levels of fruit and vegetable intakes. No effects were found on taste preferences and habit strength. Country-specific analyses showed only small differences in effect sizes between countries, except for the effect on portions of fruit per day, which was substantially stronger in Norway than both other countries. Only in the Netherlands and Spain were significant effects found for perceived availability. We conclude that the Pro Children intervention is a promising means to promote F&V intakes in European schoolchildren.

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Introduction

Epidemiological studies have shown an association of adequate intake of fruits and vegetables with decreased risk for cardiovascular diseases, obesity, hypertension and type 2 diabetes mellitus (Van Duyn & Pivonka, 2000). Promoting the intake of fruit and vegetables is therefore important. This is also the case for schoolchildren since intake of fruit and vegetables among European children is lower than recommended (Yngve et al., 2005).

During the past decades many school-based fruit and vegetable promotion interventions have been studied, mainly in the US (Blanchette & Brug, 2005). Several elements have been identified as successful key elements of an intervention. Interventions should focus on specific eating behaviours, should be guided by behavioural theory; devote adequate time and intensity; and preferably include changes in the school environment, personalized feedback and parental involvement; and using multimedia or web-based tools may be considered (Contento et al., 1995; Hoelscher et al., 2002; Klepp et al., 2005; Blanchette & Brug, 2005).

Within the Pro Children project a multi component intervention was developed that incorporated most of these elements (Pérez-Rodrigo et al., 2005), guided by the Intervention Mapping protocol (Bartholomew et al., 2001; Brug et al., 2005). The development of the intervention was based on both quantitative (Sandvik et al., 2005) and qualitative (Wind et al., 2005) studies in nine European countries to gain insight into important and changeable determinants of schoolchildren's fruit and vegetable intake. The Pro Children intervention has been implemented in three different European countries, i.e. Norway, the Netherlands and Spain. The intervention was theoretical similar in all countries, i.e. based on the same theoretical models. This paper describes the short-term effects of the Pro Children intervention on schoolchildren's fruit and vegetable intake and potential personal and environmental determinants of intake (Klepp et al., 2005).

Methods

The intervention

The classroom curriculum consisted of worksheets and a web-based computer-tailored feedback tool (Brug et al., 2003). Parents were encouraged to be

involved in the project by means of their children's homework assignments, parental newsletters and a parent version of the web-based computer-tailored tool that enabled them to get personalized feedback on their own fruit and vegetable intake levels. The content of the school curriculum and educational materials regarding parental involvement were similar in the three countries, but cultural relevant in the three countries. The school curriculum for example, addressed the national recommendations for the intake of fruit and vegetables, while activities directed at parents, such as newsletters, incorporated national information regarding relevant related projects and topics. During the intervention period schools were provided with fruit and ready-to-eat vegetables that could be consumed during school hours. In Norway a national fruit and vegetable subscription programme exists (www.skolefrukt.no) and therefore children from both the intervention group and the control group were invited to participate in the subscription programme. At participating schools, children that subscribe to the programme receive a piece of fruit or a carrot during lunch or during a fruit break each schoolday for which the parents pay a fee. In the Netherlands, children from the intervention schools received a piece of fruit, a carrot or a tomato for free during fruit breaks on two schooldays per week. In Spain, children from the intervention schools received fruit for free during the first two months of the intervention period. Intervention schools further explicitly asked the children to bring fruit from home on schooldays; a special fruit break was implemented in all intervention schools on between one to five schooldays per week. In Spain, where children are able to eat school lunches, fruit and vegetables were part of the school lunch at both the intervention schools and control schools during one to four days per week. The specific objective of this study was to increase F&V intake by 20% in intervention schools compared to control schools.

Design and participants

The effects of the intervention were examined in a group-randomised trial design among 2106 fifth and sixth graders, aged 10-11 years, from 62 schools in three European counties, i.e. in the Buskerud County of Norway, in Rotterdam, the Netherlands, and in the Bilbao region, Spain. In each country the schools were randomly assigned to an intervention or control group. Surveys among all participating children were conducted prior to the intervention (September 2003), immediately after (May 2004) and at the end of the

following school year (May 2005). In this study the short-term effects, immediately after the intervention, are described.

At baseline 282 children did not participate due to lack of informed consent or being sick on the day of data collection (response rate= 86.6%). At follow-up, an additional 141 children did not participate due to illness on the day of data collection or having changed school during the intervention period. Children were asked to complete a questionnaire during schoolhours in the presence of a project worker. Children received another questionnaire to take home for completion by one of their parents.

All data were entered and cleaned in the national centres according to a standardized protocol. All national data sets were pooled and further data processing and quality control was carried out in the Pro Children Data Management Centre at the University of Vienna (for more information on protocols and data management, as well as the Pro Children questionnaires see www.prochildren.org). Ethical approval for the Pro Children project was obtained from the medical ethical committees in all three countries. Parents had to provide written consent for their children. Responses were treated anonymously and confidential.

Measures

Primary outcome measures were the intake of fruit and vegetables, i.e. the number of portions consumed on the day prior to the day of data collection (24-hour recall) and the frequency of usual daily intake (ffq). Frequency of fruit intake was assessed by one food frequency question: 'How often do you usually eat fresh fruit'. Frequency of vegetable intake was measured by three food frequency questions: 'How often do you usually eat salad and grated vegetables', 'How often do you usually eat other raw vegetables', and 'How often do you usually eat cooked vegetables'. All four questions had eight response alternatives ranging from 'never' (0) to 'every day, more than twice per day' (7). Mean total frequency of vegetable intake per day was calculated by the sum of frequency of intake of salad/grated, raw and cooked vegetables. Secondary outcome measures were changes in determinants of behaviour, i.e. knowledge of recommended daily intake levels, general liking of fruit and vegetables, and preferences for twelve specific kinds of fruit and vegetables, perceived availability of fruit and vegetables at school, bringing fruit and vegetables to school and habit strength. All factors, except knowledge, were assessed using a

bipolar five-point scale: fully disagree (-2) to fully agree (+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 no vegetables' (0) to '5 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).

Mother's educational level, assessed by a questionnaire completed by the parents, was categorized based on the number of years of education: less than seven years, between seven and nine years, between ten and twelve years and more than twelve years.

Validity and reliability

The questionnaire, based on a theoretical framework, was tested for validity and reliability prior to the surveys (Klepp et al., 2005). Specific information on the development, reliability and validity of the intake part (Haraldsdóttir et al., 2005) and the determinant part (De Bourdeaudhuij et al., 2005) of the questionnaire has been published elsewhere.

Based on the data from the present study we again assessed Cronbach alphas for liking (two items) and preferences (twelve items). Cronbach alphas ranged from 0.66 to 0.86, indicating similar or even better internal consistency as compared to the reliability study (De Bourdeaudhuij et al., 2005). Habit strength (four items) was also included in the present study, but not in the original reliability study. Cronbach alphas ranged from 0.80-0.87, indicating good reliability. However, in the present study, Cronbach alphas for the environmental factors, assessing perceived availability at school and bringing fruit or vegetables to school, were considered to be too low (range 0.20 to 0.48). We therefore included two separate item scores in the analyses.

Respondents and preliminary data handling

In total 1824 children completed the baseline survey. Six questionnaires were considered not being reliable. Forty-two children were excluded due to over-reporting of the 24-hour recall (>1000 grams of fruit and vegetables per day). Another 18 children were excluded from analyses due to missing values on the food frequency measures at baseline. Of the remaining 1758 children 132 did not complete the follow-up questionnaire. Another 25 children were excluded

from the analyses due to overreporting and/or incompleteness of the food frequency measures at follow-up. These cases (n=157) were all considered to be dropout. Complete data on all intake measures were available for 1601 children. In order to compute scales for assessing determinants of intake, 50% of the scale items had to be answered. Due to missing values in the determinant part of the questionnaire the number of children that were included in the different analyses assessing changes in determinants of fruit intake varied from 1491-1569 in the total sample, 501-530 in Norway, 468-540 in Spain, and 486-502 in the Netherlands. When assessing changes in determinants of vegetable intake the number of children in the analyses varied from 1418-1540 for the total sample, 462-524 in Norway, 462-518 in Spain, and 487-505 in the Netherlands. Data on the mothers' educational level was available for 1205 children (75.3%).

Statistical analyses

Descriptive statistics were used to describe key participant characteristics and variable scores for the intervention and control group at baseline and follow-up. Differences at baseline between both groups were explored with Student's t-test or Chi-square-test.

All outcome measures were checked for normality. Frequency of fruit intake was normally distributed, while frequency of vegetable intake was adjusted for positive skewness with a log transformation (ln(x+1)).

Data from the 24-hour recall showed large skewed distribution due to the large number of zeros (child did not eat fruit or vegetables on the day prior to data collection), and log transformation did not result in a normal distribution. Therefore, analyses were conducted on non-transformed data. For all analyses, distribution of the residuals was checked and considered to be normal.

Normality of the distribution of habit strength and preferences for fruit and vegetables was acceptable. All other secondary outcomes measures, i.e. knowledge of recommended daily intake levels, liking, school availability and bringing fruit and vegetables to school were skewed and therefore dichotomised (negative or neutral scores = 0; positive scores = 1).

To assess potential dropout bias, multiple logistic regression analysis was conducted with dropout as dependent variable and country, gender, age, living circumstances, mother's educational level, and intake and treatment condition as independent variables.

As a consequence of the study design students were nested within schools and we expected a high probability of interdependence between the students of the same schools. To take this into account, multilevel analyses with random intercepts were conducted in MlwiN 1.10.0007 (Rabash et al., 1999) to assess the effects of the intervention on behaviour and determinants of behaviour, while controlling for gender, country and baseline value of the outcome measure. Before conducting these analyses, potential interaction effects of intervention group with gender, mother's educational level and country were explored with SPSS version 11.0 (SPSS Inc, 1999). All p-values are two-sided and 5% level of significance was used.

Results

Descriptives

Table 4.1 shows the characteristics of the study population at baseline. Children from the control group were slightly older than children from the intervention group. However, the difference was small (0.1 years) and therefore we did not adjust for age. The number of children from the three countries was not equally divided between the intervention and control group. No other significant differences on demographics between both groups were found.

In Table 4.2, mean scores on intake and determinants at baseline and follow-up are presented. Intake of vegetables in portion sizes differed significantly between the groups at baseline. Children from the control group consumed 0.27 ($p<0.01$) more portions of vegetables on the day prior to the day of data collection than children from the intervention group.

Multiple logistic regression of dropout showed that children from the intervention group (Odds Ratio (OR)=1.51, 95% confidence interval (CI) 1.05-2.17), boys (OR=1.58, 95%CI 1.11-2.26), and children from families in which at least one parents was born in a country other than the research country (OR=1.65, 95%CI 1.09-2.50) dropped-out significantly more often at follow-up than children from the control group, girls, and children from families in which both parents were born in the country where the study was conducted. Also children who ate more portions of vegetables (OR=1.11, 95%CI 1.03-1.20) dropped out significantly more often.

Table 4.1 Characteristics of the study population at baseline (n=1601)

Characteristics		Intervention group		Control group		P-value**
		N	% or mean (SD)	N	% or mean (SD)	
Country (N/ES/NL)*		243/320/305	28.0/36.8/35.2	297/236/200	40.6/32.2/27.2	0.000
Boys/girls		392/476	45.2/54.8	354/379	48.3/51.7	0.194
Age child, years		844	10.7 (0.54)	714	10.8 (0.54)	0.000
Lives with both own parents/ does not live with both own parents		658/206	76.2/23.8	557/171	76.5/23.5	0.891
Lives with two adults/ lives in single parent family		738/126	85.4/14.6	624/104	85.7/14.3	0.883
Both parents come from research country/at least one parent comes from other country then research country		595/219	73.1/26.9	523/183	74.1/25.9	0.687
Educational level mother/ female caretaker	1	54	8.3	41	7.4	0.201
	2	153	23.5	105	18.9	
	3	182	28.0	173	31.2	
	4	261	40.2	236	42.5	

* N=Norway, ES=Spain, NL=the Netherlands; ** estimated by t-test or Chi-square test for independent samples

Table 4.2.1 Consumption of fruits and vegetables in the intervention and the control groups, before and after the intervention (n=1601); means and 95% confidence intervals (95%CI).

		Intervention group		Control group		Differences at baseline†
	N	Baseline Mean (95% CI)	Post-test Mean (95% CI)	Baseline Mean (95% CI)	Post-test Mean (95% CI)	
24-hr recall						
Fruit per day, portions	869/ 732	1.80 (1.68-1.91)	1.90 (1.79-2.01)	1.71 (1.59-1.84)	1.51 (1.40-1.62)	0.345
Vegetables per day, portions	869/ 732	1.42 (1.28-1.56)	1.69 (1.54-1.85)	1.69 (1.54-1.86)	1.50 (1.35-1.66)	0.007
Food frequency						
Fruit, frequency	869/ 732	1.06 (1.00-1.12)	1.12 (1.06-1.18)	0.99 (0.94-1.06)	0.95 (0.89-1.00)	0.160
Vegetables, frequency	869/ 732	1.17 (1.10-1.24)	1.27 (1.20-1.34)	1.13 (1.06-1.21)	1.09 (1.01-1.16)	0.682

† estimated by t-test for independent samples

Table 4.2.2 Determinants of fruits and vegetables in the intervention and the control groups, before and after the intervention; means and 95% confidence interval (95%CI).

		Intervention group		Control group		Differences at baseline†
	N*	Baseline Mean (95% CI) or %**	Post-test Mean (95% CI) or %	Baseline Mean (95% CI) or %	Post-test Mean (95% CI) or %	
FRUIT						
Knowledge of recommended daily intake level	851/ 720	47.7	63.8	46.5	44.7	0.640
Liking	860/ 723	89.9	89.5	93.5	89.5	0.010
Preferences	851/ 714	1.22 (1.17-1.26)	1.20 (1.15-1.24)	1.25 (1.24-1.34)	1.25 (1.23-1.32)	0.103
School availabilty	834/ 697	27.6	46.7	28.6	31.5	0.673
Bring to school	856/ 715	15.4	16.5	17.5	15.0	0.271
Habit strength	846/ 676	0.80 (0.70-0.85)	0.81 (0.72-0.87)	0.96 (0.92-1.06)	0.86 (0.83-0.99)	0.001
VEGETABLES						
Knowledge of recommended daily intake level	849/ 704	24.9	34.8	23.3	20.2	0.475
Liking	855/ 697	62.8	57.8	67.6	56.8	0.050
Preferences	843/ 686	0.37 (0.30-0.43)	0.36 (0.31-0.43)	0.43 (0.41-0.54)	0.33 (0.32-0.46)	0.154
School availabilty	830/ 670	19.5	28.7	21.3	21.5	0.383
Bring to school	844/ 686	7.6	6.1	7.9	4.3	0.833
Habit strength	806/ 652	0.30 (0.22-0.39)	0.23 (0.14-0.32)	0.46 (0.41-0.59)	0.25 (0.21-0.41)	0.010

* N at baseline; ** % that scored positive on determinant; † estimated by t-test or chi-square test for independent samples

Effects on intake and determinants of intake

The results of the multilevel analyses for fruit and vegetable intake are summarized in Table 4.3. Table 4.4 shows the parameter estimates for determinants of intake. Results of initial fixed regression analyses conducted in

SPSS did not show evidence for interaction effects of group with gender and mother's educational level. However, significant interactions with country were found for liking fruit, preferences for fruit, bringing fruit to school and availability of fruit at school. For vegetables significant interactions of group with country were found for knowledge of recommended daily intake levels, bringing vegetables to school, school availability and habit strength. In addition to analyses on the pooled data, we therefore conducted all effect analyses for the three countries separately. Since we did not find differences in mother's educational level between the intervention and control group at baseline, and we did not find a selective dropout regarding educational level, only results without controlling for mothers educational level are shown. This increased the number of children in the analyses substantially because 396 children had missing values for mother's education. However, additional analyses with adjustments for mother's educational level did not change the results presented (data not shown).

Table 4.3 **Regression coefficients (b) and 95% confidence intervals (95%CI) derived from regression analyses with intake at follow-up as dependent variable and group (intervention vs. control) as dependent variable, controlling for gender, country and intake at baseline (n=1601)**

		FFQ fruit (frequency/day)			24H fruit (pieces/day)		
	N	b	95% CI		b	95% CI	
Total sample	1601	**0.147**	0.045	0.059	**0.359**	0.153	0.565
Norway	540	**0.147**	0.007	0.157	**0.486**	0.221	0.751
Spain	556	0.180	-0.010	0.160	0.301	-0.046	0.648
Netherlands	505	0.135	-0.010	0.160	0.252	-0.136	0.640

		FFQ vegetables (ratio)			24H vegetables (portions/day)		
	N	b	95% CI		b	95% CI	
Total sample	1601	**1.073***	1.021	1.126	0.260	-0.014	0.534
Norway	540	1.022	0.973	1.074	0.281	-0.170	0.732
Spain	556	**1.126**	1.007	1.260	0.299	-0.260	0.858
Netherlands	505	1.069	0.975	1.172	0.262	-0.110	0.634

Model random intercept at school level, adjusted for gender, baseline value, and research site (Norway, Spain, The Netherlands)
Bold: significant $p<0.05$
* back transformed regression coefficient and should be interpreted as a ratio between both groups

Table 4.4 **Odds ratios (OR) with 95% confidence intervals (95%CI) derived from multilevel logistic regression analyses with selected determinants of fruit and vegetable intake as dependent variables and group (intervention vs. control) as independent variable, adjusted for gender, country and the baseline value of the outcome measure**

	Knowledge of recommendation			Positive Liking			Preferences		
Fruit	OR	95% CI		OR	95% CI		b	95% CI	
Total sample	**2.72**	2.03	3.64	1.12	0.73	1.73	-0.013	-0.058	0.032
Norway	**3.81**	2.38	6.10	2.83	0.65	12.3	-0.059	-0.145	0.027
Spain	**2.12**	1.20	3.75	1.36	0.83	2.24	0.076	-0.008	0.160
Netherlands	**2.41**	1.61	3.63	0.47	0.22	1.04	-0.070	-0.164	0.024
Vegetables									
Total sample	**2.24**	1.65	3.04	1.20	0.90	1.60	0.069	-0.013	0.151
Norway	**3.65**	2.14	6.22	0.93	0.57	1.53	0.001	-0.097	0.099
Spain	**2.12**	1.20	3.75	1.70	0.91	3.17	0.159	-0.033	0.351
Netherlands	**1.77**	1.17	2.68	1.16	0.77	1.74	0.076	-0.040	0.192

	School Availability*			Bring to school*			Habit strength		
Fruit	OR	95% CI		OR	95% CI		b	95% CI	
Total sample	1.60	0.87	2.94	1.33	0.78	2.26	0.002	-0.088	0.092
Norway	1.69	0.52	5.48	1.03	0.66	1.63	0.013	-0.163	0.189
Spain	1.66	1.00	2.77	**4.14**	1.02	16.88	-0.065	-0.243	0.113
Netherlands	---	---	---	0.71	0.24	2.06	0.008	-0.151	0.167
Vegetables									
Total sample	1.32	0.76	2.29	1.84	0.96	3.53	0.002	-0.092	0.140
Norway	1.58	0.67	3.69	1.41	0.66	3.01	-0.185	-0.367	-0.003
Spain	1.14	0.59	2.23	2.50	0.65	9.62	0.194	-0.016	0.404
Netherlands	---	---	---	---	---	---	0.079	-0.121	0.279

Model random intercept at school level, adjusted for gender, baseline value, and research site (Norway, Spain, the Netherlands)
Bold significant p<0.05
* due to small cell sizes in the Netherlands, data from the Netherlands was left out

Fruit

Children from the intervention group reported to eat fruit 0.15 times more frequent per day and ate 0.36 more portions of fruit on the day prior to data collection compared to the control group (Table 4.3). Looking at the unadjusted data (Table 4.2.1) we see that an increase in intake was found in the intervention group, while the control group had a decrease in both frequency and portions of fruit intake. Effect estimates on usual frequency of fruit were of the same magnitude in all countries. The effect size for number of portions of fruit consumed at the previous day was substantially higher in the Norwegian

sample as compared with Spain and the Netherlands.

A positive intervention effect on knowledge of recommended daily intake levels was also found. We did not find an intervention effect on liking fruit, preferences for fruit, bringing fruit to school and habit strength in the total sample.

Country-specific analyses revealed that the effect on knowledge of recommended daily intake levels was strongest in Norway (Table 4.4).

Only in Spain, effects were found on bringing fruit to school. Spanish children from the intervention group were more likely to report to bring fruit to school than children from the control group.

Because most of the Dutch children (97.1%) reported perceived school availability to be zero at baseline, no reliable effect estimates could be obtained for perceived school availability in the country-specific analyses for the Netherlands. However, descriptive statistics shows that perceived availability of fruit at Dutch schools increased in the intervention group from 2.9% to 41.8% at post-test. The change in the control group was from 2.5% at baseline to 2.9% at post-test. Effects of perceived fruit availability at Spanish schools were of borderline significance.

Vegetables

Children from the intervention group reported to eat vegetables more often per day compared to the control group. Effect estimates were of the same magnitude in all countries. The presented regression coefficient is the back transformed regression coefficient and should therefore be interpreted as a ratio between both groups. The adjusted difference in frequency of intake between the intervention group and the control group was 7.3% (ratio=1.07). Looking at the unadjusted values we again see an increase from 1.17 at baseline to 1.27 at post-test in daily frequency of vegetable intake in the intervention group. The control group showed a decrease from 1.13 at baseline to 1.09 at post-test (Table 4.2.1). No significant effect on number of portions of vegetables consumed on the previous day was found.

In the total sample, intervention effects were found on knowledge of recommended daily intake levels. No effects were found on liking vegetables, preferences for vegetables, bringing vegetables to school, and habit strength.

Country-specific analyses again showed that the intervention effect on knowledge of recommended daily intake levels was strongest in Norwegian

children.

No reliable estimates could again be made for effects on school availability of vegetables in the Netherlands, since most Dutch children (96.3%) perceived vegetables not to be available at school at baseline. Descriptive statistics shows that perceived availability of vegetables at Dutch schools increased in the intervention group from 3.3% to 22.5% at post-test. The change in the control group was from 4.0% at baseline to 3.0% at post-test.

Discussion

The present study indicates that the Pro Children intervention significantly improved fruit and vegetable intakes in schoolchildren. The adjusted difference at post-test between intervention and control group was 23.7 % for portions of fruit on the day prior to data collection, 15.5% for frequency of usual fruit intake and 7.3% for usual vegetable intake frequency. The effects on fruit intake are in line or close to the 20% goal, but the effects on intake of vegetables stayed behind.

School-based interventions to promote consumption of fruit and vegetables among students in school settings have primarily consisted of multi-component interventions, and those including an environmental intervention component appear to be the most effective. The effect sizes from the Pro Children interventions are similar to those found in other comprehensive school-based intervention studies conducted, mostly in the US. (Blanchette & Brug, 2005; Pomerleau et al., 2005; French & Wechsler, 2004).

The intervention resulted in significant positive changes in some, but not all, determinants of intake, and these effects differed between countries. Knowledge of recommended daily intake levels have been found to be positively associated with intake (Reynolds et al., 2004) and we found a positive intervention effect on knowledge of recommended daily intake levels for fruit and vegetables in all countries. These effects were strongest in Norway, which might be explained by the fact that the Norwegian children in the present study were sixth graders while the Dutch and Spanish children were fifth graders.

Availability of fruit and vegetables and preferences are among the most important determinants of schoolchildren's fruit and vegetable intake (Blanchette & Brug, 2005, Bere & Klepp., 2004; Bere et al., 2005b). Only in the Netherlands a substantial increase in perceived availability of fruit and

vegetables at school was found. Because pre-study availability was very low in this country, there was more room for improvement. In Spain, children in the intervention group were strongly encouraged to bring fruit to school, which probably explains the significant effect on this determinant in the Spanish sample.

Unfortunately we were not able to change preferences for and liking of fruit and vegetables. Some studies suggest that repeated exposure to the taste of foods will improve likelihood of liking those foods (Birch, 1999; Wardle et al., 2003). However, up to ten exposures are probably needed. In the Pro Children study taste-testing activities were part of the interventions, but may have resulted in too few exposures to affect preferences. The fruit and vegetable deliveries in schools did improve exposure to fruits and vegetables in schools, but consisted mostly of fruits and vegetables the children probably already were familiar with. Moreover, about 89% of the children already scored positive on liking fruit and 63% on liking vegetables at baseline, which might imply ceiling effects, especially for fruit preferences.

Higher preferences for fruit and more frequent exposure to fruit compared to vegetables might explain why the effect sizes for fruit intake were larger than effects sizes for vegetable intake. Moreover, it is more common and easier to consume fruit as a snack in-between meals.

An important strength of the Pro Children is its questionnaire, which has been validated and is available in several European languages. This questionnaire might be useful to standardize measurement of intake and determinants across Europe (Haraldsdóttir et al., 2005; De Bourdeaudhuij et al., 2005). The cross-European character of the study shows that theoretically similar, but culturally sensible interventions can have an impact across countries with different intake levels (Yngve et al., 2005), determinants of intakes (Sandvik et al., 2005), as well as language. A further strength of this study is the multilevel design with inclusion and randomisation of a substantial sample of schools, using analyses in which we took clustering of children in schools into account.

In this study determinants of intake were assessed by single or few items measures, which might be less reliable than multi-item scales (Conner & Sparks, 2005). However, both self-reported measures of liking and preferences, as well as habit strength showed good test-retest or construct reliability (De Bourdeaudhuij et al., 2005). Knowledge and both environmental factors have

been assessed by single items, and might have to be considered with more care. Intake has been assessed by self-reported data, which may be liable to social desirability bias. This may be especially true for the frequency questions, which should therefore be interpreted with caution. The findings between the two self-reported measures of intake were quite consistent regarding fruit intake, but less consistent regarding vegetable intake for which we only found an effect on frequency of intake and not on portions of intake. However, the direction of the differences in intake of portions of vegetables is in favour of the intervention group. Parents may play a more important role when it comes to increasing their children's vegetable intake compared to fruit intake. Most homework assignments were more related to vegetables than to fruit, and parents might have been more willing to help their children or increase vegetable intake during the weekends, while the 24-hour recall only referred to schooldays.

Some indications were found that dropout depended on study condition. On request of the school staff, one Spanish intervention school dropped-out during the intervention period, which fully explains this selective dropout. Since all children who were present on the day of data collection completed the questionnaires, further dropout was a consequence of either children leaving school during the intervention period or being sick on the day of data collection. Thus this dropout was not caused by any conscious choice made by the child itself. Therefore intention-to-treat analysis was not conducted.

Mother's educational level was used as an indicator of social class. Although this might not be an optimal indicator of social class, it was the best measures we could use. Since mothers most often filled in the parental questionnaires, mother's educational level was used.

Differences in effects or lack of effects found might be explained by differences in or poor implementation of the school curriculum (Bartholomew et al., 2001; Green & Kreuter, 1999). The environmental component of the intervention, i.e. the distribution of fruit and vegetables, differed the most between the countries regarding frequency of distribution per week, types of food distributed, time of the day in which the food was handed out to the children and if parents had to pay to participate. Free fruit and vegetable school-schemes seem to be most promising (Bere et al., 2005a, Bere et al., 2006b), and most effective in increasing fruit intake (Eriksen et al., 2003; French & Stables, 2003). Although the school curriculum and parental components were more or less similar in the three countries, the implementation of these

components may have differed between and within countries. In Norway a home economic teacher is responsible for nutrition education and therefore took care of the Pro Children intervention, while in Spain and the Netherlands, the main teacher who is responsible for all education, was responsible for the Pro Children intervention. Further analyses will be conducted to gain insight into the degree and differences of implementation of the separate intervention components at the three intervention sites. Subsequently, by relating the implementation of these intervention components and assessing costs made for the development of the intervention components, cost-effectiveness analyses can be conducted.

Since we did not find an effect on habit strength, it is recommended to investigate effects on intake on the longer term. Habit strength theory predicts that repeating behaviour over time increases the likelihood that this behaviour will become habitual and that environmental cues, such as distributing fruit and vegetables, are needed to trigger habitual behaviour (Aarts et al., 1997). It will therefore be of importance to investigate whether effects on behaviour are maintained and whether effects on habit strength will also appear.

We conclude that the Pro Children intervention is a promising means to promote European schoolchildren's fruit and vegetable intakes, but mainly fruit intake, on the short-term. Since quite a consistent pattern was found in effects in all three countries reflecting the north, middle and south of Europe, we believe that the Pro Children intervention is applicable in other European countries as well. More studies investigating the effects, in particular the long-term effects, on behaviour and determinants of behaviour, are needed.

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Chapter 5

Long-term effects of a comprehensive fruit and vegetable promoting school-based intervention in three European countries

Abstract

The purpose of this study was to assess whether positive short-term effects of the Pro Children intervention were maintained on the longer term. The intervention consisted of a school curriculum and efforts to improve availability of fruit and vegetables at school. The long-term effects of the intervention were examined in a group (school)-randomised trial among 1488 children from 62 schools in Norway, the Netherlands and Spain. As outcome measures intake of fruit and vegetables, potential personal and environmental determinants and habit strength were measured by means of validated self-administered school-based written questionnaires. Baseline data were collected in September 2003. Follow-up measurements were completed in May 2004, and in May 2005. Data were analysed using multivariate multileveling linear and logistic regression analyses. The positive short-term effects on frequency and portions of fruit intake, frequency of vegetable intake and knowledge of recommended daily intake levels were maintained on the longer term. Country-specific analyses showed only small differences in effect sizes between countries, except for the effect on portions of fruit per day, which was substantially stronger in Norway than both other countries. No effects were found on habit strength. In the Netherlands and Norway positive effects were found on perceived availability of fruit and vegetables at school. Only in Norway was a positive effect found on taste preferences for fruit. We conclude that the longer term effects confirm that the Pro Children intervention is a promising means to promote fruit and vegetable intake among European schoolchildren.

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Introduction

Several studies have shown that European schoolchildren do not eat enough fruit and vegetables (Yngve et al., 2005; Dafne, 1998; Aranceta et al., 2003: WHO, 2004). Moreover, some studies suggest that healthy eating habits which are learned during childhood are maintained into adulthood (Kelder et al., 1994; Lien et al., 2001). Therefore the Pro Children intervention was designed to promote fruit and vegetable intake among Dutch, Norwegian and Spanish 10 to 13 year-old schoolchildren (Klepp et al., 2005).

The intervention was implemented during two school years (Klepp et al., 2005). During the first school year a multi-component intervention was implemented, and consisted of a fruit and vegetable school curriculum, activities to involve parents, and efforts to increase availability of fruit and vegetables at school. At the end of the first school year positive significant effects were found on frequency and portions of fruit intake, frequency of vegetable intake and knowledge of recommended daily intake levels. In the Netherlands positive effects were found on perceived availability of fruit and vegetables at school. In Spain positive effects were found on bringing fruit to school. No effects were found on taste preferences and habit strength (Wind et al., under review).

During the second school year the main component of the intervention consisted of the continuation of the (free) distribution of fruit and vegetables. Such interventions have been found promising (Bere et al., 2005a; Eriksen et al., 2003; French & Stables, 2003; Lowe et al., 2004).

Due to existing distribution schemes, the organisation of the distribution of fruit and vegetables differed between the three countries. During the second school year in both the Netherlands and Spain the distribution of fruit and vegetables was continued in exactly the same manner as during the first school year. In the Netherlands, children from the intervention schools received a piece of fruit, a carrot or a tomato for free during fruit breaks on two schooldays per week. In Spain, children from the intervention schools received fruit for free during the first two months of the intervention period. Intervention schools further explicitly asked the children to bring fruit from home on schooldays; a special fruit break was implemented in all intervention schools on between one to five schooldays per week. In Norway a national fruit and vegetable subscription programme exists (www.skolefrukt.no) and therefore children from both the intervention group and the control group were invited to take part in

the subscription programme. At participating schools, children that subscribe to the programme received a piece of fruit or a carrot during lunch or during a fruit break each schoolday for which the parents pay a fee. However during the last months of the second intervention year, i.e. from mid-January till mid-June, the children in the intervention schools were provided with fruit and vegetables for free.

The school curriculum and the activities to involve parents were much less extensive as compared to the first school year, and involved a free fruit and vegetable cookery book, continuation of a computer-tailored fruit and vegetable intervention, and two newsletters. The purpose of this study is to assess whether the short-term effects were maintained and whether effects on taste preferences and habit strength could be detected on the longer term, i.e. at the end of the second school year.

Methods

Design and participants

The effects of the intervention were examined in a group-randomised trial design among 2106 10-13 year-old schoolchildren from 62 schools in three European counties, i.e. in the Buskerud County of Norway, in Rotterdam, the Netherlands, and in the Bilbao region, Spain. In each country the schools were randomly assigned to an intervention or control group. Surveys among all participating children were conducted prior to the intervention (September 2003), immediately after (May 2004) and at the end of the following school year (May 2005). In this study the longer term effects at the second follow-up are described.

At baseline 282 children did not participate due to lack of informed consent or being sick on the day of data collection (response rate was 86.6%). At the second follow-up, an additional 131 children did not participate due to illness on the day of data collection or having changed school during the intervention period. Children were asked to complete a questionnaire during schoolhours in the presence of a project worker. Children received another questionnaire to take home for completion by one of their parents.

All data were entered and cleaned in the national centres according to a standardized protocol. All national data sets were pooled and further data

processing and quality control was carried out in the Pro Children Data Management Centre at the University of Vienna (for more information on protocols and data management, as well as the Pro Children questionnaires see www.prochildren.org). Ethical approval for the Pro Children project was obtained from the medical ethical committees in all three countries. Parents had to provide written consent for their children. Responses were treated anonymously and confidential.

Measures

Primary outcome measures were the intake of fruit and vegetables, i.e. the number of portions consumed on the day prior to the day of data collection (24-hour recall) and the frequency of usual daily intake. Frequency of fruit intake was assessed by one food frequency question: 'How often do you usually eat fresh fruit'. Frequency of vegetable intake was measured by three food frequency questions: 'How often do you usually eat salad and grated vegetables', 'How often do you usually eat other raw vegetables' and 'How often do you usually eat cooked vegetables'. All four questions had eight response alternatives ranging from 'never' (0) to 'every day, more than twice per day' (7). Mean total frequency of vegetable intake per day was calculated by the sum of frequency of intake of salad/grated, raw and cooked vegetables. Secondary outcome measures were changes in potential determinants of behaviour, i.e. knowledge of recommended daily intake levels, general liking of fruit and vegetables, and preferences for twelve specific kinds of fruit and vegetables, perceived availability of fruit and vegetables at school, bringing fruit and vegetables to school, and habit strength. All factors, except knowledge, were assessed with single or multiple items using a bipolar five-point scale: fully disagree (-2) to fully agree (+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 according to recommendations for health promotion. Response options ranged from 'no fruit or no vegetables' (0) to '5 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).

The questionnaire, based on a theoretical framework, was tested for validity and reliability prior to the surveys (Klepp et al., 2005). Specific information on the development, reliability and validity of the intake part and

the determinant part of the questionnaire has been published (Haraldsdóttir et al., 2005; De Bourdeaudhuij et al., 2005; Wind et al., 2006).

Respondents and preliminary data handling

In total 1824 children completed the baseline survey. In total, 66 children were excluded because of over-reporting of the 24-hour recall (>1000 grams of fruit and vegetables per day) at baseline (n=42) or missing values on the food frequency measures at baseline (n=18), or a large number of missings data on other relevant measures that made the questionnaire unreliable (n=6). Of the remaining 1758 children 230 did not complete the second follow-up questionnaire. Another 40 children were excluded from the analyses due to over-reporting (n=13) and/or incompleteness of the food frequency measures at follow-up (n=27). These cases (n=270) were all considered to be drop-outs. Complete data on all intake measures were available for 1488 children. In order to compute scales for assessing determinants of intake, 50% of the scale items had to be answered. Due to missing values in the determinant part of the questionnaire the number of children that were included in the different analyses on effects on determinants of fruit intake/vegetable intake varied from 1358-1468/1321-1428 in the total sample, 457-492/414-482 in Norway, 433-496/431-470 in Spain, and 466-480/466-480 in the Netherlands.

Statistical analyses

To describe key participant characteristics and variable scores for the intervention and control group at baseline, descriptive statistics were used. Descriptives at baseline have been reported by Wind et al., under review; see Table 4.1 in Chapter 4 of this thesis.

All outcome measures were checked for normality. Frequency of fruit intake was normally distributed, while frequency of vegetable intake was adjusted for positive skewness with a log transformation (ln(x+1)).

Data from the 24-hour recall showed a very skewed distribution due to the large number of zeros (child did not eat fruit or vegetables on the day prior to data collection), and log transformation did not result in a normal distribution. Therefore, analyses were conducted on non-transformed data. For all analyses, distribution of the residuals was checked and considered to be normal. Normality of the distribution of habit strength and preferences for fruit and vegetables was

acceptable. All other secondary outcome measures, i.e. knowledge of recommended daily intake levels, liking, school availability and bringing fruit and vegetables to school were skewed and therefore dichotomized (negative or neutral scores = 0; positive scores = 1).

To assess potential drop-out bias, multiple logistic regression analysis was conducted with drop-out between baseline and second follow-up as dependent variable and country, gender, age, living circumstances, intake at baseline, and treatment condition as independent variables.

Potential interaction effects of intervention group with gender and country were explored with SPSS version 11.0 (SPSS Inc, 1999). Since students were nested within schools with a high probability of interdependence between the students of the same schools, multilevel analyses with random intercepts were conducted in MlwiN 1.10.0007 (Rabash et al., 1999) to test for differences in outcome measures at follow-up between groups, while controlling for gender, country and baseline value of the outcome measure. All p-values are two-sided and 5% level of significance was used.

Results

As reported earlier (Wind et al., under review), at baseline a minor but statistically significant difference in age between the children in the intervention group and control group was found. However, since children from the control group were only 0.1 years older than children from the intervention group, we did not adjust for age.

Multiple logistic regression of drop-out at second follow-up did reveal some selective drop-out. Children from the intervention group (Odds Ratio (OR)=1.42, 95% confidence interval (CI)=1.07-1.89), Spanish children (OR=1.61, 95%CI 1.09-2.38), older children (OR=1.65, 95%CI 1.20-2.26), and children from families in which at least one parent was born in a country other than the research country (OR=1.42, 95%CI 1.02-2.00) dropped-out significantly more often than children from the control group, Norwegian and Dutch children, younger children, and children from families in which both parents were born in the country where the study was conducted.

Mean scores on intake and determinants at baseline and second follow-up are presented in Table 5.1. Intake of vegetables in portion sizes differed significantly between the groups at baseline. Children from the control group

consumed 0.26 ($p<0.05$) more portions of vegetables on the day prior to the day of data collection than children from the intervention group.

Table 5.1.1 Consumption of fruits and vegetables in the intervention and the control groups, before the intervention and at second follow-up (n=1488); means and 95% confidence intervals (95%CI).

		Intervention group		Control group		Differences at baseline[†]
	N	Baseline Mean (95% CI)	Post-test Mean (95% CI)	Baseline Mean (95% CI)	Post-test Mean (95% CI)	
24-hr recall						
Fruit per day, portions	804/ 684	1.82 (1.70-1.94)	1.88 (1.77-1.99)	1.72 (1.59-1.84)	1.59 (1.47-1.71)	0.227
Vegetables per day, portions	804/ 684	1.45 (1.30-1.60)	1.47 (1.33-1.61)	1.71 (1.54-1.88)	1.39 (1.24-1.56)	0.024
Food frequency						
Fruit, frequency	804/ 684	1.07 (1.01-1.13)	1.22 (1.16-1.29)	1.01 (0.95-1.08)	0.96 (0.90-1.02)	0.169
Vegetables, frequency	804/ 684	1.18 (1.11-1.26)	1.23 (1.16-1.30)	1.15 (1.07-1.23)	1.12 (1.05-1.20)	0.604

[†] estimated by t-test for independent samples

Table 5.2 presents the results of the multilevel analyses for fruit and vegetable intake. Parameter estimates for determinants of intake are shown in Table 5.3. Results of initial fixed regression analyses conducted in SPSS did not show evidence for interaction effects of group with gender. In addition to analyses on the pooled data, we conducted effect analyses for the three countries separately.

Table 5.1.2 Determinants of fruits and vegetables in the intervention and the control groups, before and after the intervention; means and 95% confidence intervals (95%CI).

		Intervention group		Control group		Differences at baseline†
	N*	Baseline Mean (95% CI) or %**	Post-test Mean (95% CI) or %	Baseline Mean (95% CI) or %	Post-test Mean (95% CI) or %	
FRUIT						
Knowledge of recommended daily intake level	778/ 720	48.4	64.9	46.9	52.5	0.574
Liking	797/ 674	90.3	88.4	94.1	88.7	0.008
Preferences	778/ 669	1.23 (1.18-1.27)	1.19 (1.15-1.24)	1.30 (1.25-1.35)	1.24 (1.19-1.24)	0.104
School availabilty	768/ 648	27.0	58.9	28.2	27.4	0.589
Bring to school	790/ 666	14.8	12.3	17.4	15.9	0.176
Habit strength	775/ 634	0.78 (0.71-0.86)	0.81 (0.74-0.89)	0.94 (0.86-1.01)	0.84 (0.76-0.92)	0.015
VEGETABLES						
Knowledge of recommended daily intake level	785/ 660	25.5	36.1	22.6	20.3	0.199
Liking	792/ 654	61.9	53.8	68.3	55.6	0.010
Preferences	778/ 647	0.37 (0.30-0.44)	0.28 (0.21-0.35)	0.46 (0.39-0.54)	0.37 (0.24-0.44)	0.218
School availabilty	765/ 637	18.6	28.1	21.5	17.0	0.167
Bring to school	779/ 645	7.6	3.8	8.4	4.9	0.479
Habit strength	738/ 611	0.30 (0.21-0.38)	0.20 (0.11-0.29)	0.46 (0.36-0.55)	0.28 (0.18-0.57)	0.041

* N at baseline; ** % that scored positive on determinant; †estimated by *t-test* or chi-square test for independent samples

Fruit

At second follow-up, children from the intervention group reported to eat fruit 0.24 times more often per day and ate 0.29 more portions of fruit on the day prior to data collection compared to the control group (Table 5.2). Unadjusted

data in Table 5.1.1 show that the intervention group had an increase in frequency of fruit intake, while the control group had a small decrease. A positive intervention effect on knowledge of recommended daily intake levels was also found.

Country-specific analyses revealed that effect estimates on frequency of fruit intake were significant in all countries. The effect size for number of portions of fruit, and knowledge, was substantially higher in the Norwegian sample compared with Spain and the Netherlands. In the Norwegian sample a positive effect was found on liking fruit was also found.

Perceived availability of fruit at Dutch schools increased substantially in the intervention group from 2.9% to 60.4% at second follow-up. The change in the control group was from 2.6% at baseline to 2.1% at second follow-up. Descriptive statistics also show that perceived availability of fruit at Norwegian schools increased in the intervention group from 58.5% at baseline to 97.7% at second follow-up, compared to a decrease from 52.9% to 48.4% in the Norwegian control children. However, for both countries no reliable tests for significance could be made, since most of the Dutch children (97.1%) reported perceived school availability to be zero at baseline, while most Norwegian intervention children perceived fruit to be available at second follow-up.

Table 5.2 **Regression coefficients (b) and 95% confidence intervals (95%CI) derived from regression analyses with intake at follow-up as dependent variable and group (intervention vs. control) as dependent variable, controlling for gender, country and intake at baseline (n=1488)**

		FFQ fruit (frequency/day)			24H fruit (pieces/day)		
	N	b	95% CI		b	95% CI	
Total sample	1488	**0.240**	0.136	0.507	**0.290**	0.039	0.541
Norway	500	**0.253**	0.067	0.384	**0.721**	0.307	1.135
Spain	506	**0.158**	0.011	0.180	-0.017	-0.231	0.197
Netherlands	442	**0.288**	0.112	0.507	0.224	-0.072	0.520

		FFQ vegetables (ratio)			24H vegetables (portions/day)		
	N	b	95% CI		b	95% CI	
Total sample	1488	**1.046***	1.006	1.088	0.150	-0.062	-0.362
Norway	500	1.018	0.960	1.080	-0.021	-0.487	0.445
Spain	506	1.016	0.094	1.099	0.040	-0.276	0.356
Netherlands	442	1.050	0.971	1.136	0.234	-0.187	0.655

Model random intercept at school level, adjusted for gender, baseline value, and research site (Norway, Spain, The Netherlands)

Bold: significant $p<0.05$; * back transformed regression coefficient and should be interpreted as a ratio between both groups

Table 5.3 **Odds ratios (OR) with 95% confidence intervals (95%CI) derived from multilevel logistic regression analyses with selected determinants of fruit and vegetable intake as dependent variables and group (intervention vs. control) as independent variable, adjusted for gender, country and the baseline value of the outcome measure**

	Knowledge of recommendation			Positive Liking			Preferences		
Fruit	OR	95% CI		OR	95% CI		b	95% CI	
Total sample	**2.25**	1.69	2.98	1.23	0.75	1.99	-0.002	-0.053	0.049
Norway	**4.02**	2.40	6.72	**4.37**	1.25	15.28	-0.021	-0.094	0.052
Spain	1.29	0.83	2.00	0.98	0.60	1.61	0.056	-0.040	0.152
Netherlands	**2.52**	1.60	3.96	0.77	0.22	2.67	-0.029	-0.139	0.081
Vegetables									
Total sample	**2.53**	1.75	3.66	1.10	0.86	1.41	-0.020	-0.106	0.066
Norway	**3.59**	2.18	5.91	1.49	0.95	2.35	-0.068	-0.186	0.050
Spain	1.68	0.76	3.70	1.12	0.69	1.82	-0.052	-0.250	0.146
Netherlands	**2.45**	1.37	4.38	0.85	0.57	1.26	0.057	-0.088	0.202

	School Availability*			Bring to school*			Habit strength		
Fruit	OR	95% CI		OR	95% CI		b	95% CI	
Total sample	---	---	---	0.94	0.59	1.48	0.037	-0.088	0.162
Norway	---	---	---	0.46	0.29	0.75	0.021	-0.157	0.199
Spain	1.28	0.83	1.96	2.86	0.79	10.40	0.085	-0.091	0.261
Netherlands	---	---	---	1.39	0.62	3.12	-0.043	-0.315	0.229
Vegetables									
Total sample	**1.97**	1.03	3.75	0.98	0.51	1.89	-0.006	-0.116	0.104
Norway	2.66	0.86	8.24	1.16	0.52	2.57	-0.113	-0.313	0.087
Spain	1.41	0.83	2.41	0.73	0.26	2.07	0.106	-0.108	0.320
Netherlands	---	---	---	---	---	---	0.016	-0.164	0.196

Model random intercept at school level, adjusted for gender, baseline value, and research site (Norway, Spain, the Netherlands)
Bold significant p<0.05
* due to small cell sizes in the Netherlands (and Norway), data from the Netherlands (and Norway) was left out

Vegetables

Children from the intervention group reported to eat vegetables more often per day compared to the control group. Effect estimates were of the same magnitude in all countries. The presented regression coefficient is the back transformed regression coefficient and should therefore be interpreted as a ratio between both groups. The adjusted difference between both groups was 4.6% (ratio=1.04), in favour of the intervention group. Unadjusted data show that daily frequency of vegetable intake increased from 1.07 at baseline to 1.22 at

second follow-up in intervention schools, while the control group showed a small decrease from 1.01 at baseline to 0.96 at second follow-up (Table 5.1.1).

Country-specific analyses again showed that the intervention effect on knowledge of recommended daily intake levels was strongest in Norwegian children, and was not found in Spain.

Descriptive statistics show that perceived availability of vegetables at Dutch schools increased in the intervention group from 4.0% to 26.2% at second follow-up. The change in the control group was from 7.0% at baseline to 2.6% at second follow-up.

Discussion

The present study indicates that the positive short-term effects of the Pro Children intervention on schoolchildren's frequency and portions of fruit intake, frequency of vegetable intake, and knowledge of recommended daily intake levels were maintained.

Effects on frequency and portions of fruit intake were even somewhat larger than on the short-term, especially in Norway. Effects for usual vegetable intake were minor on the short term and the effect sizes, although still statistically significant, became smaller on the longer term.

The largest increase in frequency of fruit and vegetable intake was found in Norway and the Netherlands, and might be explained by the fact that only in those two countries were fruit and vegetables handed out for free during the whole or part of the second intervention school year. Free provision of fruit and vegetables have been successful and most effective in increasing fruit intake (Bere et al., 2005a; 2005b). The disappointing effects on vegetable intake may be explained by the fact that most often fruit was handed out at school. Moreover, parents might be more important when it comes to promoting vegetable intake, while during the second school year only very few activities were aimed at parents.

Differences in frequency of exposure might explain why effect sizes on portions of fruit were largest in the Norwegian sample. Dutch children received fruit and ready-to-eat vegetable during two schooldays per week, while in Norway fruit and vegetables were handed out during each schoolday. The increase in perceived availability of fruit in the Netherlands and Norway may also be explained by the free distribution of fruit.

Availability of fruit and vegetables (Blanchette & Brug, 2005; Bere & Klepp, 2004; Bere et al., 2005b), preferences for fruit and vegetables (Blanchette & Brug, 2005; Bere & Klepp, 2004; Bere et al., 2005b) and knowledge of recommended daily intake levels (Reynolds et al., 2004; Blanchette & Brug, 2005; Wind et al., in press) have been found to be positively associated with intake. Changes in perceived availability at school, as well as maintenance of positive effects on knowledge were detected in the Netherlands and Norway. Only in Norway was a positive increase in fruit taste preferences found, which might be a consequence of the change in the distribution of fruit and vegetables, i.e. the free distribution of fruit and vegetables to all intervention children during five schooldays per week. Children's preferences tend to increase with the frequency of their exposure to it (Wardle et al., 2003).

Differences in effect on perceived availability, taste preferences and knowledge might explain why effects on intake were smallest in Spain, and largest in Norway.

Although we did find positive long-term effects on frequency of fruit and vegetable intake, we did not find an effect on habit strength. While habit strength theory postulates that behaviour will become habitual when behaviour is triggered by environmental cues, such as the provision of fruit and vegetables (Aarts et al., 1997). Unfortunately we were not able to assess effects on intake after cessation of the (free) fruit and vegetable distribution, because the children had left school. This study gave some indication that handing out fruit for free is associated with changes in intake, which is in line with a similar study done by Bere and colleagues (Bere et al., 2005a; 2005b). That study further suggested that effect sizes are stronger when fruit is handed out on more schooldays. Moreover, provision of fruit and vegetables for free does not increase possible existing differences in fruit and vegetable intake between social groups, since all schoolchildren are reached by such an intervention.

We conclude that the short-term effects of the Pro Children intervention largely remained one year later. This study gives some indication that providing schoolchildren with fruit and vegetables for free is an effective strategy to increase and maintain schoolchildren's intake.

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Chapter 6

Appreciation and implementation of a school-based intervention are associated with changes in fruit and vegetable intake in 10 and 11-year-old schoolchildren-the Pro Children study

Abstract

The purpose was to investigate the degree of implementation and appreciation of a comprehensive school-based fruit and vegetable intervention programme and to what extent these factors were associated with changes in reported fruit and vegetable intake, among children exposed to the intervention. The Pro Children intervention was developed, implemented and evaluated in schools in Norway, Spain and the Netherlands. Validated questionnaires were used to assess intake. Children, parents and teachers completed questionnaires regarding (1) the implementation of the school curriculum, (2) parental involvement, (3) distribution of fruit and vegetables at school, and (4) children's appreciation of the project. Univariate ANCOVAs and multilevel multivariate regression analyses were conducted. Teachers reported level of implementation of the school curriculum, which ranged from two to all sixteen lessons, and schoolchildren's appreciation of the project were important determinants of changes in intake. This implies the importance of implementing and developing an attractive school curriculum.

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Introduction

The reported intake of fruit and vegetables among European children is lower than recommended (Yngve et al., 2005). Epidemiological studies have shown an association of adequate intake of fruits and vegetables with decreased risk for cardiovascular diseases, obesity, hypertension and type 2 diabetes mellitus (Van Duyn & Pivonka, 2000). Therefore the Pro Children study was initiated in 2002, aiming at increasing fruit and vegetable intake among 10-13 year-old European schoolchildren (Klepp et al., 2005).

Based on available literature reviews of the state-of-the-art school-based interventions to promote consumption of fruit and vegetables among schoolchildren (Contento et al., 1995; Hoelscher et al., 2002; Blanchette & Brug, 2005), the Pro Children programme was designed to include a school curriculum, parental involvement, and changes in the school environment (Pérez-Rodrigo et al., 2005). The development of the Pro Children intervention was guided by the Intervention Mapping protocol, a systematic stepwise approach to ensure an evidence-based and theory-driven development and implementation of health promoting interventions.

Within the Intervention Mapping protocol the use of several theories, as well as focusing on environmental determinants besides personal determinants, is stressed (Bartholomew et al., 2001; Brug et al., 2005). The final theoretical framework used for the Pro Children study (Figure 2, page 7) proposes that more distal determinants of fruit and vegetable consumption can be found in the physical and the social environment, and that these in turn influence more proximal personal determinants such as knowledge, liking, preferences, and self-efficacy (Klepp et al., 2005), and is much in line with Flay's Theory of Triadic Influences (Flay & Petriatis, 1994).

An evaluation study assessing the effects of the Pro Children intervention has shown that the intervention was effective in changing frequency of fruit and vegetable intakes (Wind et al., under review).

When implementing comprehensive multi-component interventions, like Pro Children, it is difficult to determine which component(s) contributed to the effects. Theoretically, in the most ideal situation the effects of intervention components would have been tested separately before launching the comprehensive programme. However, such a step-wise approach requires time and money and is often not feasible, and process evaluations are therefore

recommended to explore mediators of effects (Bartholomew et al., 2001, Green & Kreuter, 1999). Judgement about the extent to which the intervention was implemented as planned and reached the intended participants, can be helpful in understanding what induced the effects of an intervention. Such studies have been conducted, mainly in the US (Baranowski & Stables, 2000; Davis et al., 2000; Story et al., 2000; Reynolds et al., 2000; Birnbaum et al., 2002). Correlating process measures with outcome is considered to be a strong approach to explore the effectiveness of intervention components and to determine or improve the cost-effectiveness (Baranowski & Stables, 2000), and has, for example, been done by Bere and colleagues (2006a).

The aim of the present study was first to investigate (1) the quantity and quality of activities that were implemented at school (school curriculum extent and fidelity), (2) the degree of parental involvement as indicated by the number of activities that were carried out with (one of) the parents, (3) exposure to fruit and vegetables as indicated by changes in weekly frequency of direct intervention-related distribution of fruit and vegetables, and (4) appreciation of the project by the child. The second aim of this study was to assess whether these four process measures were associated with the short-term effects on schoolchildren's frequency of fruit and vegetable intake.

Methods

Study design and population

The effects of the intervention were examined in a group-randomised trial design among 2106 primary schoolchildren from 62 schools with 117 classes, within three European countries, i.e. in the Buskerud County of Norway, in Rotterdam, the Netherlands, and in the Bilbao region, Spain. In each country the schools were randomly assigned to an intervention or control group. Surveys among all participating children were conducted prior to the intervention (September 2003), immediately after (May 2004) and at the end of the following school year (May 2005).

The current study aims at assessing which characteristics of the intervention, implemented between October 2003 and May 2004, were associated with the short-term effects of the intervention. Therefore we only consider the children from the intervention group that have complete intake

data at baseline and at first follow-up. Thus the eligible sample of the current study consisted of 1115 children from the intervention group.

Children were asked to complete the questionnaires during schoolhours in the presence of a project worker. Each child took a questionnaire home to be completed by one of their parents, at baseline and again at follow-up. Process questions regarding the implementation of several activities were included in the first follow-up questionnaires for both children and parents. Teachers from the intervention schools were asked to complete questionnaires halfway through the intervention period and again at the end of the intervention period. In addition to these questionnaires, teachers were asked to keep pre-structured logbooks during the intervention period.

All data were entered and cleaned at the national centres according to a standardized protocol. The national data sets were then pooled and further data processing and quality control of the intake data was carried out at the Pro Children Data Management Centre, University of Vienna (for more information on protocols and data management, as well as the Pro Children questionnaires, please see www.prochildren.org). Ethical approval for the Pro Children project was obtained from the medical ethical committees in all countries. Responses were treated anonymously and confidential.

The intervention

The *school curriculum* consisted of thirteen worksheets and a web-based computer-tailored feedback tool that children were asked to complete three times during the intervention period (Pérez Rodrigo et al., 2005). The school curriculum addressed knowledge of recommended daily intake levels, awareness of own intake, taste preferences, health benefits from fruit and vegetable consumption, influences from peers and parents, and asking and preparing skills. *Parents* were encouraged to be involved in the project by means of four homework assignments of their child, three parental newsletters and a parent version of the web-based computer-tailored tool that enabled them to get personalized feedback on their own fruit and vegetable intake levels. The *distribution of fruit and vegetables at school* differed between the three countries, since the organization was adapted to each country's situation. In Norway a national fruit and vegetable subscription programme already existed before the start of the intervention (www.skolefrukt.no). Children were invited

to subscribe to the programme and received a piece of fruit or a carrot during lunch or during a fruit break each schoolday for which the parents pay a fee. Children were able to sign on or discontinue their participation in the subscription programme at the start of each school semester.

In the Netherlands, no children received fruit and vegetables at school at the time of the baseline survey. As part of the intervention, all children received a piece of fruit, a carrot or a tomato for free during a fruit break at two schooldays per week.

In Spain, children also received a piece of fruit for free during the first two months of the intervention period during a special fruit break. After these two months, the fruit break was continued by asking the children to bring fruit from home. The frequency of this fruit break varied from one day to all five schooldays per week across participating schools. In addition to this fruit break, Spanish children were able to eat lunch at school through a subscription programme (independent of the intervention programme). Fruit was part of the school lunches during two or three days per week. Frequency of distribution of vegetables during school lunches varied between one to four days per week. In Spain, for each class, a mean frequency of distribution of fruit and vegetables was calculated, based on frequency of a fruit break and inclusion of fruit and/or vegetables during the school lunch.

To guide the teachers in implementing the intervention programme, all eligible teachers were invited to take part in a one-day teacher training prior to the start of the intervention, and they were provided with a teachers' project manual.

The Pro Children intervention was successful as assessed by a comparison of the intervention group with the control group at first follow-up. Multilevel analyses showed that the intervention group had a significantly higher mean frequency of fruit and vegetable intake adjusted for baseline intake levels. Children from the intervention group reported to eat fruit 0.15 times more often per day compared to the control group (adjusted difference). Looking at the unadjusted data an increase in intake was found in the intervention group, while the control group showed a decrease in both frequency and portions of fruit intake. The adjusted difference in frequency of intake between the intervention group and the control group was 7.3%. Daily frequency of vegetable intake in intervention schools increased from 1.17 at baseline to 1.27 at post-test, while

the control group showed a decrease from 1.13 at baseline to 1.09 at post-test (Wind et al., under review).

Measures

The development of the questionnaire assessing fruit and vegetable intake and potential determinants of intake followed several steps. A systematic literature review (Rasmussen et al., 2006), and additional qualitative research (Wind et al., 2005 (Chapter 1)) were conducted to investigate relevant determinants. Finally pilottests, including assessments of the validity and reliability of the questionnaire, were conducted in three different studies with 10 to 11 year-old schoolchildren in four to six European countries, including Norway and Spain (Haraldsdóttir et al., 2005). However, for the process measures no validated measures were available.

Intake

Primary outcome measures were frequency of usual fruit and vegetable intake. Frequency of fruit intake was assessed by one food frequency question: 'How often do you usually eat fresh fruit'. Frequency of vegetable intake was measured by three food frequency questions: 'How often do you usually eat salad and grated vegetables', 'How often do you usually eat other raw vegetables', and 'How often do you usually eat cooked vegetables'. All four frequency questions had eight response alternatives ranging from 'never' (0) to 'every day, more than twice per day' (7). Mean total frequency of vegetable intake per day was calculated by the sum of frequency of intake of salad/grated, raw and cooked vegetables.

Specific information on the development, reliability and validity of the intake part of the Pro Children questionnaire has been published elsewhere (Haraldsdóttir et al., 2005). Both the validity and the reproducibility of the food frequency questions as to ranking of the subjects were regarded to be satisfactory. Spearman rank correlations for frequency of fruit and vegetable intake as assessed by the Pro Children food frequency questions and a 7-day food record ranged from 0.40 to 0.53. Between 25-50% were classified into the same quartile and 70-88% into the same or adjacent quartile of intake. The reliability study showed that test-retest Spearman rank correlations were between 0.47 and 0.84 (Haraldsdóttir et al., 2005).

Intervention characteristics

In order to assess both the quantity (dose delivered) and the quality (fidelity) of the *school curriculum*, questionnaires completed by the teachers were used. For each of the 16 school-based activities (worksheets and computer-tailored tool) teachers were asked whether they had conducted the activity, and whether they had implemented the lesson at all ('yes'=1, 'no'=0), and whether they had followed the instructions in the teachers manual ('yes all of it'=1, 'no some of it'=0.5, 'no not at all'=0). By combining the quantity and quality of the sixteen activities, a composite score was calculated (0-16). In addition to these teacher questionnaires, logbooks were used to complete and verify the delivery and fidelity of the implementation of the school curriculum.

Parental involvement was assessed by asking the parents ('yes'=1, 'no'=0), whether they had helped their children doing the four homework assignments that specifically asked for their input, whether they had conducted the computer-tailored tool for adults, and whether they had seen at least two of the three newsletters. Parents were also asked whether they talked about the project with their child ('often'=1, 'sometimes'=0.5, 'no'=0). Subsequently, a total score for parental involvement was calculated (0-7).

To assess changes in *distribution of fruit and vegetables at school* the difference between weekly frequency of intervention-induced distribution of fruit and vegetables, assessed at follow-up and baseline, was computed.

In addition to these three intervention characteristics children were asked whether they *appreciated the project* by indicating whether they liked eight different project activities and the project in general ('liked it a lot'=3, 'liked it'=2, 'did not like it'=1). When calculating a mean score for appreciation (1-3), the number of activities that were implemented at school according to the schoolteachers was taken into account, i.e. when a child did indicate he/she liked an activity, but this activity was reported as not conducted by the teacher, the child's answer was considered not to be reliable and was omitted.

Respondents and preliminary data handling

Due to lack of informed consent or being sick on the day of data collection 117 schoolchildren did not participate at baseline (response rate=89.5%). At follow-up, 155 did not participate, due to illness on the day of data collection or having moved to another school during the intervention period (response rate=86.1%). In total, 998 children who were exposed to the Pro Children intervention

completed the baseline survey. Besides assessing usual frequency of fruit and vegetable intake, a 24-hour recall was included in the questionnaire. Twenty-three children were excluded due to over-reporting of the 24-hour recall (>1000 grams of fruit and vegetables the previous day). Another nine children were excluded from analyses due to missing values on the food frequency measures at baseline. Of the remaining 966 children, 81 did not complete the follow-up questionnaire while 17 were excluded due to over-reporting in the 24-hour recall and/or incompleteness of the food frequency measures at follow-up. Thus, complete data on all intake measures were available for 868 children. Teacher reports on both the first (80.3%) and second (83.9%) teacher questionnaire and the log books (82.1%) were used to assess implementation of the school curriculum. Complete data on the implementation of the school curriculum were available for 51 out of 56 classes (50 missing cases). In Spain data on frequency of the fruit break were lacking for four classes (86 missing cases). Twenty-six children had not filled in the questions on appreciation of the project.

The parent questionnaires were filled in and returned by 863 parents (99.4%) at baseline and 632 (72.8%) at follow-up. The number of parents that filled in the parental questionnaire at follow-up was higher in Spain (83.4%) and Norway (79.8%) compared to the Dutch sample (56.1%). Of the 632 participating parents, 559 parents had filled in the questions regarding the process data (88.4%) while 73 parents had not. Due to missing values on the four intervention characteristics the number of cases included in the different analyses varied slightly.

Statistical analyses

To assess potential drop-out bias among the children, multiple logistic regression analysis was conducted with drop-out as dependent variable and country, gender, age, immigrant status, mother's educational level, and intake at baseline as independent variables. To assess selective drop-out among the parents in the intervention group, multiple logistic regression analysis was conducted with drop-out as dependent variable and country, gender and age of the child, living circumstances, immigrant status, mother's educational level, and child's intake, as independent variables. Three parent drop-out analyses were conducted. First, to assess selective response of parents at baseline, parents that did complete a questionnaire at baseline were compared to those who did not (868 versus 5). Second, to assess selective drop-out at follow-up,

the parents that did complete the questionnaire at follow-up were compared to those who did not (632 versus 236). Third, the parents that did complete the process questions were compared to the parents who did complete the questionnaire but not the process questions (559 versus 73).

Descriptive statistics were used for key participant characteristics. Differences in appreciation of the project, parental involvement and implementation of the school curriculum between countries and gender, and differences in parental involvement according to living circumstances were explored. For the statistical tests the values of the variables of degree of implementation of the school curriculum, parental involvement, and appreciation of the intervention were recoded into tertiles: i.e. low, medium and high. A change in intervention-induced distribution of fruit and vegetables was recoded into 'an increase' (1), 'no change' (0), or 'a decrease' (-1).

Exploratory analyses were conducted to assess associations between these different levels of the intervention characteristics, and changes in frequency of fruit and vegetable intake were conducted first. Univariate ANCOVA analyses with differences in frequency of fruit and vegetable intakes between baseline and follow-up as dependent variables and different levels of the intervention characteristics, gender, country, and intake at baseline as independent variables were conducted. In addition, potential interaction effects of the process measures with country, gender, age, mother's educational level, family characteristics and immigrant status were explored with SPSS version 11.0 (SPSS Inc, 1999).

Subsequently, multivariate statistics were used. As a consequence of the study design students were nested within schools and we expected a high probability of interdepence between the students of the same schools. To take this into account, multilevel regression analyses with random intercepts were conducted in MlwiN 1.10.0007 (Rabash et al., 1999) to assess the association between the intervention characteristics and effects of the intervention, i.e. the differences in frequency of fruit and vegetable intake between baseline and follow-up. For these more comprehensive analyses the process measures were used as independent continues variables, since the distribution of those variables was considered to be normal. The multilevel regression analyses were adjusted for gender, country and baseline value of the outcome measure. Standardized regression coefficients (b) for the intervention characteristics were assessed, which enables to compare the strengths of the associations with the

dependent variable.

Two multiple regression models were tested. First the full model was analysed, including all intervention characteristics. Due to lower response rates among the parents, a second model was conducted without including parental involvement. All analyses were carried out on the whole sample and separately for each country. All p-values are two-sided and 5% level of significance was used.

Results

Drop-out

Multiple logistic regression of drop-out among children at first follow-up showed that children from Norway (Odds Ratio (OR)=0.36, 95% Confidence Interval (CI)=0.67-0.77), dropped out significantly less often than children from Spain and the Netherlands.

Multiple logistic regression of drop-out of parents at baseline did not reveal selective drop-out. At follow-up parents from families in which both parents were born in the research country (OR=0.35, 95%CI 0.23-0.52) and parents from families in which both parents of the child lived together (OR=0.45, 95%CI 0.26-0.76), dropped out significantly less often than parents from families in which at least one parent was born abroad or parents that no longer lived together. Parents that took part in the follow-up questionnaire, but did not respond to the process questions, did not differ from those that completed also those items.

Degree of intervention implementation

Characteristics of the study population are shown in Table 6.1.

The mean number of lessons that was implemented by the teachers differed significantly between all three intervention sites ($F(2,815)=112.14$, $p<0.01$) (Table 6.2). The post-hoc tests indicated that degree of implementation was significantly higher in Norway ($p<0.01$) compared to Spain and the Netherlands, and significantly lower in the Netherlands ($p<0.01$) than in Spain and Norway. Furthermore, in the Dutch sample the range in number of lessons implemented at the schools was also the widest, ranging from implementation of only two to all sixteen lessons. In Norway the numbers of lessons ranged from six and a half to thirteen lessons, while in Spain a range between seven and

fourteen was found. In all countries a similar patterns was observed in that there was a downward trend in the implementation of the school curriculum: all schoolteachers implemented the first two worksheets while the last worksheets were only implemented by only one out of three teachers.

Table 6.1 Characteristics of the study population (n=868)

Characteristics			
		N	% or mean (SD)
Country			
	Norway	243	28.0
	Spain	305	36.8
	The Netherlands	320	35.2
Gender			
	Boys	392	45.2
	Girls	476	54.8
Age child, years		844	10.7 (0.54)
Living circumstances			
	Lives with both of own parents	658	76.2
	Does not live with both of own parents	206	23.8
	Lives with two adults	738	85.4
	Lives in single-parent family	126	14.6
Parental country of origin			
	Both parents come from research country	595	73.1
	At least one parent comes from a country other than research country	219	26.9
Educational level mother/female caretaker			
	<10 years	207	31.8
	10 years or more	443	68.2

Mean score on appreciation of the project in the total sample was 2.30 (SD=0.47) and differed significantly between the three countries ($F(2,839)=11.30$, $p<0.01$). Post-hoc tests indicated that Norwegian children were the most positive about the project compared to Dutch and Spanish children ($p<0.01$).

The mean number of activities that parents were involved in also differed between all three countries ($F(2,556)=6.53$, $p<0.01$). The mean number of activities carried out with their child was significantly higher in Norway ($p<0.05$), and significantly lower in the Netherlands ($p<0.05$). Among girls (69.7%) the percentage of parents that was involved in any activity was higher than among boys (62.4%). Parents of girls did more activities together with their child than parents of boys ($F(1,557)=4.14$, $p<0.05$). Parental involvement was also higher among children that lived with both parents (mean=3.3, SD=1.9) ($F(1,813)=2.44$, $p<0.05$) or with two adults (mean=2.9, SD=1.8) ($F(1,555)=4.43$, $p<0.05$) than among children that did not live with both parents (mean= 2.9, SD=1.8) or with only one adult (mean=2.8, SD=1.7).

None of the Dutch children received fruit and vegetables at school prior to the intervention, while all Dutch children received two pieces of fruit and vegetables per week as part of the intervention. Therefore there was no variability in changes in the distribution of fruit and vegetables in the Dutch sample.

In Norway, children were able to change subscription, but hardly any children did so. In total 84.5% of the children did not change subscription, while 7.3% stopped and 8.2% started participating in the subscription programme during the intervention period. In Spain, 79.0% of the children did not change subscription to school lunches, while 10.0% did subscribe at baseline but not at follow-up, and 11.0% did subscribe at follow-up but not at baseline. As in the Netherlands there was no special fruit break in Spain before the intervention started, while there were fruit breaks at all schools as part of the intervention. Due to lack of variability in changes in distribution of fruit and vegetables in all three countries, this variable was not included in the remaining analyses.

Scores on school curriculum implementation, and appreciation were not associated with gender or age of the child, mother's educational level, family characteristics and immigrant status, when adjusted for country (data not shown). In addition to the pooled data we conducted analyses on the three countries separately.

Table 6.2 Means scores, standard deviations (SD) and results of ANOVA's to test for differences in these scores for child's appreciation of the project, extent and fidelity of the school curriculum (based on teacher's reports) and parental involvement

Characteristics	Pupils' appreciation of the project (1-3)				Teachers' report of school curriculum implementation (0-16)				Parental involvement (0-7)			
Country	N	Mean	(SD)	p-value	N	Mean	(SD)	p-value	N	Mean	(SD)	p-value
Total	842	2.3	(0.5)	0.000	818	9.1	(3.0)	0.000	559	3.3	(1.9)	0.002
Norway	240	2.4	(0.5)		225	10.9	(2.4)		160	3.4	(1.8)	
Spain	297	2.3	(0.4)		320	9.4	(1.9)		233	3.5	(1.9)	
Netherlands	305	2.2	(0.5)		273	7.4	(3.5)		166	2.8	(1.9)	
Gender												
Boys	380	2.3	(0.5)	0.128	369	9.3	(3.0)	0.392	237	3.1	(2.0)	0.042
Girls	462	2.3	(0.4)		449	9.1	(3.0)		322	3.4	(1.8)	

Table 6.3 Adjusted means and 95% confidence intervals (95% CI) of fruit appreciation of the school curriculum and parental involvement

FRUIT

		Total sample			Norway		
Intervention characteristic	Group	N	Adjusted mean	95%CI	N	Adjusted mean	95%CI
Appreciation (1-3)	Low (<2)	256	-0.13	-0.23, -0.02	27	-0.19	-0.41, 0.03
	Medium (2-2.5)	285	0.00	-0.10, 0.10	49	-0.08	-0.25, 0.08
	High (>2.5)	327	0.28	0.18, 0.37	110	0.39	0.25, 0.54
School curriculum (0-16)	Low (<7.5)	224	-0.02	-0.13, 0.10	27	-0.02	-0.29, 0.33
	Medium (7.5-10)	318	0.00	-0.09, 0.09	39	-0.16	-0.41, 0.10
	High (>10)	326	0.18	0.08, 0.28	177	0.18	0.06, 0.30
Parental involvement (0-7)	Low (<2.5)	186	0.03	-0.10, 0.15	45	0.21	-0.05, 0.47
	Medium (2.5-4)	164	0.06	-0.07, 0.20	56	0.14	-0.04, 0.37
	High (>4)	209	0.19	0.07, 0.31	59	0.19	-0.03, 0.41
		Spain			The Netherlands		
Intervention characteristic	Group	N	Adjusted mean	95%CI	N	Adjusted mean	95%CI
Appreciation (1-3)	Low (<2)	97	-0.11	-0.27, 0.06	112	-0.13	-0.30, 0.03
	Medium (2-2.5)	98	0.03	-0.13, 0.20	101	0.04	-0.13, 0.21
	High (>2.5)	125	0.24	0.10, 0.39	92	0.20	0.19, 0.38
School curriculum (0-16)	Low (<7.5)	73	-0.03	-0.22, 0.16	124	-0.03	-0.19, 0.12
	Medium (7.5-10)	168	0.07	-0.06, 0.20	111	-0.02	-0.18, 0.15
	High (>10)	79	0.18	-0.03, 0.37	70	0.19	-0.02, 0.40
Parental involvement (0-7)	Low (<2.5)	71	-0.06	-0.26, 0.13	70	0.01	-0.20, 0.23
	Medium (2.5-4)	58	-0.11	-0.33, 0.11	50	0.18	-0.07, 0.43
	High (>4)	104	0.20	0.04, 0.36	46	0.13	-0.14, 0.40

and vegetable frequency for low, medium and high implementation, and

VEGETABLES

		Total sample			Norway		
Intervention charac-teristic	Group	N	Adjusted mean	95%CI	N	Adjusted mean	95%CI
Appreciation (1-3)	Low (<2)	256	-0.09	-0.21, -0.02	47	-0.32	-0.58, -0.06
	Medium (2-2.5)	285	-0.02	-0.13, -0.08	86	-0.22	-0.41, -0.03
	High (>2.5)	327	0.37	0.27, 0.48	110	0.26	0.09, 0.43
School curriculum (0-16)	Low (<7.5)	224	-0.05	-0.20, 0.06	27	-0.04	-0.39, 0.31
	Medium (7.5-10)	318	0.12	0.01, 0.23	39	-0.13	-0.43, 0.16
	High (>10)	326	0.21	0.09, 0.32	177	0.00	-0.13, 0.14
Parental involvement (0-7)	Low (<2.5)	186	-0.02	-0.16, 0.11	45	-0.02	-0.32, 0.28
	Medium (2.5-4)	164	-0.03	-0.17, 0.11	56	-0.19	-0.45, 0.08
	High (>4)	209	0.28	0.15, 0.40	59	0.14	-0.13, 0.40
		Spain			The Netherlands		
Intervention charac-teristic	Group	N	Adjusted mean	95%CI	N	Adjusted mean	95%CI
Appreciation (1-3)	Low (<2)	97	-0.02	-0.14, 0.18	112	-0.06	-0.27, 0.16
	Medium (2-2.5)	98	0.06	-0.10, 0.22	101	0.06	-0.16, 0.29
	High (>2.5)	125	0.39	0.25, 0.54	92	0.43	0.20, 0.67
School curriculum (0-16)	Low (<7.5)	73	-0.02	-0.21, 0.17	124	-0.03	-0.23, 0.18
	Medium (7.5-10)	168	0.15	0.03, 0.28	111	0.26	0.04, 0.48
	High (>10)	79	0.41	0.23, 0.59	70	0.20	-0.07, 0.47
Parental involvement (0-7)	Low (<2.5)	71	-0.06	-0.27, 0.13	70	0.03	-0.20, 0.27
	Medium (2.5-4)	58	-0.10	-0.12, 0.33	50	0.00	-0.28, 0.27
	High (>4)	104	0.36	0.19, 0.52	46	0.25	-0.03, 0.54

Intervention characteristics associated with intake

Fruit intake

Table 6.3 shows that appreciation of the project ($F(2,861)=17.40$, $p<0.01$) and the degree of implementation of the school curriculum ($F(2,861)=4.08$, $p<0.05$) were significantly associated with changes in frequency of fruit intake.

Post-hoc tests for appreciation indicated that children that scored highest on appreciation of the intervention showed a significantly higher increase in intake compared to children who scored medium ($p<0.01$) or low ($p<0.01$) on appreciation. No differences were found between low and medium appreciation ($p>0.05$). Post-hoc tests for curriculum implementation indicated that the strongest increase in intake was found among children who had completed more than ten lessons at school compared to those who had done between seven and ten lessons ($p<0.05$) or seven lessons or fewer ($p<0.05$). No significant differences were found between low and medium degree of implementation ($p>0.05$).

No significant associations were found between parental involvement and changes in frequency of fruit intake ($F(2,552)=1.88$, $p>0.05$).

Vegetable intake

Significant associations were found between appreciation of the project ($F(2,861)=20.27$, $p<0.01$), the degree of implementation of the school curriculum ($F(2,861)=4.51$, $p<0.05$), and parental involvement ($F(2,552)=5.72$, $p<0.01$) and changes in frequency of vegetable intake.

Post-hoc tests for appreciation indicated that children that scored highest on appreciation of the intervention showed a significantly higher increase in intake compared to children who scored medium ($p<0.01$) or low ($p<0.01$) on appreciation. No differences were found between low and medium appreciation ($p>0.05$).

Post-hoc tests for school curriculum indicated that the strongest increase in intake was found among children who had completed more than ten lessons at school, compared to those who had done seven lessons or fewer ($p<0.01$). A significant difference was also found between low and medium degree of implementation ($p<0.05$). No significant difference was found between medium and high degree of implementation ($p>0.05$).

Post-hoc tests for parental involvement indicated that the children with highest parental involvement showed the highest increase in frequency of

vegetable intake, compared to children who scored medium ($p<0.05$) or low on parental involvement ($p<0.05$). No differences were found between low and medium involvement ($p>0.05$).

Multilevel analyses revealed results comparable to the exploratory analyses of variance. Appreciation (fruit: standardized regression coefficient: b=0.16; 95%CI=0.08-0.32; vegetables: b=0.18; 95%CI=0.11-0.39) and the school curriculum vegetables: b=0.11; 95%CI=0.02-0.14) showed significant associations with changes in intake. Associations between the school curriculum and changes in fruit intake were only significant when parental involvement was excluded from the analyses (b=0.09; 95%CI=0.02-0.11). Parental involvement was significantly associated with changes in vegetable intake (b=0.07; 95%CI=0.01-0.11).

Country-specific analyses showed similar results for changes in fruit and vegetable intake (Table 3). Although both in SPSS as in MlwiN some effect sizes did not always remain significant, magnitudes of effect sizes were comparable to those found in the total sample. In all countries a significantly higher increase in intake was found among children that scored highest on appreciation of the intervention, compared to children who scored medium or low on appreciation.

Country-specific exploratory analyses showed that a significant relationship between parental involvement and changes in fruit intake ($F(2, 228)=3.48$, $p<0.05$), as well as significant associations between parental involvement ($F(2, 228)=5.53$, $p<0.01$), and the degree of implementation of the school curriculum ($F(2,228)=5.48$, $p<0.01$) and changes in vegetable intake were found only in Spain.

Multilevel analyses showed a significant association between the school curriculum and changes in fruit intake in Norway (b=0.16; 95%CI=0.01-0.17) and change in vegetable intake in the Netherlands (b=0.12; 95%CI=0.02-0.16).

Discussion

In this study we investigated the degree of implementation of the Pro Children intervention, children's appreciation of the intervention, and associations between these measures and changes in frequency of fruit and vegetable intake in three countries.

In all three countries the content of the school curriculum and parental activities were comparable (Pérez-Rodrigo et al., 2005). However,

implementation and appreciation of the intervention is dependent on local circumstances and may therefore have differed between and within countries. To better interpret the effects of the intervention on changes in frequency of fruit and vegetable intake (Wind et al., under review), an assessment was made regarding the degree of implementation and appreciation of three Pro Children intervention components and their association with changes in fruit and vegetable intake.

Both between and within country differences were observed regarding appreciation of the intervention, the degree of implementation of the school curriculum and parental involvement. Norwegian children scored highest on appreciation of the intervention. The implementation of the school curriculum and parental involvement were highest in Norway and Spain, compared to the Netherlands. The observed highest mean number of implemented school curriculum in Norway might be explained by the fact that at most Norwegian schools a home economics teacher was responsible for the intervention, while Spanish and Dutch teachers might have prioritized other educational subjects. Hiring special staff to implement the intervention, and thus improving both quantity and quality of the school curriculum, has been effective in studies in the US (Reynolds et al., 2000).

This study shows that the schoolchildren's appreciation of the intervention was associated with changes in fruit and vegetable intake. Bere and colleagues also found stronger effects of a similar intervention among children who enjoyed the intervention better (Bere et al., 2005b). Our study also revealed that the school curriculum delivery and fidelity was associated with changes in fruit and vegetable intake. Similar results have been found in other studies (Story et al., 2000; Horne et al., 2004).

Although other studies (see Blanchette & Brug, 2005 for an overview) suggest that multi-component interventions have more potential to change fruit and vegetable intake, we did not find strong evidence for including parental involvement, especially for promoting fruit intake. This might be explained by the fact that most homework activities had a stronger focus on increasing vegetable intake.

Unfortunately, we could not test for associations between intervention-induced differences in intakes and the environmental component of the Pro Children intervention, i.e. the changes in school availability of fruit and vegetables. Other studies have shown that multi-component interventions,

including environmental changes are more powerful in changing fruit and vegetable intake, but mainly fruit intake (Blanchette & Brug, 2005; Knai et al., 2005; French & Wechsler, 2004; French & Stables, 2003). Moreover, free fruit and vegetable schoolschemes seem to be most promising in increasing fruit intake (Bere et al. 2005a; 2006b). In the present study, only in the Dutch schools were ready-to-eat fruit and vegetables handed out for free, and in this country a significant increase in perceived availability was indeed found (Wind et al., under review). There is evidence that increasing availability of fruit and vegetables may result in higher taste preferences (Birch, 1999; Wardle et al., 2003), and both availability and preferences are important determinants of fruit and vegetable intake (Blanchette & Brug, 2005; Bere & Klepp, 2004; Bere et al., 2005b, Wind et al., 2006).

As in other studies, parental involvement was rather low (Davis et al., 2000; Story et al., 2000), especially in the Dutch sample, which might be explained by the fact that almost 50% of the parents of the participating children in the Rotterdam schools was of non-Dutch origin. Language barriers might have caused low involvement in homework assignments. In total, only 9.6% of the parents completed the computer-tailored tool for adults, while this has been identified as a promising means to increase intake in earlier studies (Brug et al., 2003; Oenema et al., 2005). Since we did find significant associations between parental involvement and changes in vegetable intake, and since parental influences have shown to be important determinants of children fruit and vegetable intake (Patrick & Nicklas, 2005; Blanchette & Brug, 2005; Rasmussen et al., 2006; Wind et al., 2006), it is recommended to further investigate determinants of (non)-participation in school-based health promoting activities among parents.

The children were the least enthusiastic about the homework assignments that had to be carried out with one of the parents. Making these parent-related activities more attractive might lead to stronger parental involvement as well as stronger associations with changes in intake.

The findings reported should be considered in the light of some limitations. Both intake data as well as process data were based on self-reports. The validity and reliability of the food frequency questions have been tested and were regarded to be of acceptable validity and reliability (Haraldsdóttir et al., 2005), but self-report intake data are likely to be biased.

Validity and reliability of the assessment of the four intervention

characteristics has not been tested. However, the measures were based on earlier studies (Baranowski & Stables, 2000) and expert consultations. Face and content validity were checked. Moreover, we used multiple data sources to assess the implementation of the school curriculum.

Observations, questionnaires and interviews are a common combination to assess implementation (Parson & Stears, 2002; Resnicow et al., 1998; Mc Graw et al., 2000). We used questionnaires and logbooks in which detailed data were collected through those instruments. Both these self-reports were used to calculate implementation scores for the school curriculum in which quality and quantity, two important dimensions of implementation (Baranowski & Stables, 2000), were combined. Extensive interviewing of the teachers immediately after the intervention period or dual observations of fidelity might have been more valid than self-reports. However, interviewing is also a more intrusive method to assess both extent and fidelity of the implementation (Resnicow et al., 1998; Mc Graw et al., 2000). Since recall problems might have biased the results, teachers were encouraged to fill in the logbooks immedialty after implementation of an activity.

The findings for both self-reported measures were consistent. However, teachers could have given socially desirable answers and overestimated the implementation. A validation study comparing three different methods (i.e. classroom observations, teacher self-reports and post-implementation interviews) to assess implementation of a school-based health curriculum by Resnicow and colleagues (1998) showed that different methods lead to different implementations rates. In Resnicow's study implementation rates based on teachers' self-reports were higher, suggesting that overestimation of implementation might also have been the case in our study.

We did find significant associations between this intervention component and changes in intake. Given the non-optimal implementation rate in many schools, and assuming that teachers did overestimate the implementation of the school curriculum, this implies that effects of the intervention could have been better when the school curriculum had been better implemented.

Drop-out analyses among parents revealed that a selective group of parents completed the first follow-up questionnaire; parents from families in which at least one parent was born in a country other than the research country and parents from families in which both the parents of the child no longer live together are more likely to drop out. Results presented might therefore not be

representative, especially for the Dutch sample where the participation rate was lowest.

Implications for research and practice

The results of this study indicate recommendations for future research and interventions. First, our study provides support for the importance of a process evaluation; however, validation studies of process measures are recommended.

Since we could not test for associations between distribution of fruit and vegetable and intake, while others have shown promising effects of distributing fruit and vegetables for free (Bere et al., 2005a; 2006b), it is recommended to study the effects of the (free) distribution of fruit and vegetables as a stand-alone intervention. Until now, few such studies have been done (French & Stables, 2003).

Since parental involvement was rather low, while parental factors have been found to be associated with children's fruit and vegetable intakes in earlier studies (Patrick & Nicklas, 2005; Blanchette & Brug, 2005; Wind et al., 2006; Rasmussen et al., 2006), and since parental involvement was associated with changes in vegetable intake in the present study, determinants of (non)-participation of parents in such health promoting activities should be investigated.

We found significant associations between the school curriculum and changes in intake, while the implementation was not optimal. Therefore, determinants of implementing the school curriculum should also be investigated.

For public health practitioners our findings have some implications. First, the results from this study suggest the importance of involving children from the very early stages when developing an intervention, in order to make attractive interventions. Second, our study shows the importance of promoting and supporting the implementation of the school curriculum. To ensure optimal implementation, teachers should be involved in all stages of the curriculum development and implementation plan. Since lack of time might be a barrier, more research is needed to assess the most important determinants of schoolchildren's fruit and vegetable intake so that the curriculum can become even more focused, requiring fewer school hours. The observed low involvement of parents, although significant associations between parental involvement and changes in vegetables intake were found, suggests the need to make parent-related homework activities more attractive.

Acknowledgements

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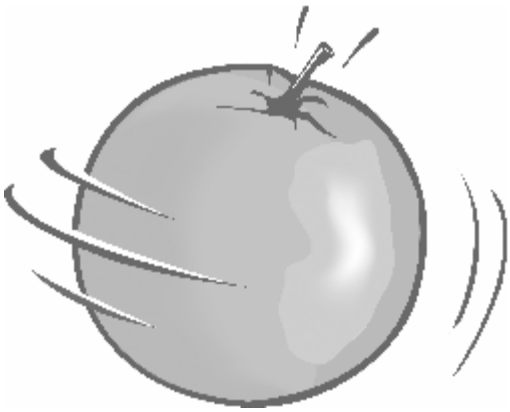
Special thanks go to all the schoolchildren, parents and teachers who took the time to participate in this intervention study.

Chapter 7



General discussion and conclusions

This thesis deals with the development, implementation and evaluation of a school-based fruit and vegetable promoting intervention aimed at 10-13 year-old European primary schoolchildren. The objective of this thesis was three-fold. First, to gain insight into important and changeable determinants of children's fruit and vegetable intake by means of a qualitative and a quantitative study. Second, to develop a multi-component intervention, tailoring the relevant determinants identified. The third part of this thesis deals with the short-term and longer term effect, as well as some parts of the process evaluation of the Pro Children intervention. The purpose of this final chapter is to summarize and discuss the main findings of the studies presented in this thesis, to address some methodological issues, and to discuss implications for future research and practice. These topics are described and discussed separately for the three parts of this thesis.

Main findings

Part I: Determinants of schoolchildren's fruit and vegetable intake

Eating behaviour is complex and determined by multicausal determinants. Most studies investigating determinants of schoolchildren's fruit and vegetable intake have been conducted in the US (Blanchette & Brug, 2005; Rasmussen et al., 2006). A main aim of the Pro Children study was to identify relevant determinants of fruit and vegetable intake among European schoolchildren. Since determinants of fruit and vegetable intake in European countries might be different from the US, a broad range of possible determinants was included in the theoretical framework used for the Pro Children study. This theoretical framework formed the basis for both the development of the questionnaires and the development of the Pro Children intervention (Klepp et al., 2005). The Pro Children theoretical framework was mainly based on Flay's theory of Triadic influence and informed by the Theory of Planned Behaviour (Ajzen, 1991), the 'attitude-social influences-efficacy model' (ASE model) (Kok et al., 1997), and the Social Cognitive Theory (Bandura, 1997).

The Theory of Planned Behaviour (Ajzen, 1991) and the ASE model (Kok et al., 1997) are two social-psychological models explaining health behaviour, which both postulate that a person's choice to act healthful is mainly determined by personal determinants, including the intention to act healthily. However, it can be questioned whether children's and adolescent's eating behaviour is likely

to be strongly influenced by personal intentions. Earlier research indicated that personal factors may account for only a small percentage of the variability in children's fruit and vegetable intake (Baranowski et al., 1999). The role of the environment, which offers the opportunities to engage in healthy behaviour (Rothschild, 1999), is highlighted in the Social Cognitive Theory (Bandura, 1997) and more so in the so-called socio-ecological models (Sallis & Owen, 2002; Baranowski et al., 2003). Flay & Petriatis (1994) divided determinants into proximal, distal and ultimate determinants of healthy behaviour. Proximal determinants, such as motivations, cognitions and skills, directly influence behaviour. More distal factors, which can be found in the social and physical environment, influence behaviour through behaviour-related cognitions. Within the Pro Children study we therefore included determinants at the personal and at the social and physical environmental level of children's fruit and vegetable intake, and the Pro Children theoretical framework reflects this focus (Figure 2, page 7).

The three levels of determinants were incorporated in both a qualitative study (Chapter 1) and a series of quantitative studies (De Bourdeaudhuij et al., under review; Kristjansdóttir et al., under review; Te Velde et al., under review; Wind et al., 2006 (Chapter 2)). In the present thesis one of these quantitative studies is incorporated (Chapter 2), based on analyses of data collected among children from Belgian-Flanders and the Netherlands. These studies revealed that intake of fruit and vegetables is indeed associated with social environmental and physical environmental determinants, besides personal determinants.

In more detail the results from the studies revealed that taste preferences for fruit and vegetables, self-efficacy to eat fruit (i.e. feel more confident to be able to eat fruit every day), and knowledge of recommended daily fruit and vegetable intake levels were important personal correlates of intake. These personal factors seem to influence fruit intake more than vegetable intake. Other studies also indicate that taste preferences (Bere & Klepp, 2004; Cullen et al., 2003; Gibson et al., 1998; Domel et al., 1996; Neumark-Stzainer et al., 2003; Resnicow et al., 1997), and knowledge of recommended daily intake levels (Reynolds et al., 2004) are important determinants of fruit and vegetable intake (Blanchette & Brug, 2005; Rasmussen et al., 2006). Others found conflicting results with regard to the influence of self-efficacy on fruit and vegetable intake (Blanchette & Brug, 2005).

Parental practices were identified as an important social environmental factor associated with schoolchildren's fruit and vegetable intake. This is consistent with findings from previous studies which showed that parental modeling behaviour (van der Horst et al., in press; Bere & Klepp, 2004; Fisher et al., 2002; Gibson et al., 1998; Young et al., 2004; Patrick & Nicklas., 2005; Blanchette & Brug, 2005; Rasmussen et al, 2006) is an important determinant of children's fruit and vegetable intake. Our studies also revealed that parents should insist that their child eats fruit and vegetables every day, and that parental facilitation (by cutting vegetables for their child) are associated with vegetable intake (Wind et al., 2006 (Chapter 2)). De Bourdeaudhuij and colleagues also found that parental pressure to eat healthily was associated with healthier behaviour among European children (De Bourdeaudhuij, 1997b). However, the opposite was found in an American study (Fischer et al., 2002), i.e. parental pressure to eat fruit and vegetables appeared to discourage intake among young American girls. Associations between such parenting practices and children's fruit and vegetable intake still remain unclear (van der Horst et al., in press). More general parenting styles, in which the combination of the two dimensions 'strictness' and 'involvement' result in four types of parenting styles, might explain why opposite results are found. Kremers et al. (2003) found that children with authoritarian parents who are strict but show low involvement, eat less healthily than authoritative parents who combine strictness with high involvement. This might suggest that low involvement explains why high strictness is not always related to healthier behaviour.

We also found that availability of fruit and vegetables at home, and improving availability at school by bringing fruit and vegetables to school were important correlates of intake. However, the question arises whether bringing fruit and vegetables to school should be considered as a physical environmental determinant, or as a combination of physical, social and personal determinants. Parents might encourage children to bring fruit to school, or the child itself may decide what to bring to school. From a qualitative study conducted among Belgian-Flemish and Dutch children it appeared that parents often prepare the lunch boxes, but that children themselves do have a say when it comes to preparing lunch (Wind et al., 2005 (Chapter 1)).

Several studies have shown the importance of environmental determinants in shaping eating habits of schoolchildren (Bere & Klepp, 2004; Story et al., 2002; Kratt et al., 2000), although findings from studies assessing

the influence of availability on intake are still inconsistent (van der Horst et al., in press), and indicated that availability may interact with other determinants of intake (Kratt et al., 2000; Young et al., 2004).

The findings from both studies reported in this thesis on explorations of determinants indicate the need to design an intervention that is tailored to personal as well as social environmental and physical environmental determinants. Based on the first part of this thesis, it can be concluded that interventions aimed at increasing schoolchildren's fruit and vegetable intake should focus on personal factors, such as improving taste preferences for fruit and vegetables, enhancing knowledge of recommended daily intake levels, improving self-efficacy with respect to eating fruit every day or to overcome barriers such as remembering to eat fruit, and asking parents to buy the fruit and vegetables they like. Interventions should also include the social environment in that parents should be encouraged to insist and facilitate their child to eat fruit and vegetables, and parents should be made aware of their function as a role model. In the physical environment availability of fruit and vegetables at home and at school should be targeted.

Part II Development of the Pro Children intervention

The importance of systemically developing health promotion interventions is well recognized. The Pro Children intervention was designed according to the Intervention Mapping protocol (Bartholomew et al., 2001) and the development process as well as the contents of the intervention is described in Chapter 3 (Pérez-Rodrigo et al., 2005). Intervention Mapping is a systematic process consisting of a series of five steps in which theory, empirical evidence and additional research are systematically incorporated to develop a health-promoting intervention. The Intervention Mapping protocol is based on a needs assessment in which the desired behaviours, environment and related determinants are identified (Figure. 1, page 4). In step one of the protocol the health-promoting behaviours, i.e. intake of fruit and vegetables, were split into specific performance objectives and linked to important as well as changeable personal, social environmental and physical environmental determinants. This resulted in a matrix of specific learning and change objectives for the intervention programme. In step two theoretical interventions and practical strategies addressing these specific objectives were identified. Subsequently, in step three, the actual intervention was designed, pre-tested and produced. A

plan for implementation was developed in step four. Teachers received a teachers' manual and were invited to participate in a teacher training at the start of the implementation of the intervention. Finally, in step five a plan for evaluating the efficacy of the intervention was made. Theoretical similar but culturally adapted multi-component interventions were designed for children in Norway, the Netherlands and Spain. Two of the main intervention components, i.e. the school curriculum consisting of worksheets and a computer-tailored programme, and the (homework) activities that were meant to involve parents were similar in the three countries. However, the school curriculum was adapted to education systems, i.e. in Norway the intervention was implemented in the sixth grade by a home economics teacher, and in Norway kitchens were available for the schoolchildren to practice preparing fruit and vegetables. In Spain and the Netherlands the regular schoolteacher implemented the intervention in the fifth grade. Country-specific recommendations for intake levels were also considered. The school curriculum addressed several determinants of fruit and vegetable intake, i.e. knowledge of recommended daily intake levels, taste preferences related to fruit, and skills to ask for fruit and vegetables at home. The parent-related activities were aimed at increasing vegetable taste preferences, increasing availability of fruit and vegetables at home, skills to prepare fruit and vegetables, and the importance of parents being good role models.

The third main component, the distribution of fruit and vegetables, differed between the three countries, due to pre-Pro Children existing distribution and subscription programmes, and was targeted at increasing the availability of mainly fruit and ready-to-eat vegetables at school.

Part III Implementation and evaluation of the Pro Children intervention

The Pro Children intervention was effective in changing usual frequency of fruit and vegetable intake, portions of fruit intake and knowledge of recommended daily fruit and vegetable intake levels. Effect sizes were comparable across the three countries, except for portions of fruit consumed on the day prior to the data collection, and knowledge, which were substantially stronger in Norway. Although the country-specific effects did not always reach statistical significance, all effect sizes pointed in the same direction. Effects on fruit intake were higher than effects on vegetable intake. The longer term effects are reported in Chapter 6 and show that the effects on intake were maintained one year after

the short-term measurement, and that effects on portions of fruit consumed on the day prior to the data collection and knowledge of recommended daily intake levels were again stronger in the Norwegian sample. Effects on knowledge of recommend daily intake levels also maintained significance in the Dutch sample, but not in Spain. In the Netherlands substantial effects were found for perceived availability of fruit and vegetables at school, both on the short and on the longer term. In Spain only short-term effects were found on perceived availability. Only in Norway were long-term effects found on taste preferences for fruit. Not finding effects on taste preferences might be a consequence of a ceiling effect since taste preferences at baseline were already positive. No effects were found on habit strength. Children were provided with the opportunity to eat fruit and vegetables, often during the same time of the day on some but not all schooldays. Since habits may be strongly triggered by such environmental cues, we expected to find a positive effect on habit strength.

The effect sizes from the Pro Children interventions are comparable to those found in effective comprehensive school-based intervention studies mainly from the US (Blanchette & Brug, 2005; Knai et al., 2006; Lister-Sharp et al., 1999; French & Wechsler, 2004).

Chapter 5 shows that implementation of the school curriculum and appreciation of the intervention were positively associated with short-term changes in frequency of fruit and vegetable intake. We found significant associations between parental involvement and changes in vegetable intake, but not in fruit intake. Associations between the third main intervention component, i.e. distribution of fruit and vegetables and changes in intake, could not be tested.

Methodological issues

This part of the discussion addresses several methodological issues that should be considered when interpreting the results of the different studies that are part of this thesis.

Part I: Determinants of schoolchildren's fruit and vegetable intake

In relation to both studies assessing determinants of schoolchildren's fruit and vegetable intake, several methodological issues will be discussed.

Methodological issues related to the quantitative study investigating

relevant determinants of schoolchildren's fruit and vegetable intake are: (1) the cross-sectional study design, (2) the validity and reliability of the questionnaire, (3) the Pro Children theoretical model, and (4) social desirability. In relation to the quantitative study investigating relevant determinants of schoolchildren's fruit and vegetable intake, external validity will be discussed.

As a consequence of the cross-sectional design, we cannot imply causality or prediction (Bouter & van Dongen, 1995). A longitudinal study design investigating determinants of fruit and vegetable intake would have been a better design. However, such a longitudinal design would have required active parental consent which leads to a larger drop-out, and subsequently would have reduced generalizability. Within the Pro Children study longitudinal data collections have been conducted in three countries, i.e. the Netherlands, Norway and Spain.

Second, since most determinant studies were done in the US, we included a broad range of possible determinants. Therefore, the study presented in Chapter 2 should be regarded as an exploratory study. In questionnaire development there is always a trade-off between precision and extensiveness within potentially important determinants and the wish to include measures of as many potentially important determinants as possible. In the Pro Children project we chose to include measures of personal, social environmental and perceived physical environmental determinants that may influence fruit and vegetable intakes. This resulted in a large number of possible determinants. In order to minimize the number of questions, most constructs had to be assessed with only a few questionnaire items. It is to be expected that including more items per construct would increase the internal consistency of the scales and may further improve the construct validity of the measurement, but may be a barrier for school-based administration. On the other hand, we used a stepwise approach to select these items, i.e. based on literature study, qualitative studies, pre-testing and testing the validity and reliability.

Reliability and predictive validity of the determinant part of the questionnaire was tested in three studies conducted prior to the cross-sectional survey and the intervention study data collections. It was concluded that the questionnaire provides an easy-to-administer tool for assessing personal, social environmental and physical environmental factors of potential influence on fruit and vegetable intake in 10 to 11 year-olds, of acceptable reliability and validity (De Bourdeaudhuij et al., 2005).

Two separate studies were conducted to assess the validity and the reproducibility of the food frequency questions. The validity study was conducted in a population of children from four of the Pro Children countries (Denmark, Norway, Iceland, Portugal), and showed that Spearman rank correlations for frequency of fruit and vegetable intake as assessed by the Pro Children food frequency questions and a 7-day food record ranged from 0.40 to 0.53. Between 25-50% were classified into the same quartile and 70-88% into the same or adjacent quartile of intake. The reliability study was conducted in a population of children from six of the Pro Children countries (Denmark, Norway, Iceland, Belgium, Portugal, Spain) and showed that test-retest Spearman rank correlations were between 0.47 and 0.84. Validity and reproducibility as to ranking of the subjects were considered to be satisfactory (Haraldsdóttir et al., 2005), but further improvements of intake measures that can be included in large population-based studies in schoolchildren are needed. Furthermore, a study conducted by Tak and colleagues (2006) compared the level of agreement on similar food frequency questions completed by slightly younger children (9-10 years) and their parents. Results from that study indicated that children overestimate their own frequency of intake, and that differences between child and parent reports became smaller as children became older.

When testing the validity of the 24-hour recall it was concluded that children tend to overestimate their intake as a consequence of the division of the day into 6 time periods and the use of photos showing different portion sizes. Therefore, in the final Pro Children questionnaire, the day was divided into three time periods and photos were left out (Haraldsdóttir et al., 2005). However, the validity of this adapted 24-hour recall has not been tested.

Third, the Pro Children theoretical framework proposes that the more distal determinants of fruit and vegetable intake can be found in the cultural, physical and social environment, and that these in turn influence more proximal personal determinants such as taste preferences, knowledge and self-efficacy.

When conducting stepwise regression analyses in Chapter 2, we could have entered the blocks of variables in another order. Since children's fruit and vegetable intake may be more strongly influenced by environmental factors than by personal motivations, we started with physical environmental factors, and subsequently added social and personal factors to see to what extent personal factors add to the explained variance. This is in line with the Pro Children theoretical framework (Figure 2, page 7). Demographic variables were entered

as a first block, since these variables were considered to be the most distal, non-modifiable potential determinants. Subsequently, blocks of physical environmental, social and personal correlates were entered in the model. When we look at the added explained variance after adding an extra block of variables we see that the most added variance is explained by environmental factors, while effect sizes for availability of fruit and vegetables at school and at home decreased after adding social environmental and personal factors, which indicates that the association between availability and intake is mediated by social environmental and personal factors. Alternatively, we could also have started with the more personal determinants followed by the environmental factors to gain insight into the added value of environmental factors.

We were, however, interested in which determinants were most strongly correlated with intake when all determinants were included in the model. Therefore, only the final model in which all blocks of determinants were entered was interpreted and discussed. Similar results can be expected if blocks of determinants had been entered in another order.

Fourth, answers to questions about food intake and determinants of food intake may be liable to social desirability. We were not able to adjust for this possible confounding factor, as a tendency to give socially desirable answers was not assessed. However, we tried to minimize social desirability by stressing the anonymity of the respondents, and by stressing that there were no right or wrong answers.

When interpreting the results from the focus group interviews it is important to realize that these were conducted in the city of Ghent and the city of Rotterdam and should not be considered as representative for both countries. However, the results found in this qualitative study were much in line with the cross-sectional surveys for which representative samples have been taken in the Netherlands and the Dutch-speaking part of Belgium.

Part II Development of the Pro Children intervention

Four important issues related to the development of the Pro Children intervention, and the selection of relevant determinants targeted by the intervention are: (1) the timing of the cross-sectional survey, and (2) the fact that the cross-sectional survey presented in Chapter 2 was conducted in Belgium-Flanders and the Netherlands while the intervention was implemented in the Netherlands, Norway and Spain, (3) the lack of evidence-based

programmes for European countries, and (4) the investments made in the development of the intervention.

A thorough needs assessment (Figure 1, page 4), i.e. investigating population health risk behaviours and related relevant determinants is necessary in order to tailor interventions aimed at these determinants. To complete this needs assessment Intervention Mapping proposes the use of qualitative and quantitative research methods, starting with reviewing the literature on relevant evidence and theories. In the most ideal situation the results from the quantitative cross-sectional survey would have been ready prior to the start of the intervention development. Since this was not feasible, the results of the focus group interviews (Wind et al., 2005 (Chapter 1)), as well as an extensive literature review (Rasmussen et al., 2006), several theories (Ajzen, 1991; Kok et al., 1996; Bandura, 1997; Flay & Petriatis, 1994; French et al., 2001) and the current state-of-the art in such health-promoting interventions (Hoelscher et al., 2002, Contento et al., 1995) were used as input for the development of the intervention.

As indicated before, the conclusions drawn from the qualitative interviews among Belgian-Flemish and Dutch children were much in line with the cross-sectional surveys conducted among representative samples in the same countries (Wind et al., 2006 (Chapter 2)). Therefore, at least for the Netherlands, it can be concluded that the Pro Children intervention was targeting relevant determinants. Furthermore, although not described in this thesis, in both Norway and Spain such qualitative interviews have also been held, and results were used when developing the intervention.

Moreover, within the Pro Children project nine countries, including Norway and Spain, participated in the Pro Children cross-sectional survey. Kristjansdóttir et al. (under review) investigated relevant determinants of Icelandic schoolchildren's fruit and vegetable intake, while Te Velde et al. (under review) further elaborated differences in determinants of fruit and vegetable intake between children from non-Western immigrant parents and children from Dutch parents in the Netherlands. De Bourdeaudhuij et al. (under review) investigated potential determinants of intake in all nine countries. Multiple binomial logistic regression analysis was used to investigate the associations of daily fruit intake (no daily fruit/vegetable consumption=0; daily fruit/vegetable consumption=1), with dichotomized personal, social and environmental variables (negative or neutral =0; positive=1). De Bourdeaudhuij et al. (under

review) concluded that in all those countries personal, as well as social environmental and physical environmental factors were associated with daily fruit and vegetable intake, which is in line with the results reported in Chapter 1 and Chapter 2. The results from the cross-sectional survey indicate that indeed a uniform intervention could be developed for increasing fruit intake in all three countries, while an intervention aimed at increasing vegetable intake should be more adapted to each country (De Bourdeaudhuij et al., under review). Thus the intervention might not have been optimal in promoting vegetable consumption for all three intervention sites.

Third, due to lack of evidence-based studies to promote fruit and vegetable intake among European schoolchildren results from the qualitative studies, an extensive literature review, as well the current state-of-the art within the healthy nutrition promotion tradition were used as a basis when developing the Pro Children intervention. School-based interventions to promote consumption of fruit and vegetables among students in school settings have primarily consisted of multi-component interventions, and those including an environmental intervention component appear to be the most promising (French & Stables, 2003). Interventions should be targeted at a specific behaviour, based on theory, devote adequate time and effort, include parental involvement, self-assessment and personalized feedback in the form of computer tailoring, and include the school environment. All these components were included in the Pro Children intervention.

However, the most effective interventions conducted in the US, lasted at least twelve months and activities were implemented regularly and lasted about at least twenty-five minutes each. Besides a long-lasting and intensive intervention, other important intervention components of those successful interventions were special training or hiring of teachers, active encouragement and participation by school staff, active involvement of parents, the development of a school nutrition policy, community involvement, and integration of the intervention into the regular school curriculum (Blanchette & Brug, 2005).

Within the Pro Children study emphasis was on the educational activities implemented during school hours, parental involvement and environmental changes at school, and less on policymaking and community involvement. Moreover, the intensive Pro Children intervention lasted about eight months and on average nine out of sixteen activities were implemented during school hours,

which might have been too short a time period or too few activities. Parental involvement was rather low, and the use of the computer-tailored tool was rather disappointing, especially among parents. Teachers were invited to join a teacher training; however, hiring special staff (Reynolds et al., 2000; Story et al., 2000) or integrating the project into the regular school curriculum might have resulted in a better implementation of the Pro Children intervention. In Norway a home economics teacher implemented the curriculum and the mean implementation score was indeed the highest in that country.

Fourth, the Pro Children intervention was designed according to the Intervention Mapping protocol (Bartholomew et al., 2001). As mentioned above, for the needs assessment mainly qualitative studies were used as an input for the development of the intervention. The needs assessment and the formulation of programme objectives (step one) and the selection of theories and practical strategies (step two) were done in all three intervention countries. Developing and designing the materials (step three), and the adoption and implementation plan (step four) were partly country-specific. As a consequence of time limitations step one and step two were combined and completed through a two-day workshop, since the complete application of the protocol would have required more time than available (Pérez-Rodrigo et al., 2005).

Although we applied the Intervention Mapping protocol in a modified way the use of the protocol had several advantages. First, the integration of multiple theories is stressed in the protocol, and both motivational and environmental determinants were included in the Pro Children intervention. Second, Intervention Mapping gives a foothold on how to change these determinants by selecting practical strategies. Moreover, the Intervention Mapping protocol gives some guidance for evaluating the effects of intervention (step five), aimed at determinants related to performance objectives.

Part III Implementation and evaluation of the Pro Children intervention

With regard to the effect and process evaluation the following issues will be discussed: (1) validity and reliability of the effect and process measures, (2) the study design, (3) internal (are the results really attributable to the intervention) and external validity (can the results be generalized to other populations) (Green & Lewis, 1986), and (4) social desirability.

Since the intervention was tailored to several determinants, and determinants of fruit and vegetable intake were addressed separately, many

constructs were included in the evaluation questionnaire that was to a large extent based on the questionnaire used for the cross-sectional survey. As described before, the reliability and validity of the constructs measuring intake and determinants were tested and regarded to be satisfactory. However, because the reliability was not optimal the questionnaire might not have been sensitive enough to detect changes in intake or determinants of intake.

Validity and reliability of the assessment of the process measures assessing the implementation of the intervention have not been tested. However, the measures were based on earlier studies reported in the literature (Baranowski & Stables, 2000) and on expert consultations. Face and content validity were checked. Moreover, we used multiple data sources to assess the implementation of the school curriculum.

To assess effects of the intervention, a community intervention trial was used. Within each intervention country, schools were randomly allocated to an intervention group or a control group. A Randomised Control Trial (RCT) is regarded as the 'golden standard' to assess effects on an intervention. Preferably such research is double-blinded. This was, however, not possible within the Pro Children study. Researchers, as well as the involved participants, were aware of the condition they participated in. Moreover, randomising pupils within schools was not possible, complete schools were allocated to one of the two conditions since pupils within schools may interact and influence each other. Therefore, the short-term as well as the long-term effects of the intervention (Chapter 4 and Chapter 5) were assessed by multilevel analyses, which takes clustering of pupils within schools into account.

However, in Chapter 6, associations of the implementation of the three main intervention components, as well as appreciation of the project by the children, with changes in intake were assessed in the intervention group only. We believed this was warranted since we did not find large differences between the intervention and control group at baseline.

The internal and external validity of the intervention study should be discussed. First, we are not completely sure that schools did not participate in other fruit and vegetable promoting activities during the Pro Children study period. Although we have stressed the importance of not doing any other activities besides the Pro Children intervention, or not doing any activities at all at control schools, we cannot rule out possible influences of other (mass media) campaigns that were going on during the same time period. However, it is very

likely that exposure to other ongoing interventions was equal between the intervention and the control group.

The results from the intervention study cannot be generalized to Norway, Spain and the Netherlands, since the intervention was implemented in specific parts of these countries. Moreover, the participation rate of schools was rather low. Schools that did not want to participate mentioned reasons such as lack of time or not considering fruit and vegetables as an important topic. The included schools might differ from schools that did not participate regarding, for example, fruit and vegetable intake, socio-economic status or ethnicity.

Fourth, intake has been assessed by self-reported data, which may be liable to social desirability bias. This may be especially true for the frequency questions, which should therefore be interpreted with caution. Tendency to give socially desirable answers can be expected in both the intervention and the control group. Although, as a consequence of being exposed to the intervention and knowing the recommended daily intake levels, the tendency to give socially desirable answers at follow-up might have been stronger in the intervention group.

Implications

The results presented in this thesis have several implications for future research and practice. Recommendations for future research are related to questions that still remain unclear after completing the present thesis, and are again described separately for the three different parts of this thesis. Recommendations for practice are related to the implementation and continuation of the use of the Pro Children intervention and similar interventions aimed at schoolchildren in the future.

Implications for future research

Part I: Determinants of schoolchildren's fruit and vegetable intake

As mentioned above, our results may have been affected by the schoolchildren's inclination to respond in a socially desirable manner. In future studies this tendency to give socially desirable answers could be assessed by including a reliable and validated questionnaire to assess social desirability, and adjusting for this factor. Baxter and colleagues (2004) have tested test-retest reliability of

a 46-item Marlowe-Crowne Social Desirability scale and selected 14 items to measure tendency to give socially desirable answers. They concluded that further testing of the questionnaire, including testing validity, is needed.

In Chapter 2 significant correlates of schoolchildren's fruit and vegetable intake were identified. A next step would be to assess the determinants which were significantly associated with fruit and vegetable intake with multi-item scales, and to test interrelationships between those personal, social environmental and physical environmental determinants, preferably with a longitudinal study design. Such a design would also give the opportunity to assess predictors of changes in intake, which gives a better foodhold for developing interventions. Within the Pro Children study such longitudinal data have been collected in three countries, therefore a next step would be to test whether associations found in the cross-sectional study can be confirmed by the longitudinal data.

By including the broad range of personal, social environmental and physical environmental factors we were able to explain about 30% of fruit and vegetable intake. In further research the most relevant correlates as identified in this thesis should be assessed with multi-item scales that are again tested for validity and reliability.

Within the range of environmental determinants, we made a selection of possible determinants, and we focused on two levels of environmental determinants: i.e. the parental influences, such as food rules, at the social level, and availability of fruit and vegetables at the physical environmental level. Our studies indeed indicate that these social environmental and physical environmental factors are important correlates of children's fruit and vegetable intake. However, the social and physical environment is complex and interrelations remain unclear.

The ANGELO framework, which is a conceptual framework for understanding the obesogenicity of environments, distinguishes four types of environmental determinants, i.e. physical, socio-cultural, economic and political that can be found in micro and macro environmental settings (Swinburn et al., 1999). Such a distinction in environmental factors might be also relevant for the consumption of fruit and vegetables. The studies described in this thesis gave some insight into the role of social and physical environmental determinants in the microenvironment (school and home). The qualitative study described in Chapter 1 gave some indications of the importance of formulating policies at

school regarding food rules, although the influence of parental food rules might be more influential than school food policies regarding fruit, at least in Belgium-Flanders (Vereecken et al., 2004). Influences of environmental determinants on the intake of fruit and vegetables might also be found in the macroenvironment, such as the influence of industries and the media. An international study comparing the amount of advertising broadcast during programming for children between several European countries including Belgium, Austria, Denmark, Norway, Sweden and the Netherlands, as well as Australia and the US, found considerable differences and large variations in the number of food advertisements on television. In Australia and the US more than 400 advertisements were counted during 20 hours of broadcasting, while countries with the lowest levels of advertising included Norway's TV2 channel, where no advertisements were recorded during the limited monitoring period, and Sweden, Belgium, Austria and the Netherlands (Dibb & Harris, 1996). Story and French (2004) examined food advertising and marketing channels targeted at children and adolescents children and concluded that children are exposed to advertisements in many ways, such as the television commercials and the Internet. However, experimental and longitudinal studies investigating influences of such environmental factors, both in the micro and the macro settings, on schoolchildren's fruit and vegetable intake, are needed.

As indicated above, more research is needed to clarify interrelationships between personal, social environmental and physical environmental determinants. Mediation and moderation analyses might reveal better insight into, for example, the role of availability, and associations between food-related parenting practices (political micro-environmental influences) and more general parenting styles with children's fruit and vegetable intake.

Differences in determinants of fruit and vegetable intake between different subgroups can also provide more input for tailoring interventions. Te Velde et al. (under review) investigated associations between ethnicity and children's fruit and vegetable intake in the Dutch sample. Ethnic minority girls reported to eat fruit more frequently, and mediation analyses revealed that knowledge of recommendations and facilitating behaviours of the parents mediated the association between ethnicity and fruit consumption among girls. Interventions addressing multi-ethnic populations of children must take such differences into account. However, the fact that including these determinants did not fully account for differences in fruit intake indicates that other, unknown

mediators should be explored (Te Velde et al., under review).

Part II Development of the Pro Children intervention

Our study gave insight into some important determinants of children's fruit and vegetable intake. However, to inform intervention development determinants should be changeable as well. Intervention Mapping makes a distinction between personal and environmental determinants of health behaviour, and suggests that environmental change is most often the results of changes in behaviour of decision makers, i.e. school staff, parents or policy makers. Therefore, determinants of behaviour change among those decision makers should be assessed and subsequently, effective strategies, methods and channels on how to reach and involve decision makers, i.e. parents and teachers, in such school-based health promoting activities should be investigated.

Parental influences were regarded to be important, while parental involvement was rather low in our study, similar to other studies (Davis et al., 2000; Reynolds et al., 2000). Therefore the question may arise 'should we avoid involving parents in such health-promoting interventions?'. To gain more insight into reasons for (non-)participation in such health promoting interventions, it is recommended to investigate determinants of parental involvement. The next step would be to determine whether these influences can be changed by health-promoting interventions.

Due to pressure of the time we have applied the protocol in a modified way. However we did pilot test all educational materials among schoolchildren and teachers. Since the importance of a systematic development of health-promotion intervention is well recognized, it is recommended to study how to best apply the Intervention Mapping protocol when developing such complex health-promoting interventions. In other parts of the Netherlands, similar fruit and vegetable promotion interventions have been implemented during the same school year and effects on intake have been assessed in all these intervention studies. However, the development of these interventions differed. For example, the development of another large-scale fruit and vegetable promotion campaign among schoolchildren called the 'Schoolgruiten' intervention was not as informed by theory compared to the Pro Children intervention. Therefore, it would be interesting to assess differences in effect between Pro Children and 'Schoolgruiten', taking the degree of implementation of the interventions into

account. Such studies might result in a better understanding of the added value of a thorough theory-driven intervention development.

Part III Implementation and evaluation of the Pro Children intervention

In this thesis we were able to show that the Pro Children intervention was effective in changing intake of fruit and vegetables. However, we did not find effects on all determinants and we did not study effects on all determinants that were included in the questionnaire. Moreover, we were partly able to show why it worked, but we still do not know through which determinants the intervention works. Mediation analyses can be helpful in determining causal pathways. Moderation analyses as well as testing stand-alone interventions might also be helpful to gain more insight into how interventions work and for whom they work.

First, mediation analyses may reveal better insight into the way, i.e. through which determinants (Reynolds et al., 2002, 2004; Baranowski et al., 1997), the Pro Children interventions works. For example, knowledge of recommendations was identified as an important determinant of intake, and significant effects on knowledge and intake were found. Mediation analyses can be helpful to test whether the increase in intake was partly mediated by improving knowledge.

Second, moderation analyses can be helpful in identifying subgroups for whom interventions work, and subsequently target interventions to specific subgroups. Potential moderators of intervention effects are rarely tested, and often only interaction effects with gender, country, and race are assessed. Within this thesis we did not find moderating effects of gender, and mother's educational level, but we did find some interaction effects with country. However, testing interaction effects with intake or taste preferences at baseline might reveal other subgroups for which the intervention works better or worse.

Third, we have tested effects of a combined multi-component intervention. Unfortunately, we were not able to provide evidence that increasing availability at school leads to higher fruit and vegetable intake, while others have shown promising effects of distributing fruit and vegetables for free (Bere et al., 2005a; 2006b). There is still a lack of systematic evidence of environmental interventions (Brug et al., 2005). Similar to others (van der Horst et al., in press), we did not find strong evidence that availability of fruit at school is an important determinant of intake. The best way to study the

influence of availability on intake is by testing an intervention targeting this determinant only in a randomised control trial and to test whether the intervention leads to changes in the determinant and subsequently changes behaviour. In the most ideal situation, effects of single intervention components should be tested prior to testing multi-component interventions. Effects of exposure to fruit and vegetables, but also effects of higher parental involvement on children's fruit and vegetable intake should therefore be tested as stand-alone interventions. Moreover, insight into the effects found and relating these effects to the costs made of these stand-alone interventions, can be helpful in determining the cost-effectiveness of the separate intervention components.

Implications for practice

The different studies assessing determinants and effects of the Pro Children intervention, as well as associations between the intervention components and the effects on frequency of intake, provide some tools for the future use of the Pro Children and similar interventions.

Interventions aimed at improving fruit and vegetable intake among primary schoolchildren should include a school curriculum which focuses on personal determinants, including knowledge of recommended daily intake levels. We did find effects on knowledge, but there is still room for improvement. Parents should be involved, especially in increasing vegetable intake. Parents should be encouraged to give the right example, to demand that their child eats fruit and vegetables, and to cut up vegetables. Availability of fruit and vegetables at school, as well as bringing fruit and vegetable to school, are also related to a more frequent consumption of fruit and vegetables. Unfortunately we could not provide evidence for the effects of distributing fruit and vegetables at school. Moreover the environment is complex and broader than parental influences and the availability of fruit and vegetables at school; therefore, for example, school staff, policymakers and the larger community might have to be involved as well.

Neither our qualitative study nor our quantitative study revealed any need to tailor interventions separately to boys and girls, or to country.

Some indications are found that interventions to increase fruit intake among Dutch children should be tailored to ethnicity, at least in girls. Intervention targeting the parents of children might also have to take ethnicity into account. Especially in the Dutch sample, parental involvement was much

lower among non-Western immigrant parents compared to native Dutch parents, which might be a consequence of language barriers, and might indicate the need to tailor interventions to subgroups.

Effects on vegetable intake were rather disappointing, because we did not reach the goal of increasing intake by 20%. Therefore, more effective ways are needed to increase intake, or to reach and involve parents. Also implementation of the school curriculum should be improved, for example by hiring special staff or integrating the project into the regular school curriculum.

In order to maintain effects of the Pro Children interventions it is recommended to continue intervening at secondary schools, and/or to assess changes in intake on the longer term.

General conclusion

The substantial effort to explore determinants of schoolchildren's fruit and vegetable intake and the investments made to develop the intervention seem to have paid off. The studies presented in this thesis give more insight into relevant determinants of schoolchildren's fruit and vegetable intake, into the application of the Intervention Mapping protocol when developing an intervention tailoring those determinants, as well as into the effectiveness of the Pro Children intervention.

- Schoolchildren's fruit and vegetable intake is influenced by several determinants at the personal (knowledge and taste preferences), social environmental (parental influences) and physical environmental (availability of fruit and vegetables at home and at school) level. Personal factors seem to play a more important role when it comes to eating fruit.
- More information is needed about interrelationships between social environmental and physical environmental determinants, as well as other parental influences and environmental influences on schoolchildren's fruit and vegetable intake.
- The systematically developed multi-component Pro Children intervention is a promising tool to increase schoolchildren's frequency and portions of fruit intake, and to a lesser extent frequency of vegetable intake.
- The implementation of both the school curriculum and the parental activities was not optimal. Therefore reasons for not implementing the

complete intervention among teachers, as well as determinants of parental involvement and possibilities to increase implementation of the school curriculum and involvement of parents in such health-promoting interventions, should be investigated.

- Despite a non-optimal implementation of the school curriculum we found evidence that the school curriculum was associated with changes in intake, and that it is important to develop an intervention, which is appreciated by the schoolchildren. In general most schoolchildren were positive about the intervention. Parental involvement was associated with changes in frequency of vegetable intake. Associations between the distribution to fruit and vegetables could not be tested.

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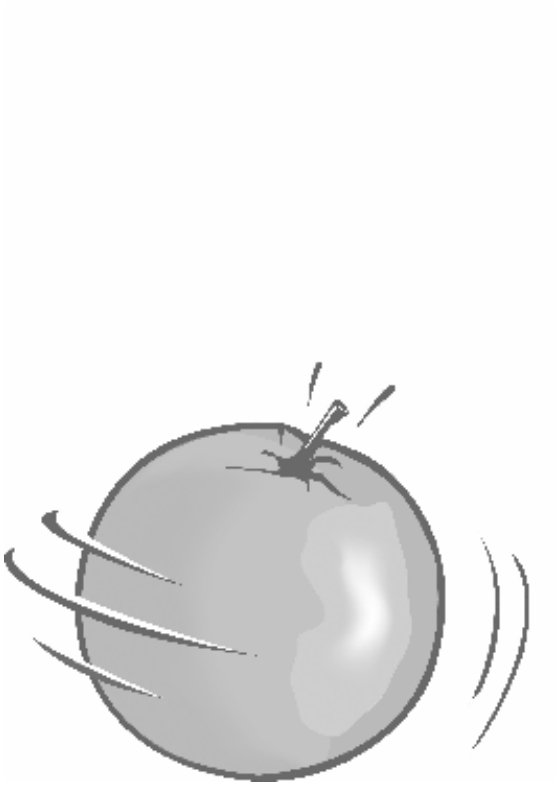

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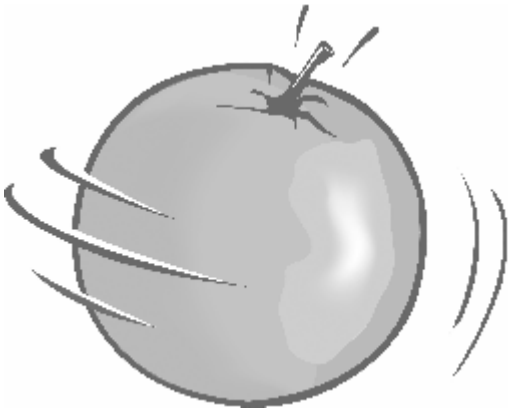
Summary & Samenvatting



Summary

Intake of fruit and vegetables among children is far below the recommended daily intake levels. Studies have shown that an adequate intake of fruit and vegetables is related to a decrease in the risk of several chronic diseases. Moreover, it might be easier to learn healthy behaviour at a younger age and there is evidence that healthy eating in childhood is to some extent maintained into adulthood. Therefore the Pro Children project started in 2002, aimed at increasing fruit and vegetables intake among 10 to 13-year-old European schoolchildren.

Within the Pro Children project two main research studies can be distinguished. First, insight into schoolchildren's fruit and vegetable intake and related behavioural determinants was gained. Both qualitative focus group interviews and quantitative cross-sectional surveys have been conducted in all nine countries that participated in the Pro Children project. These countries are Austria, Belgium-Flanders, Denmark, Iceland, the Netherlands, Norway, Portugal, Spain, and Sweden. The second research study concerned the development, implementation and evaluation of an intervention aimed at increasing fruit and vegetable intake among schoolchildren and changing related behavioural determinants. This intervention study was conducted in the Netherlands, Norway and Spain.

This thesis starts with the background and rationale of the Pro Children project (general introduction). Part 1 of this thesis deals with the results of the qualitative (Chapter 1) and quantitative (Chapter 2) studies investigating determinants of schoolchildren's fruit and vegetable intake in Belgian-Flanders and the Netherlands.

The development of the Pro Children intervention is described in part 2 of this thesis (Chapter 3). The development of the intervention is based on the Intervention Mapping protocol, which emphasises and guides the use of empirical data and theories in mapping health-promotion interventions.

Part 3 of this thesis describes the effect and process evaluation (Chapters 4, 5 and 6) of the Pro Children intervention. The intervention has been implemented during two school years. The most intensive part of the intervention was implemented during the school year 2003-2004. The short-term effects, measured at the end of this school year (May 2004), are described in Chapter 4. Chapter 5 describes the effects on the longer term, measured

exactly one year after the short-term measurement (May 2005).

During the first school year additional data regarding the implementation and appreciation of the intervention were collected among schoolchildren, teachers and parents. The degree of implementation of several intervention components and its association with the short-term effects on frequency of fruit and vegetable intake are described in Chapter 6. This thesis ends with a general discussion and implications for research and practice (Chapter 7).

To develop an intervention aimed at changing fruit and vegetable intake it is important to gain insight into determinants of intake, i.e. why do or don't children eat fruit and vegetables? One method to gain insight in such determinants is by means of an extensive and systematic literature review. From such a literature review, which has been conducted by the Danish Pro Children partner, it can be concluded that the Pro Children intervention should be aimed at children's taste preferences, parental modelling behaviour, and availability of fruit and vegetables at home. However, most of the reviewed studies were conducted outside Europe.

Another method to determine behavioural determinants is by conducting qualitative research. As a first step towards gaining a better understanding of important determinants of European schoolchildren's fruit and vegetable intake focus group interviews were held with 10 to 11 year-old schoolchildren in all nine Pro Children countries.

The results of these interviews conducted in the two Dutch-speaking countries, i.e. Belgian-Flanders and the Netherlands, are described in Chapter 1. According to the participating children, 'taste' and 'health' are important reasons for (not) eating fruit and vegetables. Knowing the recommended daily intake levels seems to be a reason for (not) eating (enough) fruit and vegetables as well. Besides these more personal factors, social and physical environmental factors appeared to play a role. Children share the opinion that their parents should be a good role model themselves and that they are responsible for buying fruit and vegetables. The focus groups also suggested that in both countries most vegetables are consumed during dinner, and bringing fruit and vegetables to school is quite uncommon.

The quantitative determinant studies (Chapter 2), also conducted in those two countries, confirm that taste preferences, knowing the recommended daily intake levels, parental modelling behaviour and the availability of fruit and

vegetables are important correlates of schoolchildren's fruit and vegetable intake. These studies also revealed that children more often eat fruit and vegetables when parents insist that they eat fruit and vegetables. Facilitating the consumption of vegetables by cutting up vegetables for their child is also related to a more frequent intake of vegetables. Children who feel more confident to be able to eat fruit and vegetables every day report eating fruit and vegetables more frequently.

The Pro Children intervention was therefore targeting these aforementioned determinants of schoolchildren's fruit and vegetable intake. Chapter 3 described the development of the Pro Children intervention implemented during the first school year. The intervention consisted of three main components: a school curriculum, materials aimed at parents, and the (free) distribution of fruit and vegetables at school. In the Netherlands and Spain the intervention was implemented in the fifth grade, while Norwegian children were one year older.

The school curriculum consisted of worksheets and a computer-tailored tool. These materials addressed knowledge of recommended daily intake levels, and skills for preparing, recognizing and buying fruit and vegetables. Social influences and taste preferences have also been targeted. In order to involve parents, newsletters and a similar computer-tailored advice for parents have been developed and implemented. Parents were made aware of their influence on their child's fruit and vegetable intake. Furthermore parents were encouraged to prepare fruit and vegetables with their child in order to learn skills and to increase taste preferences. The school curriculum and materials aimed at parents were more or less similar in all three countries. The third intervention component, the distribution of fruit and vegetables at school, differed between the countries, since in all countries different distribution programmes already existed. In the Netherlands, children from intervention schools that participated in the Pro Children project received free fruit and ready-to-eat vegetables at school during two schooldays per week. In Norway all children (both intervention and control) were able to participate in a fruit and vegetable subscription programme that already existed before the start of the Pro Children project. When a child participated, the child received fruit and ready-to-eat vegetables on all schooldays. Parents had to pay 30 eurocents per day. In Spain, during the first two months of the first school year all intervention children received fruit and ready-to-eat vegetables for free during each

schoolday. After two months children had to bring the fruit and vegetables from home. In all countries these fruit and vegetables were consumed during a special fruit break. In addition to this fruit break, Spanish children were able to eat lunch at school. When a child ate lunch at school, for which parents had to pay a fee, the child received fruit on two to three schooldays per week. Vegetables were part of the lunch on between one to four schooldays.

During the second school year the (free) distribution of fruit and vegetables was continued in all countries in a similar way. Only a Norway some changes were made: all intervention children received fruit and vegetables for free on each schoolday during the last five months of the intervention. Furthermore, parents received two newsletters and were able to use the computer-tailored test through the Pro Children website. The school curriculum was less extensive. All children received a cookery book that contained recipes which the children had made themselves during the first school year, as part of an international recipe competition, and the schools were encouraged to continue using the computer-tailored programme.

Chapter 4 describes the short-term effects of the intervention implemented during the first school year. Effects on fruit and vegetable intake and relevant determinants of intake have been assessed, i.e. knowledge of recommended daily intake levels, taste preferences, perceived availability of fruit and vegetables at school, bringing fruit and vegetables to school, and habit strength. In total 1601 children from 62 schools participated in this study. Positive significant effects were found for frequency of fruit and vegetable intake, and portions of fruit intake consumed on the day prior to data collection. Children from the intervention group reported to eat more fruit and to eat fruit and vegetables more often than children from the control group. Children from the intervention group reported to eat 0.36 more portions of fruit than children from the control group. The difference in frequency of vegetable intake between both groups was 7.3%.

Also, a positive significant increase was found in the number of children that knew the recommended daily intake levels for fruit and vegetables. Before the intervention about 45% of the intervention children knew the recommendations for fruit, while about 64% knew these recommendations after the implementation of the intervention. For vegetables these percentages were, respectively, 22% and 35%. Prior to the intervention the number of children that knew both recommendations did not differ between the intervention and

control group. Within the control group no changes were found in the number of children that knew the recommendations.

Chapter 5 shows that the positive significant effects on frequency of fruit and vegetables intake, as well as portions of fruit intake, and the percentage of children that knows the recommended daily intake levels were maintained on the longer term. In this study 1488 children participated.

Chapter 6 describes the degree of implementation of the school curriculum and parental involvement, and the schoolchildren's appreciation of the school curriculum. In general children were positive about the intervention. The school curriculum consisted of sixteen lessons. The mean number of lessons that was implemented at school curriculum was nine. The degree of implementation of the school curriculum was the lowest in the Netherlands compared to Norway and Spain. Parental involvement was rather low in all countries. The mean number of activities that parents participated in was around three out of seven activities.

Associations between the degree of implementation of the school curriculum, parental involvement and schoolchildren's appreciation of the intervention and short-term effects on frequency of fruit and vegetable intake are also assessed. In this study, 868 children from the intervention group participated. Main findings are that the highest increase in frequency of fruit and vegetable intake was found among children that appreciated the intervention the most, and among children from schools that implemented the most lessons. This indicates the importance of involving children and teachers from the start of the intervention development, in order to develop an attractive intervention for children. Teachers should also be involved to increase the chance of a complete implementation of the school curriculum. Parental involvement was found to be associated with an increase in frequency of vegetable intake.

The final chapter of this thesis describes and discusses the main findings of the six chapters of this thesis. Furthermore, some methodological issues of all six studies are addressed, and implications for future research and practice are discussed.

We concluded that schoolchildren's fruit and vegetable intake is determined by personal, social and environmental factors. The Pro Children intervention was tailored to those determinants, and increased the children's fruit and vegetable intake, but mainly fruit intake. The implementation of the school curriculum and the appreciation of the intervention were associated with

those changes in intake. However, the implementation of the school curriculum and the involvement of parents need to be improved.

Samenvatting

De consumptie van groenten en fruit is de laatste jaren afgenomen. Er zijn studies bekend die hebben aangetoond dat het eten van voldoende groenten en fruit een positieve uitwerking zou hebben op de gezondheid. Ook zouden gezonde eetgewoonten makkelijker op jonge leeftijd aan te leren zijn en beter vol te houden zijn tot op latere leeftijd. Daarom is in 2002 het Pro Children project van start gegaan, een Europees onderzoeksproject ter bevordering van de consumptie van groenten en fruit onder 10-13 jarige Europese kinderen.

Binnen het Pro Children project is een onderscheid te maken in twee hoofdonderzoeken. Ten eerste is inzicht verkregen in de consumptie van groenten en fruit onder kinderen in deze leeftijdsgroep, en in de daaraan gerelateerde determinanten van deze gedragingen. Hiervoor is zowel kwalitatief onderzoek, bestaande uit focus groep interviews, als kwantitatief cross-sectioneel onderzoek gedaan in negen Europese landen, te weten België (Vlaanderen), Denemarken, Nederland, Noorwegen, Oostenrijk, Portugal, Spanje, IJsland en Zweden. Het tweede hoofdonderzoek bestond uit het ontwikkelen, implementeren en evalueren van een interventie gericht op het verhogen van de groenten en fruit consumptie bij 10 tot 13-jarige kinderen en het veranderen van de daaraan gerelateerde gedragsdeterminanten. Deze interventiestudie heeft alleen in Nederland, Spanje en Noorwegen plaatsgevonden.

Dit proefschrift begint met de achtergrond van het Pro Children project (inleiding). Deel 1 van dit proefschrift beschrijft de resultaten van het kwalitatieve (Hoofdstuk 1) en het kwantitatieve (Hoofdstuk 2) determinantenonderzoek dat is gehouden in de twee Nederlandstalige landen van het Pro Children project, namelijk Vlaanderen en Nederland.

De ontwikkeling van de interventie wordt omschreven in deel 2 van dit proefschrift (Hoofdstuk 3) en is deels gebaseerd op de resultaten van het kwalitatieve determinantenonderzoek. Bij de ontwikkeling van de interventie, die grotendeels gelijk was voor de drie deelnemende landen, is gebruik gemaakt van het Intervention Mapping model. Een belangrijk kenmerk van dit model is dat zoveel mogelijk systematisch gebruik wordt gemaakt van empirische en theoretische kennis over gedragsdeterminanten, werkzame gedragsveranderingstrategieën en effectieve interventies gericht op het stimuleren van de consumptie van groenten en fruit door kinderen.

Deel 3 van dit proefschrift (Hoofdstuk 4, 5 en 6) beschrijft de effect- en procesevaluatie van de Pro Children interventie. De interventie is gedurende twee schooljaren geïmplementeerd, waarbij de nadruk lag op het eerste schooljaar (2003-2004). De korte termijn effecten, gemeten aan het eind van het eerste schooljaar (mei 2004), zijn omschreven in Hoofdstuk 4. Hoofdstuk 5 omschrijft de effecten op de langere termijn die precies een schooljaar later (mei 2005) zijn gemeten. Tijdens het eerste schooljaar zijn ook aanvullende gegevens verzameld onder de schoolkinderen, docenten en ouders om inzicht te krijgen in de mate van implementatie en waardering van de interventie. De relatie tussen de implementatie en waardering van deze interventie en de gevonden korte termijn effecten wordt in Hoofdstuk 6 toegelicht. Tot slot wordt dit proefschrift afgesloten met een algemene discussie en aanbevelingen voor toekomstig onderzoek en de praktijk (Hoofdstuk 7).

Om een interventie te ontwikkelingen ter bevordering van de consumptie van groenten en fruit door kinderen, is het van belang eerst inzicht te krijgen in redenen waarom kinderen wel of niet (voldoende) groenten en fruit eten. Een belangrijke methode om hier inzicht in te verkrijgen is het houden van een uitgebreide en systematische literatuurstudie. Uit deze literatuurstudie, die door de Deense Pro Children partner is uitgevoerd, bleek dat de Pro Children interventie zich vooral moest richten op smaakvoorkeuren van kinderen, voorbeeldgedrag van ouders, en de beschikbaarheid van groenten en fruit thuis. Een tweede methode om determinanten van gedrag te achterhalen is het doen van kwalitatief onderzoek. Het belang van zulk onderzoek onder Europese kinderen werd door de literatuurstudie bevestigd, aangezien hieruit bleek dat veel determinantenstudies, zowel kwalitatief als kwantitatief, uit de Verenigde Staten afkomstig zijn. Om een nog beter beeld te krijgen van belangrijke determinanten van de groenten en fruitinname onder Europese kinderen zijn daarom focus groep interviews gehouden met 10 en 11-jarige kinderen uit alle negen Pro Children landen. De resultaten van de focus groep interviews gehouden met de kinderen uit Vlaanderen en Nederland worden omschreven in Hoofdstuk 1. Volgens deze kinderen waren het aspect ‘gezond’ en ‘smaak’ belangrijke redenen voor het wel of niet eten van groenten en fruit. Ook het niet kennen van de dagelijks aanbevolen hoeveelheid lijkt een reden voor het niet eten van (voldoende) groenten en fruit. Naast deze meer persoonlijke factoren, lijken sociale en fysieke omgevingsfactoren een rol te spelen. Zo geven kinderen

aan dat ouders zelf het goede voorbeeld moeten geven en verantwoordelijk zijn voor de aanschaf van groenten en fruit. In beide landen wordt de meeste groenten tijdens de warme maaltijd gegeten en wordt maar weinig groenten en fruit mee naar school genomen.

Dat smaakvoorkeuren, het kennen van de dagelijks aanbevolen hoeveelheid, voorbeeldgedrag van ouders en de beschikbaarheid van groenten en fruit belangrijke determinanten van de consumptie van groenten en fruit lijken te zijn, wordt bevestigd in het kwantitatieve determinantenonderzoek, omschreven in Hoofdstuk 2. Verder kwam uit dit onderzoek naar voren dat kinderen vaker groenten en fruit eten als ouders eisen dat ze groenten en fruit moeten eten. Ook het vergemakkelijken van het eten van groenten door het klaar te maken, hangt samen met het vaker eten van groenten. Kinderen die zich in staat voelen iedere dag groenten en fruit te eten geven ook aan vaker groenten en fruit te eten.

De Pro Children interventie is daarom gericht op het beïnvloeden van deze determinanten van gedrag. In Hoofdstuk 3 wordt de totstandkoming van de verschillende onderdelen van de Pro Children interventie beschreven. Ten eerste is lesmateriaal ontwikkeld dat op een aantal basisscholen is geïmplementeerd. In Nederland is het project van start gegaan in groep 7 van de basisschool. In Spanje waren de kinderen van dezelfde leeftijd, terwijl de Noorse kinderen gemiddeld een jaar ouder waren. Dit lesmateriaal, bestaande uit werkboekjes en een computergestuurd advies op maat, was onder andere gericht op het vergroten van de kennis van de aanbevolen dagelijkse hoeveelheden die gelden voor de consumptie van groenten en fruit, alsook het kunnen herkennen en leren waarderen van verschillende soorten groenten en fruit en vaardigheden om groenten en fruit te kopen en klaar te maken. Ook is aandacht besteed aan sociale invloeden en smaakvoorkeuren. Naast de lesmaterialen zijn drie nieuwsbrieven en een computergestuurd advies op maat voor ouders ontwikkeld die waren bedoeld om ouders meer bij het project te betrekken. Ouders werden zich bewust gemaakt van de invloed die zij kunnen hebben op de consumptie van groenten en fruit door hun kinderen, alsook op vaardigheden om groenten en fruit klaar te maken met het kind en smaakvoorkeuren. De lesmaterialen voor de kinderen en de materialen voor de ouders waren vrijwel gelijk in de drie interventielanden. Naast deze materialen is ook fruit en af en toe hapklare groenten uitgedeeld op school. Het aantal dagen waarop fruit en groenten werd uitgedeeld en de te betalen prijs

verschilde tussen de drie landen vanwege verschillen in reeds bestaande verstrekkingsprogramma's. In Nederland werd gratis twee maal per week een stuk fruit, en af en toe tomaatjes of worteltjes, uitgedeeld. Deze verstrekking van fruit en groenten werd afgeleid van 'Schoolgruiten', een vergelijkbaar door het Voedingscentrum en AGF Promotie Nederland opgezet en uitgevoerd project in zeven Nederlandse steden. In Noorwegen konden kinderen uit zowel de interventiegroep als de controlegroep al voor de start van de interventie deelnemen aan een bestaand verstrekkingsprogramma waarvoor de ouders een bijdrage van 30 eurocent per dag betaalden. Kinderen die deelnamen aan dit programma kregen iedere schooldag een stuk fruit of hapklare groenten tijdens een speciale pauze. Alleen in Spanje konden de kinderen een lunch nemen op school. Ook hiervoor werd aan de ouders een bijdrage gevraagd. De kinderen die op school een lunch aten, kregen gemiddeld op één tot vier dagen groenten en op twee of drie dagen fruit. Naast de lunch kregen de kinderen gedurende de eerste twee maanden van het eerste schooljaar gratis fruit tijdens een speciale fruitpauze. Na deze twee maanden werd aan de kinderen en ouders gevraagd groenten en fruit van huis mee te nemen naar school.

Tijdens het tweede schooljaar, in Nederland groep 8 van de basisschool, werd een veel minder omvangrijke interventie geïmplementeerd. In elk land werd het (gratis) verstrekken van groenten en fruit gecontinueerd. In Noorwegen vond een verandering plaats: alle interventiekinderen kregen iedere schooldag gratis een stuk fruit of hapklare groente gedurende de laatste vijf interventiemaanden. Ouders konden nog steeds het advies op maat invullen op de Pro Children website en ontvingen twee nieuwsbrieven. Op school werd minder aandacht besteed aan lessen over groenten en fruit. De kinderen ontvingen een Pro Children kookboekje dat bestond uit recepten die de kinderen uit de drie landen zelf hadden gemaakt naar aanleiding van een internationale receptenwedstrijd die tijdens het eerste schooljaar was uitgezet.

Hoofdstuk 4 beschrijft de korte termijn effecten van de interventie die is uitgevoerd tijdens het eerste schooljaar op de consumptie van groenten en fruit en op een aantal determinanten van gedrag, te weten kennis van de dagelijkse aanbevolen hoeveelheid, smaakvoorkeuren, de waargenomen beschikbaarheid van groenten en fruit op school en het meebrengen van groenten en fruit naar school, en de vorming van de gewoonte om iedere dag groenten en fruit te eten. Aan dit onderzoek hebben 1601 kinderen van 62 scholen meegedaan. Er werden positieve significante effecten gevonden op de frequentie van de inname van

groenten en fruit, alsook een toename in porties gegeten fruit. Kinderen uit de interventiegroep gaven aan 0.15 keer vaker en 0.36 meer porties fruit te eten dan de kinderen uit de controlegroep. Het verschil tussen beide groepen in frequentie van het eten van groenten was 7.3% in het voordeel van de interventiegroep. Bovendien werd een toename gevonden in het percentage van de kinderen dat op de hoogte was van de dagelijks aanbevolen hoeveelheden. Na afloop van de interventie wist ongeveer 64% van de kinderen uit de interventiegroep de aanbevolen dagelijkse hoeveelheid voor fruit. Vóór de interventie kende ongeveer 45% van de kinderen deze aanbeveling. Vooraf kende 22% van de kinderen de aanbevelingen voor de inname van groenten. Na afloop van de interventie was dat 35%. Binnen de controlegroep waren geen veranderingen gevonden in het aantal kinderen dat de aanbevolen hoeveelheden kende.

In hoofdstuk 5 worden de effecten op de langere termijn onder 1488 kinderen, gemeten één jaar na de korte termijn effecten, omschreven. Dit hoofdstuk laat zien dat effecten op de frequentie van de inname van groenten en fruit, en de toename in porties gegeten fruit, behouden zijn. De gevonden toename in het percentage van de kinderen dat op de hoogte was van de dagelijks aanbevolen hoeveelheden, bleef ook bestaan.

In hoofdstuk 6 is gekeken naar het gebruik van de lesmaterialen op school, het gebruik van de materialen door ouders en de verstrekking van groenten en fruit op school tijdens het eerste schooljaar. Aan kinderen is ook gevraagd wat zijn van het project vonden. Over het algemeen waren de kinderen positief over het project. Van de zestien lessen die op school konden worden uitgevoerd werden gemiddeld negen uitgevoerd. Nederland scoorde daarbij lager dan Noorwegen en Spanje. De betrokkenheid van ouders was laag. Gemiddeld zijn iets meer dan drie activiteiten met de ouders gedaan, terwijl er zeven activiteiten waren gericht op de ouders.

In dit hoofdstuk is ook gekeken naar het verband tussen de mate van implementatie van de lesmaterialen op school, het gebruik van de materialen door ouders, de waardering van de interventie door de kinderen, en de gevonden stijging in de frequentie van de consumptie van groenten en fruit op korte termijn. Dit onderzoek is uitgevoerd onder 868 kinderen uit de interventiegroep. De belangrijkste resultaten zijn dat de grootste effecten op de frequentie van de consumptie van groenten en fruit gevonden zijn onder de kinderen die de interventie het meest waardeerden, en toont hiermee het belang

aan van het vroegtijdig betrekken van de doelgroep bij het ontwikkelen van een dergelijke interventie. Ook bleek uit deze studie dat de sterkste toename in frequentie van de groenten en fruitconsumptie werd gevonden bij de kinderen waar de meeste lessen over groenten en fruit zijn gegegeven. Dit wijst op het belang van een goede en volledige implementatie van het lesmateriaal. De betrokkenheid van ouders bij het project hing samen met een toename in de frequentie van het eten van groenten.

In het laatste hoofdstuk van dit proefschrift (Hoofdstuk 7) worden de belangrijkste resultaten van de zes studies samengevat en bediscussieerd. Tevens wordt gereflecteerd op een aantal methodologische aspecten van de verschillende studies. Tot slot worden implicaties voor verder onderzoek, alsook voor de praktijk, besproken.

Wij concludeerden dat de inname van groenten en fruit door kinderen wordt beïnvloed door persoonlijke, sociale en fysieke omgevingsfactoren. De systematisch ontwikkelde Pro Children interventie, die was gericht op zowel persoonlijke, sociale en fysieke omgevingsfactoren, was effectief in het verhogen van de inname van groenten, maar met name de inname van fruit. De implementatie van de lessen op school en de waardering van het project door de kinderen hangt samen met de gevonden gedragsverandering. De implementatie van de lessen op school en de betrokkenheid van ouders dient verbeterd te worden.

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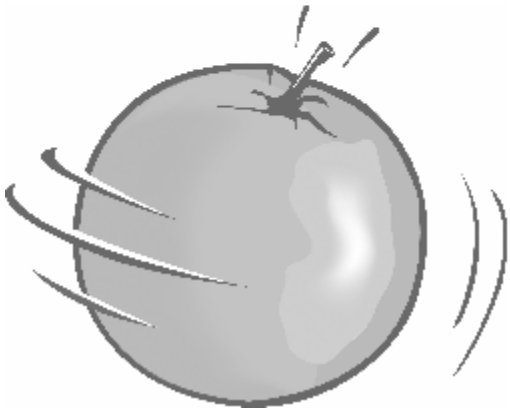

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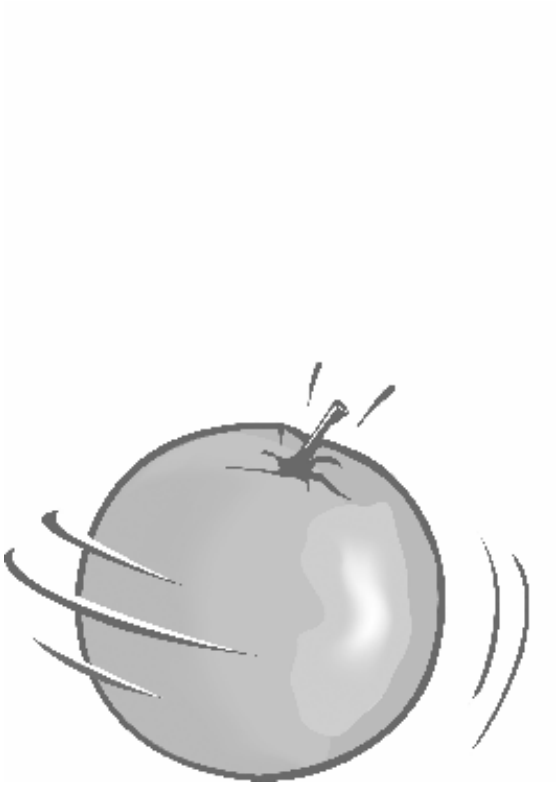
Curriculum Vitae & Publications



Curriculum Vitae

Marianne Wind was born on August 15th, 1977 in Emmeloord, the Netherlands, and was raised in Lemmer. In 1995 she received a VWO diploma at the Zuyderzee College in Emmeloord. She then moved to Groningen to start studying Nutrition and Dietetics at the Hanzehogeschool, Hogeschool of Groningen. In 1999, she obtained her bachelor degree by writing a thesis at the University of Gothenburg, Sweden. Afterwards she started studying Health Education and Health Promotion at the faculty of Health Sciences of Maastricht University. While studying at Maastricht University, in 2000, she started working as a research assistant at the Department of Health Education and Health Promotion at that same University. In 2002 she graduated *cum laude* and obtained her Master of Science degree. In that same year she started her PhD project on the promotion of fruit and vegetable intake among European schoolchildren, 'The Pro Children project' at the Department of Public Health of Erasmus MC in Rotterdam. She is currently working as a campaign coordinator at the Dutch Diabetes Federation.

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