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Flanders preschool dietary survey: rationale, aims, design, methodology and population characteristics

by

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Abstract

Background. Until 2002, detailed information on dietary habits of young children was still lacking in Flanders, Belgium. In an attempt to bridge this gap, the Ghent University conducted its first Flemish Preschool Dietary Survey in 2002-2003. In this paper, the rationale, aims, design, and instruments of this survey are described. In addition, to assess whether the study sample was representative of the entire target population, some subjects' characteristics known to possibly influence dietary intakes were compared with some characteristics of the target population.

Design. The target population contained all preschool children living in Flanders. Individuals were selected via random cluster sampling at the level of schools, stratified by province and age. Schools were randomly selected from lists made available by the Flemish Ministry of Education and Training. A total of 2426 children were invited to take part in this study. Information on food intake was collected using 3-day estimated diet records in combination with a semi-quantitative food-frequency questionnaire, both completed by the parents/caregiver. Socio-demographic and lifestyle characteristics were obtained with an additional questionnaire. Information about nutrition related school policies was collected through a school questionnaire, completed during an interview with the school principal. The fieldwork was carried out from October 2002 until February 2003. After exclusion of low quality data, a total of 1847 children (participation rate: 76%) was included in this study.

Discussion. The results demonstrated good geographical representativity. Six percent of the target population was excluded as only 94% starts attending preschool classes from the age of 2.5 years old onwards. The results of this study are used as a basis for nutrition promotion campaigns in Flanders, taking into account the major gaps in our Flemish preschooler's dietary habits. Furthermore, authorities use these data in order to evaluate current policies and to develop and implement new policies whenever necessary.

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Background

In preschool children, dietary intake is not only linked to growth, development, and nutrition-related diseases, but also to risk factors for chronic diseases, such as obesity, increased cholesterol levels, and hypertension (1). Some disease promoting pathways are considered to be initiated early in life, in fact perhaps already during growth in utero (2-5). In addition, nutritional lifestyle factors and eating habits are often adopted very early in life and tend to persist throughout life. Hence, food consumption patterns in childhood tend to be associated with subsequent risk of developing diseases in adult life (6;7). In other words, establishing healthy diet in early childhood may be one way of contributing to the prevention of future morbidity and mortality.

Because of the multiple reasons described in the previous paragraph, it is crucial to monitor diet habits already early in life in order to plan and develop targeted health promotion actions against nutrition related diseases that find their onset already in childhood, when diet habits are still being formed.

However, until 2002, with the exception of certain studies conducted in communities or cities, detailed information on dietary habits of young children did not exist in Flanders (Northern, Dutch-speaking part of Belgium). In an attempt to bridge this gap in available descriptive data, a population-based survey was carried out in preschool children in Flanders in 2002-2003.

The aim of this paper is to describe the rationale, objectives, design and methods of this dietary survey in preschool children in Flanders and to report some population characteristics.

Objectives of this Flanders preschool dietary survey

The primary aim of this dietary survey in preschool children is to monitor the nutritional adequacy and toxicological safety of the food and nutrient consumption in preschool children living in Flanders. More in detail, the specific objectives are:

- to provide information on the distribution of food, nutrient and contaminant intake in the population of preschool children in Flanders
- to compare actual food and nutrient intake with recommendations
- to compare the intake of suspected toxic food components with safety levels

- to investigate the differences in meal pattern, energy intake and food and nutrient intake between different subgroups of the population (as defined by the socio-demographic and age variables) and to compare these with the recommendations
- to identify subgroups at risk for a deficient or excessive intake of specific foods, nutrients or contaminants (e.g. patulin, pesticide and nitrate exposures)
- to examine the impact of schools on the diet of preschool-aged children.

Last, the authors aimed to conceptualise an accurate and easy tool, namely a Food Frequency Questionnaire (FFQ) for estimating calcium and food(group) intakes in preschool children in Flanders. On the basis of this newly developed FFQ, calcium intakes (8) and a diet quality score for preschool children can be calculated. This tool can then easily be used for other surveys in this population in order to receive an accurate and quick view of the usual calcium intakes and diet quality of preschool children. The main reason for developing an easy tool to assess usual dietary calcium intakes in preschool children is because calcium intakes during childhood are considered to play an important role in current and future bone health. Therefore, it is important to assess usual calcium intakes in childhood in order to allow evidence-based interventions designed to optimise bone health early in life.

A dietary survey of this kind is an indispensable tool and source for different types of evaluation, risk assessment and policymaking decision algorithms in the field of nutrition and food safety in young children.

Design and methods

Subjects and sampling procedures

The target population for this study were all preschool children living in Flanders. The sample size has been defined based on sample size calculations, to allow description of food consumption in different predefined age-groups (2.5-4 years; 4-6.5 years) and in both genders. Sample size calculations were carried out in line with the objectives of the study. Although sample size calculations were done for estimating the mean intakes of different nutrients, the final sample size was based on an estimated mean intake for calcium to fall within a 5% interval around the true population mean with a 95% probability, since this was the nutrient requiring the largest sample size of all nutrients/constituents of main interest (e.g. energy, macronutrients, fibre, water, calcium, iron, sodium, potassium, thiamine, riboflavin). These sample size calculations suggested inclusion of 225 individuals per age-gender stratum, resulting in a minimum total sample size of 900 individuals for the entire survey. The standard deviation and mean calcium intake used for these sample size calculations were derived from previous studies in preschool children (9;10).

In order to achieve at least 900 cases with good quality data in our final study sample, we considered a possible refusal rate of 50%. In addition, because of quality problems of the received data some posterior exclusions were foreseen (estimated at 25% of the participants). When taking into account these two considerations, we aimed to invite at least 2250 preschool children in our sample.

Using a cross-sectional epidemiological design, representative samples of preschool children aged 2.5–6.5 years old were selected on the basis of random cluster sampling at the level of schools, stratified by province and age.

TABLE 1. Calculation of number of schools to be randomly selected within the different provinces in Flanders

Province	Schools in Flanders (n)*	Schools in Flanders (%)	Schools to be selected (n)
Antwerp	731	24.6	12
Limburg	427	14.4	7
East-Flanders	741	25.0	13
Flemish Brabant	457	15.4	8
West-Flanders	612	20.6	10
Total	**2968**	**100**	**50**

* Lists made available by the Flemish Ministry of Education and Training.

Cluster sampling was carried out in two stages: first, schools were selected as primary sampling units (PSU) from lists made available by the Flemish Ministry of Education and Training; second classes were selected as secondary sampling units. Within every school participating in the study, one class was randomly selected for each age group (secondary sampling unit), including all the children within the selected classes as final sampling units. Although most schools had three different age groups (2.5-4 years; 4-5 years; 5-6.5 years), smaller schools sometimes only differentiated between two age groups. Children were excluded from the study when

(a) they were staying in an institution where the food was provided by the institution (for example, a hospital school);

(b) they were not attending school during the whole period of the fieldwork;

(c) they were living abroad (e.g. in the Netherlands) but attended school in Flanders;

(d) neither of their parents spoke Dutch;

(e) they had an older brother or sister participating in the study.

In order to achieve the aim of inviting at least 2250 preschool children, fifty preschools were needed in the final sample of schools, when considering fifteen eligible children per class (and as mentioned before, three classes per school). In total sixty-five nursery schools were randomly selected in order to reach the aim of fifty participating schools.

So, within the selected classes of these participating schools, all eligible children were invited by a letter accompanied by an informed consent form. The letter explained the aim of the study and what was expected from the respondents.

The Ethical Committee of the Ghent University Hospital (Belgium) granted approval for the study.

Instruments

In view of the fact that no validated instruments were available for measuring dietary intake in this particular target population, new instruments had to be developed, taking into account that proxy administrations were required. Since it has been demonstrated that combining a quantitative method (like a diet record) with a qualitative method (like a FFQ) can be a valuable substitute for more expensive and respondent-burdening dietary assessment methods (such as a 7-day or 14-day diary) (11), information on food intake was collected using a consecutive 3-day EDR in combination with a FFQ, both administered by the parents or another proxy. Additional data on socio-demographic and lifestyle characteristics were obtained with an additional questionnaire. Since schools were used as primary sampling units, a school questionnaire was used in order to obtain extra information about the school policies (mainly in relation to food supply).

The used tools required a great involvement of the parents and the staff members of the different participating schools. The teachers were asked to distribute the questionnaires and diaries among the children and to assist in motivating the parents to participate. Teachers were also asked to collect the completed questionnaires and diaries, which the parents could return in a sealed envelope for the sake of confidentiality.

Food-frequency questionnaire

As mentioned before, a self-administered semi-quantitative FFQ has been developed specifically for the purpose of this dietary survey in preschool children in Flanders. This questionnaire was completed by the parents or another proxy who spent most time with the child. The food categories in the FFQ were based on the classification system, described in the Flemish Food guide (the so-called food triangle) in order to reassure comparability with the Flemish Food Based Dietary Guidelines (FBDG) (12). As one of the objectives of this investigation was to develop a practical tool for estimating the calcium intake of Flemish preschool children, food (groups) with a high calcium content and part of the typical Flemish diet or with a moderate calcium content but commonly eaten by children in Flanders, were also included in this FFQ. The semi-quantitative FFQ contained questions on the average consumption of 47 food items during the past year (8). Furthermore, the FFQ included 15 additional questions inquiring more detailed information about some product groups. The frequency questions used in this questionnaire are based on those used and advised by Willett (13): every day; 5-6 days/week; 2-4 days/week; 1

day/week; 1-3 day/month; never or <1 day/month. The questionnaire also contained three or four daily portion size categories per food item and a list of common standard measures as examples. For solid food groups, only three portion size categories were included, as the daily portion sizes of preschool children are too small to divide in four categories. Liquid products are consumed in higher quantities, which makes it feasible to create four portion size categories. Parents were asked to indicate the frequency of consumption and the portion size category that best fits the daily portion of their child.

This newly developed FFQ demonstrated good repeatability and fairly good ability to classify subjects into extremes of calcium intake. Pearson correlation for calcium intakes estimated by EDR and FFQ was 0.52 and cross-classification analyses of the FFQ and EDR classified 83% of the subjects in the same or adjacent category and 2.4% in extreme quartiles. Correlation between repeated administrations was 0.79. More detailed information on the FFQ and its validity and reproducibility is given elsewhere (9).

Estimated diet records

In the study a 3-day EDR was used in order to gather more detailed and quantitative information about consumed food products (e.g. brand name, type of fruit, type of fat used). Since this is an open-ended method, it allows the assessment of a wide range of nutrients, foods and contaminants. In addition, the EDR was chosen as reference method for estimating the relative validity of our newly developed FFQ. Although non-consecutive days are recommended above consecutive days for estimating usual dietary intakes, because of the higher risk for dropouts when using non-consecutive days, it was decided to use consecutive days. When using consecutive days, at least 3 days are required to estimate usual dietary intakes by means of the NUSSER method (14;15). In these EDRs, days were subdivided into six eating occasions, namely breakfast, morning snacks, lunch, afternoon snacks, dinner and evening snacks. Detailed information on the type (including brand names) and portion size of the consumed foods was collected using an open entry format. Parents were asked to collect structured EDRs over three consecutive days. On a separate sheet, parents were invited to give details on recipes, ingredients, cooking methods, etc. The staff supervising the children during lunchtime were asked to record the foods the child ate during lunchtime. This information, together with the daily menu, was given to the parents, who were asked to copy this information in the food diary of their child. The teachers were also asked to report to the parents whether the child had been eating and/or drinking the foods provided by the parents during the breaks and/or if they had been eating other food products during the breaks.

Only good quality EDRs containing adequate descriptions of the food products and portion sizes consumed, were included in the study. However, use of standard portion sizes (16) was inevitable for some food products, which were difficult to estimate by the respondent (e.g. French fries, mixed recipes). Two dieticians, with a long-standing experience in nutritional epidemiological

fieldwork, carried out the exclusion procedure of the EDRs, using objective exclusion criteria. As a crosscheck, average energy intake and nutrient intakes were calculated as the mean of the three recorded days. Diaries that produced very high or very low estimates of intake for some nutrients (energy, proteins, fat, carbohydrates, water, fibre, calcium and iron) were rechecked by dieticians. This amounted to 5% of the diaries. In this crosscheck, only diaries having extremely low estimates for some nutrient intakes, explained by an exceptional day (like sickness of the child), have been excluded from the study. After these quality checks, the remaining diaries were coded and entered in a `Diet Entry and Storage' software programme (BECEL) (17). The food list and food composition data for this programme were based on the following tables: Belgian food composition table NUBEL (18), Dutch food composition database NEVO (19), food composition table of the Belgian Institute Paul Lambin (20); McCance and Widdowson's UK food composition table (21).

General questionnaire

In order to evaluate possible determinants of food consumption habits, a general questionnaire, registering additional information about the child (e.g. gender, physical activity level, special diet, use of diet supplements, consumption of lunch at school), its parents (e.g. age, parental education levels, work status, birth countries) and the family / household composition was used. In this general questionnaire, the parents were also asked to report the weight and height of their child.

These sociodemographic parameters can be used to describe the study population and identify subgroups of interest within the population. The lifestyle characteristics are important to indicate to what extent less healthy dietary habits are related to other unhealthy lifestyle characteristics.

School questionnaire

In order to evaluate possible determinants of food consumption habits related to the school (or school policies), a school questionnaire, registering additional information about the school policy and food supply was completed during a face-to-face interview with the head teacher. The main topics of this school questionnaire are:

(1) lunches (=meals taken during lunchtime) at school (e.g. possibility to have a hot meal or to bring their own bread meal)

(2) snacks / drinks (e.g. school milk) distributed at school

(3) vending machines (for snacks or drinks) at school

(4) nutritional education courses for preschool children at school

(5) nutrition campaigns recently held at school

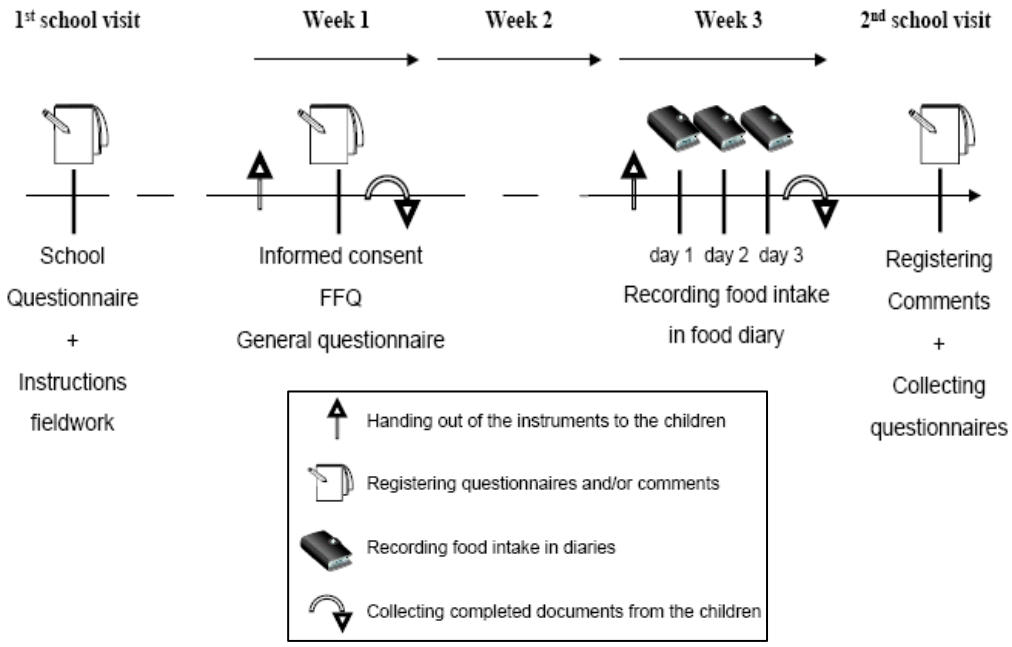
(6) nutrition policy at school (e.g. whether snacks are allowed during the breaks, whether soft-drinks are allowed)

Fieldwork

The fieldwork of the dietary survey in preschool children in Flanders was carried out in the autumn and winter of 2002-3. As mentioned before, the parents were invited to participate in the study by means of an invitation letter. This invitation letter, together with an informed consent form, the general questionnaire and the FFQ was distributed to the parents. All instruments given to the children and their parents were handed out in paper bags, that could be decorated by the children in the classroom in order to make sure that the children proudly took care themselves (or stimulated their parents to take care) of their paper bag (including the instruments). In order to increase the response rate, the parents were promised to receive the global results from the study and were invited to attend a workshop about dietary habits in preschool children once the first results were calculated. The paper bags and the feedback were both initiated in the hope to increase the response rate by motivating the children as well as the parents without other incentives.

The parents were asked to return the completed FFQ after one week and they had to sign the informed consent in order to take part in the study. The 3-day EDR was then distributed one week after the completed FFQs were collected. It is noteworthy that diet records were only distributed to the children who returned the FFQ. In the EDR, detailed instructions were elaborated for the parents. To ensure that all days of the week would be approximately equally covered in the diet records, the research team determined beforehand the days to be registered by each child.

FIGURE 1. Diagram presenting the data collection and flow during the fieldwork



As shown in table 2, all days of the week were represented in the total sample of diet records. However, Monday, Tuesday and Sunday were somewhat less represented than the other days of the week.

TABLE 2. Distribution of the registered days over the week

Day of the week	Frequency	Percentage
Monday	304	12
Tuesday	288	11
Wednesday	458	17
Thursday	398	15
Friday	414	16
Saturday	428	16
Sunday	336	13
Total	**2626**	**100**

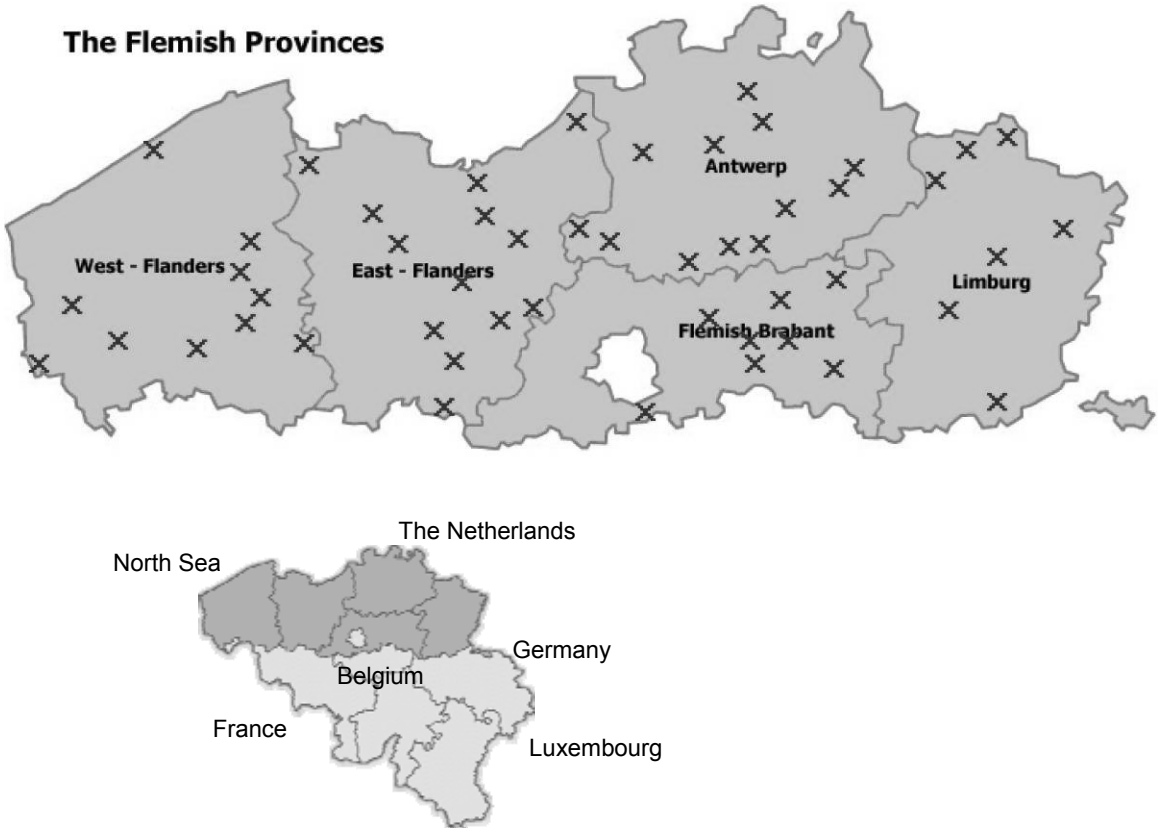
Results

School Participation

From the sixty-five randomly selected nursery schools, two schools had to be excluded, based on the exclusion criteria mentioned above: the first school was a hospital school, while the second school was a school for French-speaking preschool children only. Out of the remaining sample of sixty-three eligible nursery schools, thirteen schools refused to participate in this dietary survey, while the other fifty schools participated. Figure 2 shows a map of the fifty participating schools (PSU) for the dietary survey in preschool children in Flanders. Of these fifty schools, seven schools refused to distribute food diaries, as this was considered too big a burden for the children and their parents. The remaining forty-three schools that participated in the whole study were proportionally spread over the different provinces in Flanders.

Within these forty-three schools, a total of 2095 children were invited in this study. When adding the children who were invited in the seven schools that only distributed the FFQ and the general questionnaire, 2426 preschool children out of a total of 2604 were invited to participate in our survey. The remaining 178 children attending the selected classes had to be excluded from the study because they were not eligible (having at least one of the exclusion criteria given above).

FIGURE 2. Distribution of the fifty schools participating in our diet survey for preschool children in Flanders



Child Participation

The 2426 preschool children invited to participate in the study were asked to complete the general questionnaire and the FFQ. In total, 1844 children returned a FFQ and a general questionnaire (participation rate: 76%). However, only 1766 FFQs were useful for data analyses, since less than half of the questions had been answered on the remaining questionnaires (e.g. only the recto pages and no versos). It is noteworthy that the 1766 FFQs used for data analysis could contain a limited number of missing data as well.

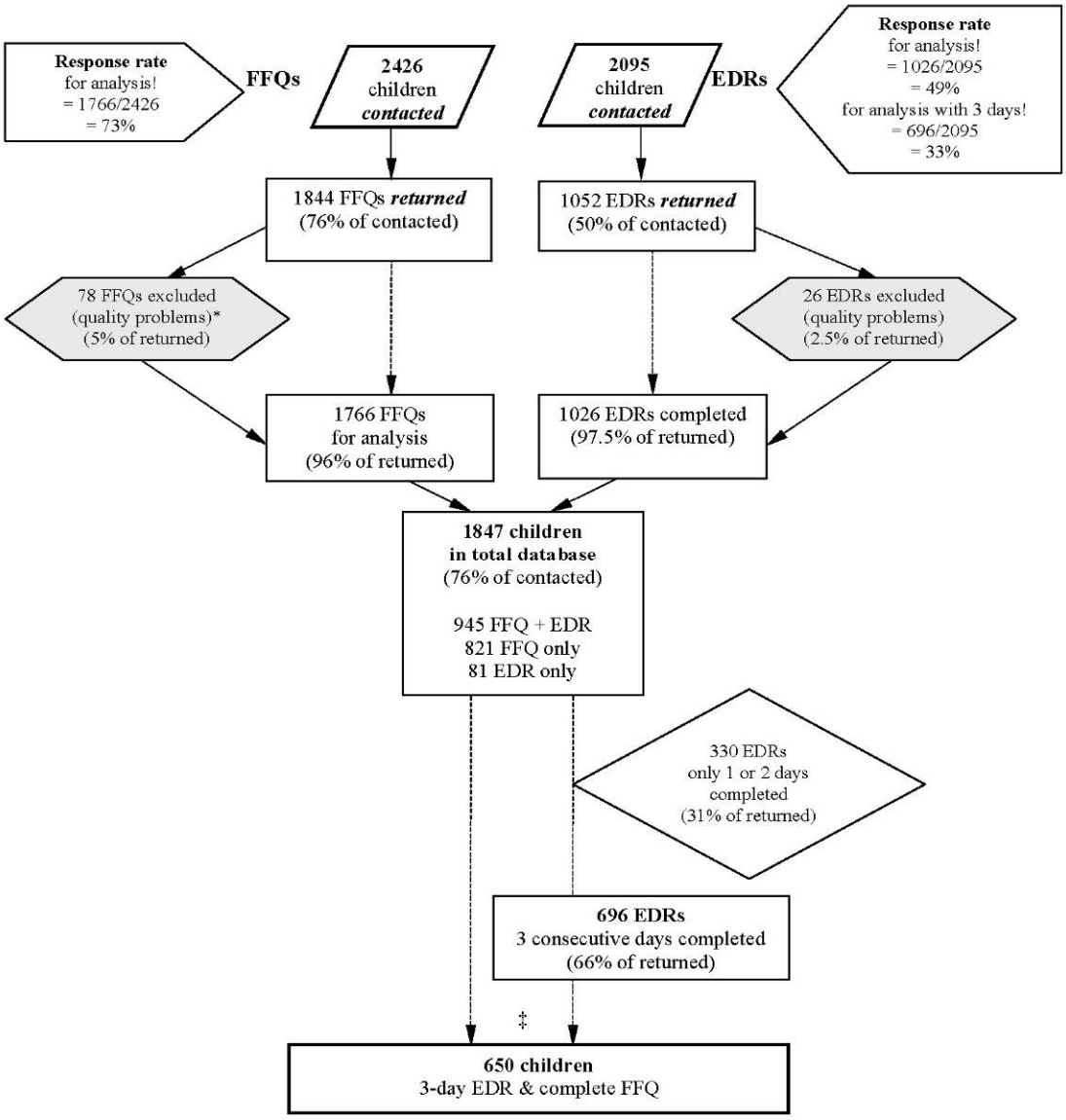
From the 2095 preschool children who participated in the whole study and were asked to complete a 3-day EDR after having returned their FFQ and general questionnaire, 1052 children returned an EDR (PR: 50%). As mentioned before, only good quality EDRs were used for analysis. In total, the food diaries of twenty-six children needed to be excluded because of quality problems.

Of the 1026 remaining children, 696 completed three good quality days, 208 only two days and for 122 children barely one record day was useful for analysis. Because age and/or gender in-

formation is missing for thirty-five children, only 661 children can be included in the analysis for age and gender groups, using data of the EDR.

In total, 1847 children were included in the whole sample of questionnaires and/or EDRs useful for analysis. For eighty-one of these 1847 children, only the EDR could be included in the study, since the questionnaires were insufficiently completed and had to be excluded for the analyses. In figure 3, the participation rates over the course of the study are visualised in a flowchart.

FIGURE 3. Response rates over the course of the study



FFQ: food-frequency questionnaire; EDR: estimated diet record.
* less than half of the questions have been answered (excluded from analysis).
‡ forty-six children completed a complete 3-day EDR, but their FFQ was not useful for analysis.

As presented in table 3, the sample of preschool children participating in our study was representative for the total population of preschool children in Flanders with regard to the distribution over the different Flemish provinces.

TABLE 3. Comparing number of participants with total number of preschoolers living in the Flemish provinces

Province	Number (percentage) of children living in Flanders	Number (percentage) of children participating in our study
Antwerp	108,093 (28)	535 (29)
Limburg	50,422 (13)	168 (9)
East-Flanders	88,048 (23)	435 (24)
Flemish Brabant	68,313 (18)	317 (17)
West-Flanders	69,787 (18)	392 (21)
Total (N)	**384,663 (100)**	**1847 (100)**

School questionnaire

Although the results from the school questionnaires, including a comparison of the different school policies, will be discussed in more depth in another paper, it is noteworthy that in our study sample, more than half of the schools (58%) were serving a hot meal during lunchtime and none of the preschools had vending machines at their disposal.

General questionnaire

Different characteristics that have been questioned in the general questionnaire, including information about the child, its parents and the family have been described in table 4. Boys and girls were equally represented and the distribution over the three age categories of preschool classes was almost equal. More than 30% of our Flemish preschool children take dietary supplements (predominantly multi-vitamin and/or mineral supplements), while only few are following a special (medical) diet (2%) or eating pattern (e.g. vegetarian) (4%). More than half of the children always take their lunch at school, while only 27% never consumes lunch at school. It should be noted that 'lunch at school' does not necessarily imply a meal provided by the school, but also includes a cold/bread meal prepared by the parents. The most important remark from the parents, whose children were attending schools where no school lunch was provided, was that they preferred the provision of a hot meal at school during lunchtime. In general, parents complained about insufficient food provisions at school and more in particular not enough healthy foods like fruit and vegetables.

When investigating some parental characteristics of the children participating in the Flanders preschool dietary survey, we found that in 36% of the families at least one parent was smoking (18% of the mothers and 29% of the fathers). In 64% of the families, the highest parental educa-

tion level was at least 'higher education' (e.g. bachelor or master degree). When considering the parents separately, 54% of the mothers had attained higher education grades, compared to only 46% of the fathers. In nine percent of the families, at least one of the parents was not born in Belgium (5% of the mothers and 6% of the fathers).

TABLE 4. Characteristics of the children participating in the Flanders preschool dietary survey

	Children reported	
	n[§]	(%)
Gender		
Boys	896	(50.1)
Girls	894	(49.9)
Age		
2.5-4 years	573	(32.0)
4-5 years	599	(33.4)
5-6.5 years	619	(34.6)
Special diet		
Special diet for diabetes	1	(0.1)
Gluten-free diet (gluten-intolerance)	1	(0.1)
Lactose-free diet (lactose-intolerance)	9	(0.5)
Special diet for food allergies	22	(1.2)
Energy-restricted diet	2	(0.1)
Other diet (e.g. laxative diet, high energy diet, fibre restricted diet)	5	(0.3)
Total	40	(2.2)
Special eating pattern		
Vegetarian or semi-vegetarian (no red meat)	17	(1.0)
Lacto-ovo-vegeterian	8	(0.4)
Ovo-vegeterian	2	(0.1)
Lacto-vegeterian	2	(0.1)
Biological diet	24	(1.3)
Religious or other eating pattern	17	(0.9)
Total	70	(3.8)
Used dietary supplements during previous month		
Iron	36	(1.9)
Calcium	20	(1.1)
Fluoride	3	(0.2)
Multi-minerals	14	(0.6)
Vitamin C	91	(4.9)
Vitamin B complex	11	(0.6)
Fat-soluble vitamins	8	(0.4)
Multi vitamins	234	(12.7)
Multi minerals & vitamins	185	(9.8)
Echinacea	55	(3.0)
Total*	576	(31.2)
Taking lunch at school		
Always	957	(51.8)
Sometimes	330	(17.9)
Never	505	(27.3)

From the children taking their lunch at school		
Taking their own (bread) meal prepared at home	852	(46.1)
Taking a hot lunch meal provided by the school	435	(23.6)
Remarks from parents not happy about the food provision at school	193	(10.4)
No food provision at all (or insufficient)	49	(2.7)
Lacking provision of		
A hot meal at lunch time	42	(2.3)
Soup at lunch time	20	(1.1)
Vegetarian products and soymilk	9	(0.5)
Healthy food items like fruit and vegetables	54	(2.9)
Unhealthy food items like soft drinks and biscuits	3	(0.2)
Too high provision of unhealthy products like soft-drinks, sugared milk drinks…	13	(0.7)
Too expensive	3	(0.2)

* The total number of children using dietary supplements is not equal to the sum of the children using the different types of dietary supplements as some of the children were using more than one type of dietary supplement.

§ n=number of children reported (N study sample=1847). It is noteworthy that the total number of children for the different variables is not necessarily equal to 1847, because data was sometimes missing for some of the children (e.g. for 57 children, the gender was missing).

Discussion

As mentioned before, monitoring of dietary habits in our preschool population is crucial for the planning and development of targeted health promotion actions against nutrition related diseases that find their onset already in childhood, when diet habits are still being formed. If serious deviations from the dietary recommendations are detected early in life, nutritional education of the child populations at risk should start as early as possible in order to prevent growth and developmental problems during childhood itself, but also in order to prevent nutrition-related diseases in adult life.

Furthermore, dietary monitoring surveys are necessary in all stages of life, in order to allow development, implementation and evaluation of policies aimed at improving nutrition-related health in the population (22). As described by Margetts *et al*., identifying key nutrition-related problems is the first step in the Public Health Nutrition cycle, designed to identify the key steps required to develop a logical approach to the best way of solving problems (23).

However, it should be noted that the assessment of dietary intake of preschool children is notoriously difficult, due to the necessity of relying on proxy records (mostly the parents). Only 1% of the records were completed by another proxy than the parents. Furthermore, when the child is still too small to recall or report its own food intake, the help of schoolteachers might be required for reporting snacks and lunches consumed during school days. Because of these logistical problems, data about our preschool populations is very scarce and none-existing for Flanders. Therefore, the Ghent University (Belgium) has set up this Flanders preschool dietary survey in 2002, while investigating many efforts to overcome the logistical limitations mentioned before. As mentioned in the methodology description, teachers of the children participating in the study re-

ceived special instructions to report food and beverage intakes consumed by the children at school to their parents. In addition great efforts were done to motivate the parents and the children to participate in our study. The paper bags, including the forms and questionnaires were a great success with the children and they prevented that forms or questionnaires would get lost since children took good care of their self-decorated paper bags and proudly handed them over to their parents. Besides, the children's enthusiasm might have motivated the parents as well. Feedback to the parents about the general results and the major bottlenecks in the dietary pattern of our Flemish preschool children was another way of motivating the parents.

This study was able to collect useful information from 1847 children living in Flanders (76% of the invited children). While the data from the validated FFQ allow us to rank individuals according to their diet intake, the detailed data from the 3-day EDR permit variance estimations and more accurate determination of mean intakes and of the percentage of children at risk. In addition this validated FFQ will be a useful tool for quick food and calcium intake assessments in Flemish preschool children in future dietary surveys.

Large preschool nutrition promotion actions have been launched in Flanders in 2005 when the primary results of this study were reported to the parents of the children who participated in this dietary survey. In addition, parents of preschool children were invited to workshops organised in the different Flemish provinces in order to present the major bottlenecks in the diet of our Flemish preschool children. During these workshops parents were shown how to overcome these dietary problems in their preschool child by different kinds of tips (e.g. cooking tips, tips for healthy snacks,…). For the broader public of preschool children, parents, educators, teachers, etc in Flanders, brochures with recommendations and tips were distributed (currently more than 300,000 copies have been distributed) (24). On the website http://www.123aantafel.be/ extra info and tips are given for a healthy diet in preschool children.

Furthermore, authorities use these data in order to evaluate current policies and to develop and implement new policies when necessary at both the nutritional and the food safety level. Our data have been used as a source for nutritional policies (12) and for food safety issues (25).

Methodological considerations

The instruments

The accuracy and precision of the newly developed FFQ was tested in validation and reproducibility studies (8). The validation study for estimating calcium intakes revealed that our semi-quantitative FFQ tended to underestimate actual daily calcium intakes in preschool children when registered by the parents/proxy, and would not be appropriate for determining absolute calcium intakes of individuals. Other methods, such as multiple replicates of food records, would be better in estimating accurate calcium intakes for individual children. However, for use in large-

scale epidemiological studies, food records also have limitations and FFQs are more appropriate because of their lower respondent burden and lower workload for computing dietary information, in comparison with dietary records. Given its fairly good ability to classify subjects into extremes of calcium intake and to indicate children having calcium intakes lower than the Recommended Dietary Allowances (RDA), the FFQ used in the present study is a valid tool for calcium intake assessments in large epidemiological studies of preschool children, using parents as a proxy. Although the results of the validity and reproducibility of the FFQ for estimating food intakes and dietary patterns in preschool children are in the process of publication, it can be noted that this validation study revealed good validity and reproducibility for ranking and classifying children according to their dietary pattern.

A further major drawback of the EDR used, with only a limited number of record days, is that it does not necessarily reflect usual intake of individuals and that it does not allow to quantify proportions of non-consumers for particular food items, a fortiori for infrequently consumed foods. However, a statistical modelling method (like the NUSSER-method (14,15)) that accounts for within-individual variability can be used in order to calculate valid usual nutrient and energy intakes. As described in the description of the instruments, a combination of a FFQ and the EDR enhances the quality and the usefulness of the survey for both nutritional and food safety purposes in a very substantial way. Therefore the authors decided to implement 3-day dietary records in the study design, in addition to the newly developed FFQ. As mentioned before the days of the week that the parents / proxy had to record were determined beforehand by the research team in order to avoid that the respondent would choose a day that was most convenient to record (like a day when the child was at home all day, eating foods that are easy to record) as this might cause some bias (e.g. underreporting of complex meals or meals consumed away from home). On the other hand the limitation of diet records that respondents can adapt the eating habits of their child on the day of recording still remains. Unfortunately, information is lacking about the size of this type of recording bias (13).

Although the information collected with the open-ended diet record method can be used for the assessment of a wide range of nutrient, food and contaminant intakes, the food and food constituent intakes that actually can be estimated is always limited by the availability of food composition data that need to be linked with the food consumption data.

Although the FFQ has been validated and tested for reproducibility, it is noteworthy that (except for parentally reported weight and height) the questions in the general questionnaire have not been validated. However, the reproducibility has been assessed together with the FFQ reproducibility test and revealed good reproducibility for most variables of the questionnaire (data not published).

The accuracy of classification of the parentally reported weight and height values in preschool children has been validated in an additional study (26). Since the capability of parents for esti-

mating their preschool child's weight and height was shown to be limited, the percentage of children that were found to be overweight or obese (10%) will not be used for further analysis in this Flanders preschool dietary survey (26).

Sampling and representativeness

The cluster sampling design with schools as primary and classes as secondary sampling units that has been used in the Flanders preschool dietary survey is always less precise than a simple random sample of the sample size. However, in order to achieve a specified level of precision it is often less expensive and more convenient to use a larger cluster sample, using schools as PSU, than a smaller simple random sample. Taking into account the financial means and time available for the Flanders preschool dietary survey a multi-stage cluster sampling design was most optimal. Although special formulas exist for calculating sample sizes for multi-stage cluster sampling designs, because of lack of data to implement in these complex formulas, sample size calculations for the Flanders preschool dietary survey were performed as if simple random sampling were being used. Also normality assumptions were made for the nutrients included in the sample size calculations because the shapes of the underlying distributions were unknown.

The representativeness of the present study was tested by comparing our study sample with some characteristics of the target population, namely preschool children in Flanders.

First, the proportion of children attending schools in Flanders at the considered age was calculated. Data from the Flemish Ministry of Education and Training revealed that about 94% of the children between 2.5 and 6.5 years old were attending nursery schools in Flanders in 2003 (27;28). This percentage is a rough estimate, based on the total population of preschool children (2.5-6.5 years) in Flanders in 2003 and the number of preschool children attending schools at that time.

When taking into account that about 6% of the Flemish preschool children do not attend schools, it should be noted that our sampling frame 'the lists of schools made available by the Flemish Ministry of Education and Training' might introduce some selection bias, since children not attending schools might differ from preschool children attending schools. However, it is not known what the impact is of the mentioned biases on the present study.

Furthermore some parental characteristics like smoking and educational level were compared with those of the Flemish population. Data about the percentage of smokers in Flanders were derived from the 'Study and information centre of the consumers' organisation' (OIVO) and the 'Federal Public Service (FPS) Finance' in Belgium (29). These data revealed that the percentage of smokers in Flanders in 2001 was estimated at 27.3% of the total Flemish population (22.9% daily smokers and 4.4% occasional smokers). The percentage of smokers in men (33.9%) was higher than in women (23.5%). When only considering adults between twenty-five and thirty-four years old the percentage of smokers was 34.5% (28.8% daily smokers and 5.7% occasional

smokers). When looking at the parents of the children participating in our Flanders preschool dietary survey, the percentage of mothers and fathers who reported being smokers was 18% and 29%, respectively. Taking into account the differences in smoking status between men and women and different age groups in our Flemish population we can only roughly compare our results from the Flanders preschool dietary survey with those reported by OIVO/FPS Finance. From this rough comparison we can conclude that the percentage of parents who smoke in our study is slightly lower than the percentage in the general Flemish population.

Data about the education level of the population in the Flemish region were derived from tables published on the website of the Flemish authorities (30). In Table 5, the distribution of different education levels in the Flemish population aged 25-34 years old in 2002, is compared with the education levels reported by fathers and mother of the children participating in our Flanders preschool dietary survey in 2002. From this table it can be concluded that the percentage of fathers (46%) and mothers (54%) with higher educational levels (e.g. bachelor or master) in the Flanders preschool dietary survey is higher than in the general Flemish population 25-34 years of age at that time (39%). So, it is possible that the parents who participated together with their preschool child in our Flanders preschool dietary survey are higher educated than the parents who refused to participate. This latter finding could indicate some non-participation bias in our Flanders preschool dietary survey.

TABLE 5. Distribution of education levels of mothers and fathers participating in the Flanders preschool dietary survey in comparison with the Flemish population 25-34 years old in 2002 (in %)

Highest education	**Flemish population 25-35 years old in 2002**	**Mothers**	**Fathers**
Lower secondary education	19.4	6.4	9.5
Higher secondary education	42.1	39.9	44.4
Higher education (e.g. bachelor)	21.1	40.6	26.7
University degree (e.g. master degree)	17.5	13.1	19.3

Furthermore, the proportion of Flemish preschool children in the different provinces was compared with the proportions in our study population and this comparison confirmed good demographic representativeness of our study sample (27). While the children in Limburg were slightly underrepresented, those living in West-Flanders were slightly overrepresented.

Although sample size calculations stipulated that our sample size should have a minimum of 900 subjects (225 per age and gender category), the final study sample for the FFQ almost doubled that. For the EDR, a total sample of 1026 children was obtained including 904 subjects with at least two good quality EDR-days. The final response rate (after exclusion of low quality data) for the FFQ was 73% (1766 children), while only 49% (1026 children) for the EDR. This lower response rate for the EDR was presumably caused by the higher respondent burden of the EDR in comparison with the FFQ. Although, no doubt, willingness to participate leads to some selection bias as well, this type of bias is prone to all studies recruiting volunteers. Although obligating the

recruited persons would increase the response rate, one can question the accuracy of these data that were obligatorily gathered. Participants who are not motivated and feel forced to complete a questionnaire might only try to get it done quickly without taking care of the quality and accuracy. Further it is noteworthy that for the EDR a selection bias might exist, since records of children who have taken a hot meal at school needed to be excluded more frequently than records from other children, since portion size was often insufficiently detailed for hot school lunches.

When doing statistical analysis for age and gender groups, using data from the children who completed food quality 3-day EDR, the total sample of 696 children decreased to 661 children, since age and/or gender was missing for thirty-five. Since all questionnaires were anonymous, it was impossible to retrieve the correct age and gender of the children whose parents did not report these parameters in the general questionnaire. The smallest group of children in these analyses are girls between 2.5 and 4 years old, for whom a sample size of ninety-five children was achieved. Although this sample size should still be sufficient for comparing group means between populations for energy and macronutrient intakes ($n \leq 100$), it might be inadequate for showing significant differences between population groups in different micronutrient intakes (e.g. calcium needed 225 days/age and gender category).

Since all days of the week were included in the study, it is possible to adjust our data to remove the effect of day of the week. Unfortunately, it is impossible to correct for seasonal variations, because our fieldwork was conducted only during autumn and wintertime. No data were found about potential seasonal influences on nutrient intakes in this population group in Belgium. However, from our National Food Consumption Survey in 2004, it could be concluded that seasonal variations were only limited for nutrient intakes in our Belgian population of at least fifteen years old (31). These low seasonal variations in our Belgian population could be due to the widespread availability of most foods all year round.

In summary, these data represent a more general population of preschool children in Flanders, in comparison with other food consumption surveys in children, which are mostly restricted to local areas (32).

Conclusions

In 2002-2003 the fieldwork of the first dietary survey in preschool children was organised in Flanders. Information on food intake was collected using a consecutive 3-day EDR in combination with a FFQ covering forty-seven food(group) items. During this survey 1847 preschool children living in Flanders were interviewed and the whole of all sampling days was distributed almost equally over the seven days of the week. The distribution over the different provinces compared well with the proportion of preschool children living in the different provinces, confirming good demographic representativeness of our study sample. The results of this study have

been used to start nutrition promotion campaigns in Flanders and are now broadly used for estimating major gaps in the dietary pattern of Flemish preschool children by means of comparisons with nutritional recommendations and dietary exposure assessments. Furthermore, authorities use these data to evaluate current policies and to develop and implement new policies whenever necessary.

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