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Feasibility of Young Children's Nutrition Assessment on the Web

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Abstract

Methods to assess detailed dietary data are cumbersome, expensive and difficult to implement with large samples. The purpose of the present paper was to evaluate the feasibility of collecting data from parents on their child's diet using an online dietary assessment tool. The "Young Children's Nutrition Assessment on the Web" (YCNA-W), was developed as part of a longitudinal study on familial influences on food intake of preschool children. A sample of 862 parents from 56 nursery schools completed a paper and pencil questionnaire containing sociodemographic variables, a food frequency questionnaire on their child's diet and psychosocial variables. Subsequently, a subset of parents were asked to either complete a pencil food diary or YCNA-W (n=88); those remaining who provided e-mail addresses were asked to complete the YCNA-W (n=467) and a user-acceptability questionnaire. This resulted in 39 useful paper and pencil diaries, 217 useful YCNA-Ws and 164 user-acceptability questionnaires.

Mann-Whitney U tests comparing nutrient (macronutrients, vitamin C, calcium and fiber) and food group intakes of data collected with YCNA-W versus paper and pencil diaries resulted in no significant differences, except for water. Attrition analyses indicated that drop out for the online assessment was associated with gender (father completing the questionnaire), lower social status, being a smoker, and lower nutritional knowledge. The online measure was well received by respondents: the majority found it user-friendly (79%), attractive (68%) and clear (93%). YCNA-W is a promising tool to collect online dietary data in large-scale surveys.

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Keywords

preschool children; nutrition assessment; internet

INTRODUCTION

Different instruments are used to collect dietary information, each with advantages and disadvantages. In the last decade computer administered querying has received increased attention for large-scale population nutrition research (1–6). Self-administered computer tools have many advantages: standardization of the questions and questioning sequence, fast and easy data processing, immediate results, increased flexibility, as well as increased privacy and confidentiality (7,8).

The Familial Influences on Food Intake (FIFI) study, started in 2008, following Flemish children bi-annually from the age of three through adolescence. As part of the FIFI, the Young Children's Nutrition Assessment on the Web (YCNA-W) was developed to collect detailed parent report of child dietary intake. The YCNA-W is the first self-administered online dietary assessment tool to collect child dietary intake data from parents of young children; no other such assessment was identified by literature search.

Few studies (6,9,10) have investigated the feasibility and user-acceptability of computer-mediated record approaches. These are important aspects, as dietary record-keeping, whatever administration mode is used, demands the involvement and interest of the participants (11). Therefore, the purpose of the present study was to compare online self-administration of YCNA-W to traditional paper and pencil assessments and test the feasibility of online assessment. To this aim, 1) the reported energy and nutrient intake from the YCNA-W will be compared with paper and pencil dietary data collected from a subsample of participants, 2) the response characteristics of those participating in the online survey will be compared with non-participants, and 3) the respondents' acceptability of the program will be investigated. Comparison of the online assessment with more commonly used and well understood collection methods is a simple and inexpensive way to provide some information about the performance of the new instrument (12). As with any new mode of assessment, particularly those technologically based, understanding sampling biases introduced and respondent reactions is important.

MATERIAL AND METHODS

The data used for this study were collected as part of the baseline data of the FIFI. Data collection was carried out during January to April 2008. Ethical approval for the study was obtained from the ethical board of Ghent University Hospital.

Sample

Eighty schools in East and West Flanders (Belgium), randomly selected from the school list provided by the Ministry Department of Education, were approached for participation (Figure 1). Forty-six schools and ten sub-departments agreed to participate. Within these schools, all the parents from the first pre-primary grade were invited to participate. All the parents who agreed to participate returned informed consent.

Design

Four types of data were collected. All the parents from the 56 schools were asked to fill in a questionnaire containing a food frequency questionnaire (FFQ) to describe the dietary patterns

of their child, sociodemographic characteristics and several constructs that could influence their child's diet.

Follow-up dietary assessments were taken one to three weeks later. To address the question of comparability of assessment mode, a paper and pencil food diary (PPFD) and a letter were sent home with children of participating parents from four randomly selected schools. The letter requested parents to complete a child intake assessment using either the paper and pencil format or the online format. The days to be completed were selected by the research team and listed in the letter. Parents were instructed to complete the diary at each meal or snack.

Parents from the remaining 52 schools who provided their e-mail address were requested via e-mail to fill in YCNA-W for three non-consecutive days. A reminder was sent by e-mail one day in advance. Parents were instructed to record their child's food intake during the day on a memory sheet and to complete YCNA-W in the evening. For children who ordered their meal at school, a printable food record sheet to be completed by the teachers was provided. All the parents who completed YCNA-W were sent a final e-mail asking them to complete a short online evaluation form.

It was emphasized that participants should not make any alterations to their children's normal diets. No training was provided, however specific instructions were included in both instruments and parents could call or e-mail the project staff at any time with questions.

Materials

The questionnaire—The 25-page machine-readable questionnaire was developed to investigate the dietary habits of preschoolers and factors influencing these habits. For the present paper, questions on sociodemographics, (gender of the child, family structure, birth year, parents' education and occupation), children's food consumption, parents' fruit and vegetable consumption, parents' nutritional knowledge and attitudes were used. Parents' education was categorized as high (bachelor or master), intermediate (technical or general secondary) or low (vocational or lower). Occupation classifications were based on the International Standard Classification of Occupation (ISCO): high=managers and professionals (ISCO 1–2); intermediate=technicians, clerks, service workers (ISCO 3–5), and low= skilled and non-skilled workers (ISCO 6–9)(13).

To assess children's food intake, parents were asked to fill in a FFQ, containing questions on the average consumption of 77 food groups for the past 3 months. The selection of items was based on a previously developed 46-item FFQ for assessing calcium intake in preschoolers (14), further elaborated to describe general eating habits and to capture macronutrient and fiber intake. Complete information can be obtained from the authors on request. Parents' fruit and vegetable consumption was assessed with comparable questions. For these analyses, food intake was categorized into 20 major food groups which were then dichotomized based on the median split.

The food-related knowledge section asked nine questions that mainly focused on misconceptions in children's diet (e.g. "when preschoolers consume fish, preferably it should be low fat fish"). The response options were "RIGHT!", "I think it is right", "I think it is a fault", "FAULT" and "I don't know". Correct responses were scored +2, if respondents were sure about them, and +1 if not sure ("I think ..."); responses that were not correct were respectively scored as -2, if they were sure, and -1 if not sure. Missing values and "don't know" were scored zero. Items were summed to create a knowledge index. The attitude section asked the respondents to indicate on a five-point scale to what extent they agreed with eight food-related attitudes (e.g. "healthy eating is more expensive"). The attitudes were scored from -2 (very negative) to +2 (very positive). Items were averaged to create an attitude scale. For these

analyses, a dichotomous variable (high versus low) was created for both knowledge and attitudes based on median split.

The paper and pencil food diary—For each day of the PPF, three pages were provided, divided into six “eating occasions” (breakfast, midmorning snacks, lunch, afternoon snacks, dinner and evening snacks), further subdivided into food groups (e.g. for lunch: beverages, bread, sandwich filling, soup/starter, potatoes, vegetables, meat/fish/eggs, dessert and other). Detailed information regarding quantities consumed, brand names and type of preparation were requested. Instructions were provided on the first page and an example day was included.

The completed food records were converted into food quantities by means of a standard manual on food portions and household measures developed for assessing dietary intake in the Belgian population (15).

The web-based tool (YCNA-W)—YCNA-W was developed based on previous experience with computer stand-alone dietary assessment instruments (9,16). To enhance user-friendliness a consumers’ perspective was used to structure the items; for example, items that could be placed into different groups from a layperson’s perspective were repeated at different locations in the menu structure. The user interface was kept simple, with a help button to provide extra information if necessary. Each day was divided into 24 potential eating occasions linked to the hours of the day. The parents were invited to report their child’s food and beverage intake in the nearest hour of the day. The food items were selected from a hierarchical tree structure with 25 main food groups such as ‘beverages’, ‘breakfast cereals’, ‘fish & crustaceans’, ‘vegetarian products’, ‘oils & fat’, and ‘items not found’. This structure expands each time an item is selected until a specific food can be selected, with a maximum of eight levels. Based on data from previous dietary surveys in the Belgian population, approximately 800 different food items were included (17,18).

For each selected item, one or more screens were provided to gather detailed information on portion sizes or number of portions consumed. Amounts could be adapted by clicking a ‘more’ or ‘less’ button or direct entry using the text box. The amounts changed were adapted for this age group (e.g. for a banana, clicking on the buttons increased or decreased the amount by 1/4). Portion sizes were based on the Belgian manual on food portions and household measures (15). If more than one measurement unit was common for a food item, several measurement units (e.g. spoon, can, glass, gram) were available. In addition, almost 200 standardized picture sets were available to assist in portion size estimation.

To enhance completeness of reporting, a pop-up message appeared on the screen probing for food items often eaten in combination with other items, e.g. breakfast cereals, “Don’t forget the milk!”. In addition, the software was programmed to prompt the participant to check the entry if after entering the meal a food item had an amount of zero, no beverages were reported, if breakfast cereal was reported but no dairy, and if bread was reported but no spreadable fat. If the respondent could not retrieve a food item, it could be added by clicking “items not found”. Respondents selecting this option were asked for a description of the food item, its unit and amount consumed. A search engine helped to locate a food in the menu structure in case the user could not find an item. The data included for each food item was respondent ID, amount consumed, amount per unit, date, eating time, food group code and nutrient database code. After a meal was completed, MySQL 4.0.24 database (Sun Microsystems Inc, Santa Clara, CA, 2005) stored the information. Respondents could go back to make corrections to any previously entered data by entering their password. The software was developed with Apache 1.3.33 (Apache Software Foundation, Delaware, USA, 2004) webserver and PHP 4.3.10–22 (Open Source Software).

The evaluation form—The evaluation form queried the user-friendliness, enjoyment, attractiveness and clarity of the tool using a five-point scale (e.g. user-friendly=1, not user-friendly=5). Additionally, participants were asked which dietary assessment instrument they preferred: a computer based food record, a paper and pencil food record, a computerized FFQ or a paper and pencil FFQ.

Analysis

To compare intakes across the two follow-up assessment tools, the average daily intakes of energy, six nutrients and twenty food groups were calculated. Energy and nutrient intakes were computed for both instruments with a database based on the Belgian (NUBEL, 2004) and Dutch (Nevo, 2001) food composition tables. Standard recipes were used for the calculation of nutrients and food items of prepared dishes. Mann-Whitney U tests were used to compare both samples.

To assess differences on sociodemographic variables as reported on the baseline questionnaire between the group that completed all three days of the YCNA-W and those who refused, provided no e-mail address, or only completed one day of assessment, stepwise backward multinomial regression analyses were conducted using those who completed all three days of the assessment as the referent group. To assess differences on lifestyle variables multinomial regression was conducted for each variable including smoking, participation in sports, parent consumption variables, child consumption variables, nutritional knowledge and attitude. All variables were entered as categorical with as reference high education, high occupation, not smoking, doing sports and above the median for each food item, nutritional knowledge and the attitude score. Significant sociodemographic characteristics were controlled for in all models.

All the analyses were performed using SPSS 15.0.1.1 (SPSS Inc, Chicago, IL, 2007). Values were considered significant at $p < 0.05$.

RESULTS AND DISCUSSION

Eight hundred and sixty two of the 1611 parents approached for participation, returned the completed questionnaire (Figure 1). In this sample, 91% were completed by mothers; 50% of the children were boys; the mean age of the children was 3.5 (SD=0.4) years, of mothers was 33.3 (SD=3.5) years, and of fathers was 36.1 (SD=5.2) years; 92% were living in a traditional two-parent family.

Of the 88 parents asked to register their child's diet either in a PPF or through YCNA-W, the majority (n=52) returned a PPF; five parents chose the YCNA-W; their data was included with the other online assessments. Due to a lack of information on food type or portion sizes for one or more meals, 14 PPFs were excluded from the current analyses.

Of the 467 parents sent an e-mail requesting them to fill in YCNA-W, 295 visited the online application, 40 completed one day, 14 completed two days, and 212 completed three days. The online acceptability survey was completed by 164 respondents.

Comparison of YCNA-W versus PPF

On average, those who completed the PPF consumed 1329 kcal/day (SD=294) and those who completed the YCNA-W consumed 1294 kcal/day (SD=260), both within the recommendations for this age group (1123–1350 kcal/day, depending on gender and physical activity level (19)).

A comparison of the energy, nutrient and food intakes of both samples resulted in only one significant difference: a higher water intake was observed in the PPF (Table 1). The YCNA-

W may give a more accurate estimate. Most water was consumed from glasses. In YCNA-W, parents most often selected the smallest glass out of the four presented pictures, while in the PPF, parents most of the time just wrote “glass” without any specification. On the other hand, the data are from different samples and hence might reflect a real difference in intake between the groups, especially given the small sample size in PPF. Comparison of sociodemographics from both groups resulted in significant differences in parents’ age, with parents filling out the PPF being younger (mothers: 31.3 (SD=3.6) versus 33.9 (SD =4.3), $p=0.001$; fathers: 34.3 (SD =4.4) versus 36.3 (SD =4.8), $p=0.015$) and having lower education levels (mothers: low=28% versus 12%, intermediate=15% versus 22%, high=56% versus 65%, $p=0.034$; fathers: low=37% versus 18%, intermediate=21% versus 30%, high=42% versus 52%, $p=0.029$, respectively PPF and YCNA-W). No significant differences were found in children’s age and gender, parental occupation, family structure, smoking status and sport participation.

User acceptability

When given the choice of mode of completion, only five of 57 parents chose the online assessment over the paper and pencil version. Perhaps parents did not want to expend the effort to start up their computer, type in the URL, get acquainted with unknown software and search for foods in the application, thinking it easier and more convenient to write it down on a paper and pencil version.

Of the 164 parents who filled in YCNA-W and the evaluation tool, the majority indicated that the YCNA-W was user-friendly (79%), attractive (68%), well-liked (66%), adequate instructions (92%) clear information (93%), clear pictures (91%) and easy-to-find food items (88%). A small number of parents evaluated the tool negatively (e.g. 2.6% did not find it user-friendly and 7.2% did not like the tool). When parents were asked their preference for reporting method, 73% preferred a 3-day computerized food record, 12% selected paper and pencil 3-day food record approach and 10% computerized or paper and pencil FFQ (6%). Congruent with other studies (6,9), these results indicate that YCNA-W may be preferable to conventional paper and pencil food record approaches. Nevertheless, the ratings need to be interpreted with caution because they are based on data provided by the selected sample of those completing YCNA-W.

Attrition analysis

The study had two different types of loss to follow-up. First, only those parents who registered their e-mail address were invited to participate in YCNA-W, resulting in a loss of 37% of the original sample. Many of those probably have access to the Internet. Parents do not always choose to report their e-mail address. Of the five parents who chose to fill out the YCNA-W instead of the PPF only two reported their e-mail address on the questionnaire. In future research, participation may be increased by contacting parents by traditional mail or telephone in addition to e-mail.

Second, the burden of completing food records may have impacted the response rate obtained. When a topic is sensitive or a large effort is required the risk of a low response rate is particularly great (11). This study was no exception; 49% of the delivered e-mails resulted in three days of YCNA-W. However, once they had filled in one day, the drop out was relatively small (20%). Notably, these parents had already completed a questionnaire of 25 pages (45–60 minutes).

The dropout analysis (Table 2) indicated that non-response was associated with gender, social status, smoking, and nutritional knowledge. Fathers were four times as likely to be among the refusals as mothers, compared to those who completed all three days of dietary intake. Those with low compared to high maternal education and occupation were more likely to have not reported an e-mail address (ORs=2.63, CI=1.46–4.73, and 4.59, I=1.62–12.96, respectively);

those with low maternal occupation were also more likely to refuse (OR=2.63, CI=1.46–4.73). Mothers who smoke compared to non-smokers were more than twice as likely to be refuse (OR=2.22, CI=1.22–4.04) or report only a single day (OR=2.84, CI=1.11–7.22) than to report all three days of YCNA-W. Concerning the food items, no clear pattern emerged. Similarly, significant effects were obtained for nutrition knowledge. Those with low nutrition knowledge compared to high were more likely to refuse (OR=1.55, CI=1.03–2.35) or not report their e-mail address (1.79, CI=1.21–2.63). The higher nutritional knowledge among participants may suggest a higher interest in healthy food; nonetheless, their attitude was not significantly different. The higher interest of women in health and health-related topics (20,21) could explain the higher response in women. The lower availability of e-mail addresses in those from lower occupational levels might be because they are less used to working on the computer and with the Internet. Moreover, those from intermediate or higher occupational levels are more likely to have an e-mail address in relation to their job.

Conclusion and application in practice

From the perspective of the researcher, YCNA-W has many advantages: more standardized reporting, less missing data on portions, improved time efficiency and reduced opportunity for data entry errors. The dietary pattern of those completing YCNA-W was in general similar to the dietary pattern of those completing PPF, giving some reassurance about the performance of the instrument; nevertheless, future validation in a larger sample with a stronger validation protocol (e.g. a comparison of both methods in the same individuals) is advocated. The program was well received by the respondents. Nonetheless, selection bias, a well-known but often neglected problem in population-based research (22), might compromise the generalizability of the results.

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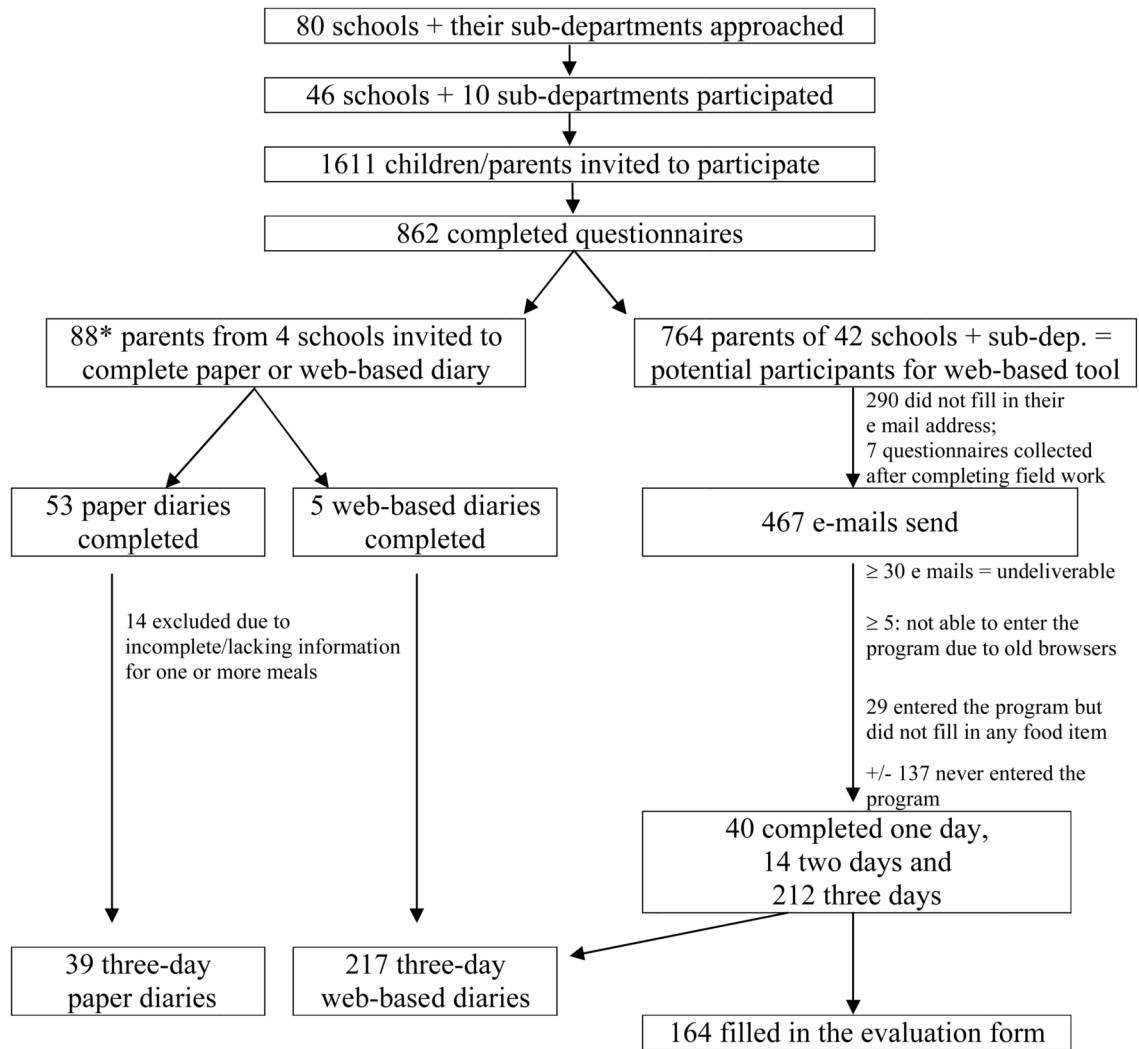
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*10 children were not invited because the questionnaires were not yet received when the diaries were distributed

Figure 1. Overview of Participation at School and Individual Level for the Different Parts of the Study

Table 1
Comparison of Energy, Nutrient and Food Group Intake Estimated from Paper Pencil Food Diaries (PPFD) and the Online Tool YCNA-W

	Sample 1: PPFD (n=39)				Sample 2: YCNA-W (n=217)				P		
	Mean	SE	P25	P50	P75	Mean	SE	P25		P50	P75
Energy (kcal)	1329	47	1162	1281	1466	1294	18	1112	1276	1430	0.641
Nutrients											
Proteins (g)	51	2	44	50	55	51	1	43	52	60	0.971
Carbohydrates (g)	180	6	150	183	194	171	2	145	168	192	0.210
Fat (g)	45	2	35	43	52	43	1	36	45	53	0.710
Fiber (g)	13	1	10	13	14	12	0	9	12	15	0.262
Calcium (mg)	798	43	611	796	960	794	18	628	766	950	0.856
Vitamin C (mg)	71	6	43	65	101	74	3	45	68	94	0.837
Food groups (g)											
Soup	52	11	0	50	100	50	4	0	25	75	0.865
Water	340	36	175	311	488	271	14	117	233	380	0.046
Milk	221	30	67	188	333	201	13	0	155	333	0.401
Sweetened milk	139	24	0	83	200	148	10	28	133	217	0.645
Soy beverages	34	17	0	0	0	45	9	0	0	0	0.922
Fruit & vegetables juices	158	19	67	133	227	153	9	39	133	225	0.521
Soft drinks	66	13	0	50	121	72	7	0	20	100	0.628
Coffee & tea	1	0	0	0	0	5	1	0	0	0	0.956
Milk based desserts & cream	41	8	0	40	53	54	4	0	42	83	0.407
Fruit	124	12	61	108	182	125	5	68	113	169	0.922
Sweets & sugary products	23	3	8	18	37	22	1	10	19	30	0.865
Savory snacks	3	1	0	0	0	2	0	0	0	3	0.472
Biscuits & pastry	44	4	25	42	56	39	2	19	34	52	0.126
Bread & rolls	75	6	51	74	94	64	2	41	60	85	0.087
Breakfast cereals	7	2	0	0	10	6	1	0	0	8	0.909
Cheese	11	2	4	10	17	11	1	0	8	19	0.413
Meat, fish, eggs & meat substitutes	81	5	68	77	96	82	2	58	81	105	0.750
Vegetables	57	7	22	50	73	49	2	21	43	70	0.437
Potatoes & grains	83	4	67	77	102	80	2	55	77	103	0.299
Fat & sauces	32	3	18	28	46	28	1	12	25	38	0.105

p of Mann Whitney U test

Table 2
Sociodemographic and Lifestyle Characteristics of Dropouts versus Participants of the Online Tool (YCNA-W): Odds Ratio's (95% CI) of Multinomial Logistic Regression Analyses^a

	Percents for Sociodemographic and Lifestyles Variables by Participation Group				Multinomial Regression Odds Ratios (95%CI; Referent Group is 3-day YCNA-W)		
	3 days %	Invited for YCNA-W 1 day %	Refused %	No E-Mail %	1-day	Refused	No e-mail
Questionnaire completed by father							
Education mother	3	8	12	7	2.98 (0.7-12.69)	4.17 (1.62-10.74)**	2.09 (0.79-5.52)
High	65	78	51	44	referent	referent	referent
Intermediate	22	15	29	21	0.52 (0.2-1.41)	1.50 (0.90-2.50)	1.13 (0.69-1.85)
Low	12	8	20	35	0.43 (0.1-1.82)	1.47 (0.75-2.89)	2.63 (1.46-4.73)**
Occupation mother							
High	27	28	21	14	referent	referent	referent
Intermediate	61	63	57	55	1.20 (0.54-2.69)	1.06 (0.63-1.76)	1.36 (0.83-2.24)
Low	3	8	15	14	4.48 (1.53-12.92)**	4.45 (1.53-12.92)**	4.59 (1.62-12.96)**
Does not work	10	3	8	17	0.37 (0.04-3.40)	0.58 (0.23-1.44)	1.59 (0.74-3.43)
Smokers							
Mother	10	20	24	21	2.84 (1.11-7.22)*	2.22 (1.22-4.04)**	1.68 (0.94-2.98)
Father	24	34	32	34	2.13 (0.98-4.66)	1.28 (0.79-2.06)	1.16 (0.74-1.81)
Does not sports	52	40	59	58	0.63 (0.30-1.30)	1.13 (0.75-1.72)	1.02 (0.69-1.50)
Mother	43	33	49	55	0.71 (0.33-1.53)	1.16 (0.75-1.78)	1.22 (0.81-1.83)
Parents' consumption below the median cut-off point for							
Mothers' fruit consumption	49	52	50	51	1.19 (0.60-2.37)	0.90 (0.60-1.34)	0.94 (0.64-1.37)
Fathers' fruit consumption	45	55	54	50	1.63 (0.81-3.32)	1.36 (0.89-2.06)	1.14 (0.77-1.68)
Mothers' vegetable consumption	48	61	52	48	1.66 (0.82-3.36)	1.10 (0.73-1.65)	1.03 (0.71-1.50)
Fathers' vegetable consumption	50	58	53	47	1.33 (0.64-2.76)	1.08 (0.71-1.65)	0.91 (0.62-1.36)
Children's consumption below the median for^b							
Soup	65	50	55	58	0.51 (0.25-1.04)	0.64 (0.42-0.96)*	0.82 (0.55-1.21)
Milk	53	35	50	52	0.48 (0.26-0.99)*	0.78 (0.52-1.18)	0.86 (0.59-1.29)
Meat, fish and meat substitutes	53	60	45	50	1.31 (0.66-2.63)	0.60 (0.39-0.90)*	0.81 (0.56-1.18)
Nutritional knowledge below the median	40	47	58	62	1.41 (0.70-2.83)	1.55 (1.03-2.35)*	1.79 (1.21-2.63)**
Attitude below the median	43	45	48	52	1.02 (0.51-2.03)	1.10 (0.73-1.66)	1.31 (0.89-1.90)

^aReference of the multinomial logistic regression analysis: those completing 3 days of YCNA-W. All analyses controlled for respondent completing the questionnaire, mother's education and occupation. Separate analyses were run for each lifestyle factor with as reference not smoking, doing sports and above the median for each food item, nutritional knowledge and the attitude score.

^b20 food groups were investigated, only significant food items/groups are presented, no significant differences were found for: water, sweetened milk, soy beverages, fruit and vegetable juices, coffee and tea, soft drinks, milk based desserts, cheese, fruit, sweets and sugary products, savory snacks, biscuits and pastry, bread and rolls, cereals, vegetables, potatoes and grains, fat and sauces