Dietary patterns track from infancy to preschool age: cross-sectional and longitudinal perspectives

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Abbreviations used: BMI, body mass index; EDEN, Etude des Déterminants pré et post natals du développement et de la santé de l'ENfant); FFQ, food frequency questionnaire; PCA, principal component analysis.

Abstract

Background. While it has been suggested that dietary patterns emerge early in life, less is known about the extent to which they track over toddlerhood and preschool ages.

Objective. The objectives were to derive cross-sectional dietary patterns at 2, 3 and 5 y and assess their correlations; and to derive multi-time-point dietary patterns from 2 to 5 y and assess their associations with socio-demographic factors and infant feeding patterns.

Methods. Depending on the age considered, analyses included 989 to 1422 children from the EDEN mother-child cohort. Dietary intake was collected using FFQs at 2, 3 and 5 y. Principal component analyses were applied to these data, first cross-sectionally at each age, then longitudinally accounting for the data collected at all three ages. Tracking between patterns was estimated by Spearman correlation coefficients and associations with either the infant feeding patterns or the demographic and socio-economic factors were assessed using multivariable linear regression analyzes.

Results. Overall, we derived two main cross-sectional patterns labelled "Processed, fast foods" and "Guidelines", the latter being characterized by intakes approximating age-specific dietary guidelines; and two multi-time-point dietary patterns which corresponded to consistent exposures to similar foods across the three ages. The first, labelled "Processed, fast-foods at 2, 3 and 5 y", was inversely associated with maternal education and age, and positively to the presence of older sibling(s). The second, called "Guidelines at 2, 3 and 5 y", was predicted by maternal education. Moderate tracking was observed between similar patterns assessed at different ages.

Conclusions. Our findings confirmed the emergence of dietary profiles socially differentiated early in life as well as a moderate tracking of the diet. The promotion of healthy dietary trajectories should be encouraged as soon as infancy, in particular in the presence of older siblings and amongst the most socially disadvantaged population groups.

Key words

Dietary patterns; Tracking; Toddlers; Preschool children; EDEN; Principal component analysis; socio-economic position.

Introduction

Early childhood is a period of rapid growth, associated with changing physiological requirements and nutritional needs. There is now growing evidence suggesting that early childhood is a critical period during which susceptibility to many chronic diseases is established (1,2). Nutrition in particular, is a major driver of adequate early life development, and the consequences of under- and/or over-nutrition in early life have been well documented (3).

The transition in diet from infancy to preschool age also marks important changes in terms of social and educational developments (4,5), as the child progressively moves from the close family (in particular the parents) to the external world (caregivers, childcare, preschool). Within this changing environment, early childhood food exposures influence the development of taste and food preferences, which in turn impact on subsequent eating habits (6,7). Dietary patterns have indeed been suggested to emerge early (8-11), and to track through infancy (8) into later childhood (12), and from childhood to adulthood (13).

The analysis of dietary patterns has been widely used over the last decade, as it allows the synthesis of a large number of dietary data into a measure of the whole diet, accounting for the complex interactions between foods and nutrients. They therefore represent a relevant and robust alternative to the traditional single-food or single-nutrient approaches (14). Principal component analysis (PCA), an empirical data-driven approach, is the method that has been mainly used to derive dietary patterns in children aged 1 to 5 y, as recently reviewed by Smithers *et al*. (9).

The objectives of the present study were to derive cross-sectional dietary patterns at 2, 3 and 5 y in the EDEN (Etude des Déterminants pré et post natals du développement et de la santé de l'ENfant) mother-child cohort and to assess the extent to which dietary patterns identified at a given age were correlated to those obtained at later ages. We also aimed to derive multi-time-point dietary patterns including simultaneously data collected at 2, 3 and 5 y and to assess if these were predicted by socio-demographic factors and the infant feeding patterns previously described in the same cohort (15).

Methods

Study design and participants

The EDEN mother-child study is a prospective cohort aiming to assess pre- and post-natal determinants of child growth, development and health and it has been described elsewhere (16). In brief, between 2003 and 2006, 2002 pregnant women (< 24-weeks gestation) aged 18-45 y were recruited at Nancy and Poitiers university hospitals. Exclusion criteria were multiple pregnancies, diabetes history, illiteracy in French, and planning to move outside the delimited recruitment sites in the next three years. Approval for the study was obtained from the Bicêtre Hospital ethics committee (Comité Consultatif de Protection des Personnes dans la Recherche Biomédicale: ID 02-20) and the National Committee for Processed Data and Freedom (Commission Nationale de l'Informatique et des Libertés: ID 902267). Written consent was obtained from each participant.

Measurements

Data used in the current study were collected using self-reported questionnaires completed by the mothers at different stages of the follow-up: for the mother during pregnancy (24-28 weeks gestation) and for the child when aged 2, 3 and 5 y.

Dietary data

Three feeding patterns were previously identified over the first year of life by Betoko *et al.* using PCA on data collected at birth, 4, 8 and 12 months, that is breastfeeding duration, age of introduction to 14 complementary foods, and type of food used at 12 months (i.e. ready-prepared baby-food, adult food or home made) (15). The first pattern was labelled "Later dairy products introduction and use of ready-prepared baby foods" given the positive factor loadings concerning both the age of introduction of all dairy products and the use of ready-prepared baby-foods; the second pattern was the closest to infant feeding guidelines in terms of breastfeeding duration, age of weaning and the use of home-made foods and thus labelled "Longer breastfeeding, later main meal food introduction and use of home-made foods"; the third pattern was mainly characterized by the use of ready-prepared not baby-specific foods and thus called "Use of ready-prepared adult foods".

Children dietary intakes at 2, 3 and 5 y were collected using food frequency questionnaires (FFQs). These are short versions of the FFQ utilized in mothers during their pregnancy, which was validated in adults and adolescents (17). In these short versions, the food classification was established based on similarities in food type and context of consumption and was set to be able to describe the patterns of the child diet. These three FFQs included 26 common food groups along with seven possible responses, ranging from “Never” to “Several times per day”, that were converted into weekly frequencies (“Never” was coded as zero, “<1 per month” as 1/8 per week, “1 to 3 times per month” as 2/4 per week, “1 to 3 times per week” as twice per week, “4 to 6 times per week” as 5 times per week, “Once a day” as 7 times per week, and “Several times per day” as 14 times per week). Diet and non-diet carbonated soft drinks were assembled into a single food category at all ages (with their frequencies of consumption summed) due to a relatively high proportion of non-consumers of diet soft-drinks (i.e. >65%). Additional questions (outside of the FFQ) allowed us to determine the frequency of milk intake at 2 and 3 y (number of times per day) and of various types of baby foods at 2 y (assembled into a single group, number of times per week). Breaded fish and milk were included as additional items in the FFQ at 3 and 5 y, respectively. Overall, 27 food group variables were available at 2 and 3 y, and 26 at 5 y, covering the whole diet (listed in the Results section).

Socio-demographic variables

Maternal education and household income were obtained from the questionnaire completed by the mother during her pregnancy (missing data were substituted by the modal class value in <5% of mothers). Mother's pre-pregnancy height and weight were also reported and maternal BMI (kg/m^2) categorized as: thin (<18.5), normal (18.5≤BMI <25), overweight (25≤BMI<30) and obese (30≤BMI). Clinical records provided data on maternal age at delivery, gestational age (weeks of amenorrhea), birth weight and parity.

Population studied

Of the 2002 women initially recruited, 96 no longer continued in the study after delivery, four were excluded because of intrauterine death, and three due to delivery outside the geographical area of the study, resulting in 1899 eligible children at birth (Figure 1).

The FFQs at 2, 3 and 5y were completed by 1436, 1321 and 1195 mothers, respectively. At each age, children with more than one third of missing dietary variables were excluded from analyses (n=14 at 2 y, n=12 at 3 y and n=13 at 5 y). Otherwise, we replaced the missing data by the modal value of the distribution (n=134 at 2 y, n=71 at 3 y and n=56 at 5 y, with most children having 3 missing variables or fewer). Dietary data were therefore available for analysis for 1422, 1309 and 1182 children at 2, 3 and 5 y respectively. Multi-time-points patterns were assessed in the 989 children with data at all three ages. We deliberately chose to derive cross-sectional dietary patterns within a maximum sample at each age.

Statistical analyses

We described the children from the EDEN cohort who had all dietary data available at 2, 3 and 5 y (n=989). Socio-demographic factors were then compared between this sample and the children eligible at birth but not included in the analysis because of dropping out, exclusion or missing data (n=910). Chi-square and Student - *t* tests were used to compare frequencies and means, respectively.

Cross-sectional dietary patterns were first derived independently at 2, 3 and 5 y using PCA of the 26 or 27 standardized dietary variables. The number of patterns was selected considering eigenvalues >1.0, the scree plot and the interpretability of the patterns (18,19). To interpret the results and provide a label to a given pattern, we considered the items most strongly related to that pattern, i.e. those for which the absolute value of the loading coefficient (which is the correlation of each variable with the given dietary pattern) was >0.30. The PCA scores for each dietary pattern were calculated at the individual level by summing the observed standardized frequencies of consumption per food group, weighted according to the PCA loadings.

Multi-time-point dietary patterns were then derived including the standardized dietary variables defined at all three ages, i.e. 2, 3 and 5 y, in a single PCA (n=989). The same criteria were addressed to retain and label the resulting patterns. This multi-time-point application of PCA was previously used by Brazionis *et al*. (20) to assess transition diets in children from 6 to 24 months of age.

Spearman correlation coefficients and associated P-values were estimated between cross-sectional dietary patterns derived at 2, 3 and 5 y (n=989) to assess tracking from 2 to 5 y. Recommendations for interpreting these correlation coefficients are: low <0.3, moderate 0.3-0.6 and high >0.6 (21).

The associations between each of the cross-sectional dietary patterns identified at 2 y and the multi-time-point dietary patterns (dependent variables) and both the demographic (child age and gender, older sibling(s) at home, maternal pre-pregnancy BMI and age at delivery) and socio-economic (household income, maternal education level) factors were analyzed by means of multivariable linear regression analyzes, adjusted for recruitment center and season. The same covariates were included in the multivariable regression analyzes undertaken to assess the longitudinal associations between each of the multi-time-point dietary patterns (dependent variables) and the three infant feeding patterns previously published (15) (n=660). The significance level was set at 5%. Values in the text are either percentages (%) or means ± SD. Analyses were conducted using SAS software (version 9.3).

Results

Characteristics of the study population

Sample characteristics are presented in **Table 1**. While children excluded from the analysis (due to drop out, exclusion or missing data) did not differ according to sex, prematurity, and birth weight, they were more likely to be born to younger (28.8 y ± 5.1 *vs.* 30.2 y ± 4.6, P=0.003), single (3.5% *vs*.1.0%, P=0.0002), multiparous (59.4% vs. 52.0%, P=0.001) mothers. Also, their mothers were less likely to have a University degree (42.4% *vs*. 61.8%, P<0.0001) and to live in Poitiers (43.4% *vs*. 52.4, P<0.0001).

Characteristics of dietary patterns

Cross-sectional approach

Three dietary patterns were identified in toddlers aged 2 y, accounting for 26.8% of the explained variance (**Supplemental Table 1**). The first pattern was positively correlated with intakes of French fries, processed meat, carbonated soft drinks, chocolate, crisps, biscuits, pizzas, fruit juices, meat, dairy puddings and ice-creams (by descending order of PCA loadings). We labelled this pattern “Processed, fast-foods”. The second pattern, labelled “Guidelines”, was mainly characterized by high consumption frequency of cooked vegetables, rice, fresh fruit, raw vegetables, low fat fish, potatoes, ham, stewed fruit and meat. The third pattern had high positive loadings for baby foods, breakfast cereals and stewed fruit and negative loadings for raw vegetables and fresh fruit. We named this pattern “Baby foods”.

At 3 y, two dietary patterns were identified with characteristics consistent with those of the two first patterns identified one year earlier (**Supplemental Table 1**). These were therefore given the same labels, i.e. “Processed, fast-foods” and “Guidelines”. They accounted for 22.0% of the explained variance.

For children aged 5 y, two dietary patterns accounting for 20.8% were derived (**Supplemental Table 1**). The first pattern was positively associated with a large variety of foods, such as foods of animal origin (ham, meat, processed meat, fish, and eggs), starchy foods (potatoes, rice, legumes, and bread), vegetables (raw and cooked), fresh fruit, and pizzas. This pattern was labelled “Protein-rich and diversified”. The second pattern, labelled “Processed, fast foods”, was mainly characterized by high loadings for crisps, carbonated soft drinks, biscuits, chocolate, dairy puddings, ice-creams and processed meat, and was inversely related to both cooked and raw vegetables, as well as fresh fruit.

Longitudinal approach

We identified two multi-time-point dietary patterns spanning 2 to 5 y, which accounted for 15.0% of the explained variance (**Supplemental Table 2**). We found that these profiles corresponded to consistent exposures to the same food groups across the three ages (i.e. 2, 3 and 5 y). We therefore labelled the first pattern “Processed, fast-foods at 2, 3 and 5 y” given the repeated exposures to French fries, processed meats, crisps, chocolate, carbonated soft drinks, biscuits, meat, and fruit juices. The second multi-time-point dietary pattern, called “Guidelines at 2, 3 and 5 y”, displayed positive loadings at all ages for fresh fruit, vegetables (raw and cooked), low-fat fish and bread.

Multivariable associations with demographic and socio-economic factors

At 2 y, higher adherence to the “Baby foods” pattern was observed in children born to mothers with lower education level and younger (**Table 2**). Conversely, higher maternal education level was related to higher scores on the “Guidelines” pattern. Lower maternal education level, younger age and the presence of older sibling(s) at home were independently associated with higher adherence to the “Processed, fast-foods” dietary pattern. Similar results were obtained with the multi-time-point dietary patterns. We however further found that being a boy or maternal pre-pregnancy obesity predicted higher scores on the “Processed, fast-foods at 2, 3 and 5 y” dietary pattern.

Tracking from infancy to preschool age

Overall, the largest correlation coefficients were observed between similar patterns assessed at different ages, reaching 0.40 and 0.53 for “Processed, fast-food” and “Guidelines” dietary patterns, respectively (**Table 3**). These correlations were moderate according to our set definition (21). In addition, the “Guidelines” dietary patterns identified at 2 and 3 y were both negatively correlated with the “Processed, fast-foods” pattern derived at 5y (correlation coefficients -0.42 and -0.66, respectively). The “Baby food” dietary pattern (2 y) was rather correlated to a less healthy diet at later ages (3 and 5 y). Both the “Processed, fast-foods” and the “Guidelines” dietary patterns at 2 and 3 y correlated positively with the pattern labelled “Protein-rich, diversified” at 5 y.

After accounting for all demographic and socio-economic covariates, our findings showed that the infant feeding pattern called "Longer breastfeeding, later main meal food introduction and use of home-made foods" (15) predicted respectively lower and higher adherence to the “Processed, fast-foods” and “Guidelines” multi-time-point dietary patterns (**Table 4**). The reverse was observed with the infant feeding pattern called “Use of ready-prepared adult foods". "Later dairy products introduction and use of ready-prepared baby foods" predicted lower scores on the multi-time-point dietary patterns "Processed, fast-foods".

Discussion

To our knowledge, this is the first study in France assessing dietary patterns across toddler and preschool ages. This study provides original insights to the broad international literature on early dietary patterns, by accounting for both cross-sectional and longitudinal perspectives. The previous (15) and current findings from the EDEN cohort suggest the emergence of distinct profiles of feeding practices and food choices early in childhood, consistent with other studies involving infants and toddlers (9,11,22-24). Overall, from 2 to 5 y, we derived two main cross-sectional patterns types that we labelled "Guidelines" and "Processed, fast-foods", which correspond to the "Healthy" and "Unhealthy" dietary patterns most often described in children aged 1 to 5 y, as recently reviewed by Smithers *et al*. (9). The "Baby food" dietary pattern is close to that derived at 2 y in a Norwegian population sample (23) and at 6 months of age in the Southampton Women's Survey and broadly the reverse of the pattern called "12-month infant guidelines" in this same cohort (8). The "Protein-rich and diversified" dietary pattern derived at 5 y, which is a mix of both healthy and more protein- and energy-dense foods, has not really been described earlier in young children.

Consistent with other studies, we found that children of less educated (8,9,20,22,23) and younger (8,9,20,23-25) mothers, and in the presence of an older sibling at home (8,9,20,23), had higher scores on patterns characterized by processed and fast-foods, both cross-sectionally at 2 y and longitudinally (from 2 to 5 y); and that maternal education predicted lower scores on the "Baby foods" pattern at 2 y (23) and higher adherence to both the cross-sectional and multi-time-points "Guidelines" (8,9,20,22,24) dietary patterns.

Our findings suggested moderate tracking between similar profiles of food intake identified at different ages, with a relatively higher tracking when healthier profiles were addressed. This is consistent with other studies involving children aged up to 5y (8,12,25) or older (26,27). Complementary cross-tabulation analyses (results not shown) indicated that 54% and 48% of the children in the highest tertile of the “Processed, fast-foods” dietary pattern at 2 y remained in the highest tertile of the “Processed, fast-foods” patterns at 3 and 5 y, respectively. This figure was 57% regarding the “Guidelines” pattern between 2 to 3 y.

Research on tracking has gained interest over the past decade as it provides insights into the relevance of intervening early through nutritional programs. Beyond the assessment of simple correlations or cross-tabulations between dietary patterns identified at different times (8,12,25,28), other tools have been developed to address tracking, such as generalized estimation equations (27) and mixed models (29,30). These methods were not applied to our dataset as they require that exactly the same variables are measured at different times, which was not the case here, as the questionnaires were adapted to the natural evolution of food intake across the first years of life. The current analysis of tracking confirmed the moderate stability of food choices over this early stage of life, suggesting that children exposed to healthy foods at 2 y (via adherence to dietary guidelines) are more likely to be still exposed to healthy foods one and three years later, with the reverse being true regarding processed- and fast-foods. Our findings further suggested that healthy food choices at either 2 or 3 y predicted lower scores in the “Processed, fast-foods” pattern at 5 y, as informed by the moderate (-0.42) and strong (-0.66) correlations observed. Consistent and complementary to these findings, cross-tabulation analyses (results not shown) indicated that only 18% and 11% of the children in the highest tertiles of the “Guidelines” dietary pattern at respectively 2 and 3 y were found in the highest tertile of the “Processed, fast-foods” pattern at 5 y, respectively.

While the multi-time-point PCA approach was initially undertaken to capture trajectories potentially stable or not, the variability inherent in our data allowed us to derive two patterns characterized by repeated exposures to the same foods over time. As such, higher scores on the “Processed, fast-foods at 2, 3 and 5 y” denoted higher tracking for these types of foods, while higher scores on the “Guidelines at 2, 3 and 5 y” pattern could be interpreted as a stable adherence to a diet of high nutritional quality. These two patterns are therefore relevant as longitudinal measures of high tracking on either diet.

The use of cross-sectional or multi-time-point dietary patterns certainly depends on the research question and hypothesis to be addressed. Whether the issue is to account for total diet at a given point in time, we would advise using all cross-sectional dietary patterns identified at that particular age. In the context of life course approaches, the multi-time-point dietary patterns derived based on the EDEN data are probably relevant when the outcomes (e.g. food preference or obesity) are supposed to be predicted by repeated exposures and/or the cumulative effect to either healthy or less healthy foods. The derivation of dietary patterns throughout early childhood by combining these two complementary approaches, cross-sectional and longitudinal, therefore provided interesting tools for further research based on the EDEN mother-child cohort.

Importantly, while our findings suggested that the “Use of ready-prepared adult foods” over infancy predicted unhealthy tracking from 2 to 5 y, the feeding pattern closer to infant guidelines "Longer breastfeeding, later main meal food introduction and use of home-made foods" predicted a diet closer to nutrition guidelines from 2 to 5 y. This is consistent with a previous study which showed that breast-feeding and introduction of complementary feeding after 4 months were associated with a positive dietary pattern in the second year of life (22). Overall, our longitudinal findings provide comprehensive and dynamic insights into the EDEN dietary data, and support the hypothesis that healthy feeding practices during infancy are more likely to track to a healthy diet across toddler and preschool ages. Along with the previous publication based on the mother-child EDEN cohort (15), the current study also confirms that diet is predicted by social determinants at very early stages of life. Infants and toddlers with older sibling(s), born to younger, less educated and overweight mothers are more likely to track on an unhealthy diet, and thus appear as a more vulnerable group probably relevant to be targeted through early obesity prevention interventions. The latter should involve parents, as they are deeply involved in the setting of feeding practices, the provision of foods to their baby and also because they are important role models for their child's dietary intake (31,32). The presence of older siblings should also be accounted for in such interventions, as their food exposure and/or food preferences towards processed and fast-foods are likely to challenge the parent's willingness to follow dietary guidelines (8).

While women from all socio-demographic positions were recruited at baseline, university-educated mothers were over-represented in the samples analyzed. This is a typical limitation of cohorts, which may limit generalizability of these results. It is however noteworthy that the robustness of the patterns derived at 2 and 3 y was checked by running again the PCAs at these two ages on the sub-sample of 989 children, leading to consistent results; we also reanalyzed the PCAs excluding children with imputed dietary data, and the PCA loadings remained overall the same (not shown). Further, our results confirmed the social gradient associated with diet, often reported with maternal education, maternal age, household income and parity (9), which also argues towards internal validity of the dietary patterns obtained from PCA in the present study. These elements also support the FFQ used, despite it has not been validated in young children with regards to energy and nutrient intakes. Finally, we acknowledge that in the current study the follow-up length is reduced to 5 years. During this early stage of life, children's food choices are largely driven by the child's parents and environment. A future area of research would be to examine how these patterns map onto dietary patterns in middle and late childhood when children have more autonomy.

In conclusion, the EDEN dataset, with repeated measures of feeding practices and dietary intake from birth to 5 y, allowed us to address total diet both cross-sectionally and longitudinally. The current analysis provided us with comprehensive and synthetic variables of total diet and tracking, which will be useful for future research. Our findings confirmed the emergence of dietary profiles socially differentiated early in life as well as a moderate tracking of dietary patterns. Given the growing evidence showing that taste and food preferences are built upon repeated exposures to specific foods (6,7), our findings should encourage the promotion of healthy feeding practices and healthy dietary trajectories as soon as infancy, in particular amongst the most socially disadvantaged population groups.

Authors' contributions

S. L. designed the research, conducted the statistical analysis, interpreted the results, drafted and edited the manuscript, and had primary responsibility for final content. M. -A. C., and B. H. designed and led the EDEN mother-child cohort; A. B. provided the infant feeding pattern scores resulting from a previous study; A. F. is responsible for the EDEN data management; and A. B., A. F., M. -A. C., B. H. and B. L. -G. guided the statistical analysis, contributed to interpretation of results, and edited the manuscript. All authors have read and approved the final manuscript.

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Table 1. Characteristics of the sample. The EDEN Study.

Child characteristics	
Male sex	53.3
Premature birth (<37 weeks of amenorrhea)	5.9
Birth weight, g[1]	3295 ± 505
Parental characteristics	
Maternal BMI category[2]	
Thin	7.7
Normal	66.0
Overweight	17.5
Obese	8.9
Maternal age at delivery, y	30.2 ± 4.6
Maternal marital status (single)	1.0
Maternal education	
No diploma	20.8
High school diploma	17.6
2-year university degree	23.9
≥3-year university degree	37.7
Primiparous[3]	48.0
Monthly household income[4], €	
<1501	10.2
1501-2300	30.0
2301-3000	30.2
>3000	29.5
Other variables	
Recruitment center (Poitiers)[5]	53.6

n=989

Values are % yes or mean ± SD, n=989 except stated otherwise.

[1] Average birth weight was 3231±584 g in the French national perinatal survey performed in 2003 (http://www.drees.sante.gouv.fr/IMG/pdf/enp_2003_rapport_inserm.pdf).

[2] This variable was available for n=972 children.

[3] This variable was available for n=987 children.

[4] The median monthly household income in France in 2003 was 2458 euros. (http://www.insee.fr/fr/themes/tableau.asp?reg_id=0&ref_id=NATSOS04202%C2).

[5] The second recruitment center was Nancy.

Table 2. Results of the multivariable[1] linear regression analyzes, with the cross-sectional dietary patterns at 2 y and the multi-time-point dietary patterns as the dependent variables. The EDEN Study.

	Cross-sectional dietary patterns at 2 y			Multi-time point dietary patterns	
	"Processed, fast-foods"	"Guidelines"	"Baby foods"	"Processed, fast-foods at 2, 3 and 5 y"	"Guidelines at 2, 3 and 5 y"
	n=1393			n=970	
Sex					
Girls	0	0	0	0	0
Boys	0.03 ± 0.05	-0.10 ± 0.05	0.11 ± 0.05	0.14 ± 0.06	-0.07 ± 0.06
P-value	0.50	0.06	0.05	0.02	0.28
Older sibblings at home					
Yes	0	0	0	0	0
No	-0.29 ± 0.07	0.01 ± 0.07	0.13 ± 0.07	-0.23 ± 0.08	0.03 ± 0.08
P-value	<0.0001	0.92	0.06	0.003	0.71
Maternal age at delivery, y	-0.14 ± 0.03	-0.01 ± 0.03	-0.09 ± 0.03	-0.12 ± 0.04	0.05 ± 0.04
P-value	<0.0001	0.78	0.005	0.002	0.22
Maternal BMI category					
Thin	-0.05 ± 0.09	0.13 ± 0.10	0.00 ± 0.10	0.17 ± 0.12	0.22 ± 0.12
Normal	0	0	0	0	0
Overweight	0.11 ± 0.07	0.08 ± 0.07	-0.03 ± 0.07	0.14 ± 0.08	0.01 ± 0.08
Obesity	0.09 ± 0.10	0.24 ± 0.10	0.09 ± 0.10	0.29 ± 0.11	0.00 ± 0.11
P-value	0.30	0.07	0.77	0.02	0.32
Maternal education level					
No diploma	0.53 ± 0.08	-0.47 ± 0.08	0.24 ± 0.08	0.60 ± 0.10	-0.59 ± 0.10
High school diploma	0.27 ± 0.08	-0.27 ± 0.08	0.03 ± 0.08	0.16 ± 0.10	-0.30 ± 0.10
2-year university degree	0.04 ± 0.07	-0.15 ± 0.07	0.04 ± 0.07	0.09 ± 0.08	-0.15 ± 0.08
≥3-year university degree	0	0	0	0	0
P-value	<0.0001	<0.0001	0.02	<0.0001	<0.0001
Household income, €					
<1501	0.10 ± 0.10	-0.15 ± 0.11	-0.12 ± 0.11	0.21 ± 0.13	-0.04 ± 0.13

1501-2300	0.07 ± 0.08	-0.01 ± 0.08	0.02 ± 0.08	0.02 ± 0.09	-0.14 ± 0.09
2301-3000	0.01 ± 0.07	0.03 ± 0.07	0.01 ± 0.07	0.04 ± 0.08	-0.06 ± 0.08
>3000	0	0	0	0	0
P-value	0.69	0.34	0.45	0.35	0.44

Values are linear regression coefficients ± SE
[1] In addition to the variables listed in this table, models were further adjusted for child age, recruitment center and season.

Table 3. Spearman correlation coefficients[1] and P-values between cross-sectional dietary patterns scores identified at 2, 3 and 5 y. The EDEN Study.

	3 y		5 y	
Cross-sectional dietary patterns	"Processed, fast-foods"	"Guidelines"	"Processed, fast-foods"	"Protein-rich and diversified"
2 y				
"Processed, fast-foods"	0.40***	-0.36***	0.35***	0.26***
"Guidelines"	0.26***	0.53***	-0.42***	0.33***
"Baby food"	0.08**	-0.25***	0.26***	-0.03
3 y				
"Processed, fast-foods"			0.13***	0.43***
"Guidelines"			-0.66***	0.16***

*p<0.05, **p<0.01, ***p<0.001, n=989

[1] Recommendations for interpreting these correlation coefficients: low <0.3, moderate 0.3-0.6 and high >0.6 (21)

Table 4. Results of the multivariable[1] linear regression analyzes, with the multi-time-point dietary patterns as the dependent variables and the infant feeding patterns as the independent variables of interest. The EDEN Study.

	Multi-time-point dietary patterns (2 to 5 y)[2]	
	" Processed, fast-foods at 2, 3 and 5 y "	" Guidelines at 2, 3 and 5 y "
Feeding patterns identified over the first year of life[3]		
"Later dairy products introduction and use of ready-prepared baby foods"	-0.16 ± 0.04	0.02 ± 0.04
P-value	<0.0001	0.62
"Longer breastfeeding, later main meal food introduction and use of home-made foods"	-0.11 ± 0.04	0.29 ± 0.04
P-value	0.006	<0.0001
"Use of ready-prepared adult's foods"	0.10 ± 0.04	-0.11 ± 0.04
P-value	0.006	0.004

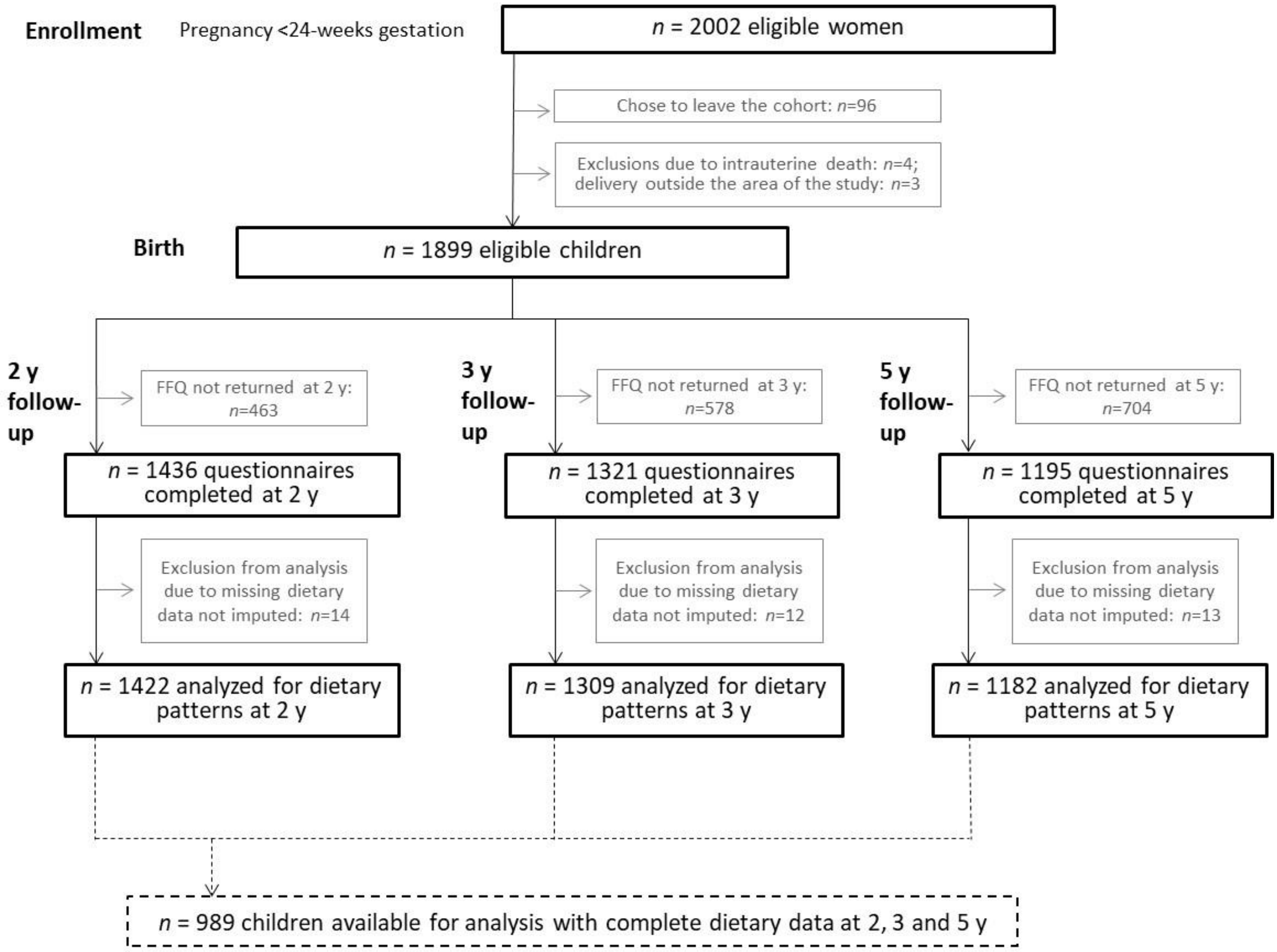
Values are linear regression coefficients ± SE, n=647

[1] Models were adjusted for demographic (child age and gender, older sibling(s) at home, maternal pre-pregnancy BMI and age at delivery), socio-economic (household income, maternal education level) factors, recruitment center and season.

[2] Dependent variables.

[3] Independent variables (15).

Figure 1. Flow-chart of study participant selection



Online Supporting Material

Supplemental Table 1. PCA loadings for the cross-sectional dietary patterns derived at 2, 3 and 5 y. The EDEN study.

	2 y (n=1422)			3 y (n=1309)		5 y (n=1182)	
	1st pattern	2nd pattern	3rd pattern	1st pattern	2nd pattern	1st pattern	2nd pattern
Food groups							
Milk	-0.04	0.02	0.14	-0.02	-0.08	0.06	0.03
Dairy: yogurt and cottage cheese	-0.07	0.25	0.20	0.22	0.18	0.22	-0.08
Dairy puddings and ice-creams	0.33*	0.06	0.15	0.31*	-0.19	0.25	0.34*
Cheese	0.08	0.26	-0.19	0.19	0.28	0.31*	-0.20
Rice	0.10	0.52*	0.13	0.35*	0.27	0.40*	-0.08
Potatoes	0.08	0.42*	0.26	0.46*	0.14	0.41*	0.11
French Fries	0.60*	-0.05	0.04	0.47*	-0.39*	0.42*	0.49*
Pizzas	0.43*	0.11	-0.25	0.36*	-0.18	0.42*	0.19
Legumes	0.33*	0.17	-0.16	0.47*	0.15	0.38*	-0.01
Cooked vegetables	-0.31*	0.60*	0.03	0.11	0.65*	0.32*	-0.56*
Raw vegetables	0.10	0.45*	-0.45*	0.16	0.52*	0.39*	-0.53*
Ham	0.27	0.41*	0.18	0.55*	0.14	0.46*	0.04
Meat	0.34*	0.36*	0.06	0.54*	0.02	0.46*	0.06
Processed meat	0.56*	-0.05	-0.01	0.50*	-0.28	0.39*	0.30
High fat fish	0.23	0.27	-0.09	0.45*	0.20	0.46*	-0.20
Low fat fish	0.04	0.45*	-0.02	0.30*	0.30	0.38*	-0.26
Breaded fish	na	na	na	0.55*	-0.14	na	na
Eggs	0.19	0.27	-0.26	0.30	0.13	0.38*	-0.16
Fresh fruit	-0.02	0.48*	-0.42*	0.20	0.59*	0.35*	-0.51*
Stewed fruit	-0.14	0.39*	0.32*	0.26	0.29	0.27	-0.17
Fruit juice	0.43*	0.04	0.08	0.31*	-0.16	0.29	0.15
Carbonated soft drinks	0.56*	-0.20	0.13	0.25	-0.40*	0.19	0.45*
Breakfast cereals	-0.02	0.19	0.53*	0.17	0	0.14	0.07
Bread	0.21	0.29	-0.09	0.25	0.26	0.32*	-0.24
Biscuits	0.47*	-0.12	0.29	0.34*	-0.30	0.24	0.42*
Chocolate	0.55*	-0.11	0.14	0.32*	-0.36*	0.27	0.39*
Crisps	0.53*	-0.18	0.16	0.43*	-0.40*	0.30	0.46*
Baby foods	-0.27	0.24	0.68*	na	na	na	na
% of variance explained	10.9	9.3	6.6	12.8	9.2	11.6	9.2
Label	"Proces-sed, fast-foods"	"Guide-lines"	"Baby foods"	"Proces-sed, fast-foods"	"Guide-lines"	"Protein-rich and diver-sified"	"Proces-sed, fast-food"

*Factor loadings <-0.30 or >0.30

Online Supporting Material

Supplemental Table 2. PCA loadings for the multi-time-point dietary patterns from 2 to 5 y[1]. The EDEN Study.

	1st pattern (2 to 5 y)			2nd pattern (2 to 5 y)		
	2 y	3 y	5 y	2 y	3 y	5 y
Food groups						
Milk	-0.02	-0.03	-0.02	0.01	-0.10	-0.07
Dairy: yogurt and cottage cheese	-0.06	0.10	0.06	0.12	0.18	0.10
Dairy puddings and ice-creams	0.25	0.30	0.31*	-0.03	-0.07	-0.05
Cheese	0.05	0.05	0.05	0.24	0.29	0.32*
Rice	0.13	0.18	0.17	0.29	0.32*	0.28
Potatoes	0.14	0.29	0.27	0.20	0.23	0.14
French Fries	0.47*	0.55*	0.49*	-0.15	-0.09	-0.10
Pizzas	0.27	0.38*	0.31*	0.01	0.01	0.10
Legumes	0.29	0.36*	0.25	0.09	0.26	0.21
Cooked vegetables	-0.22	-0.14	-0.13	0.52*	0.57*	0.55*
Raw vegetables	0.01	0.01	0.01	0.46*	0.54*	0.55*
Ham	0.35*	0.35*	0.29	0.20	0.23	0.18
Meat	0.33*	0.41*	0.32*	0.20	0.18	0.19
Processed meat	0.41*	0.53*	0.48*	-0.13	-0.08	-0.08
High fat fish	0.20	0.31*	0.28	0.21	0.31*	0.36*
Low fat fish	0.12	0.11	0.08	0.34*	0.33*	0.33*
Breaded fish	na	0.48*	na	na	0.04	na
Eggs	0.14	0.23	0.12	0.24	0.25	0.28
Fresh fruit	-0.01	-0.01	-0.03	0.54*	0.60*	0.55*
Stewed fruit	0	0.09	0.10	0.18	0.28	0.21
Fruit juice	0.36*	0.37*	0.30	-0.06	-0.04	0.05
Carbonated soft drinks	0.39*	0.40*	0.39*	-0.28	-0.27	-0.23
Breakfast cereals	0.03	0.10	0.14	0.02	0.04	0.02
Bread	0.14	0.09	0.06	0.31*	0.36*	0.32*
Biscuits	0.39*	0.35*	0.35*	-0.24	-0.17	-0.18
Chocolate	0.40*	0.44*	0.36*	-0.18	-0.12	-0.09
Crisps	0.47*	0.52*	0.40*	-0.26	-0.14	-0.14
Baby foods	-0.08			0.03		
% of variance explained	8.0			7.0		
Labels	"Processed, fast-foods at 2, 3 and 5 y"			"Guidelines at 2, 3 and 5 y"		

n=989

[1] In the SAS output, different ages are in different rows.

*Factor loadings <-0.30 or >0.30.