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Einführung von Beikost in fünf europäischen Ländern

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Einleitung

In keinem anderem Lebensalter verändert sich die Ernährung so stark wie im ersten Lebensjahr. Von der reinen Muttermilch bzw. Säuglingsanfangsnahrung wechselt sie über die pürierte Beikost zur Familienkost. In diesen stoffwechselaktiven und von intensivem Wachstum geprägten Monaten kann eine frühkindliche Prägung einen sowohl kurz- wie auch langfristigen Einfluss auf die Entwicklung und die Gesundheit des Säuglings haben (1;2).

Die Ernährung des Säuglings im ersten Lebensjahr, sein Wachstum und seine Gewichtszunahme werden mit Übergewicht, Adipositas, erhöhtem Blutdruck und Diabetes in späteren Jahren in Zusammenhang gebracht (3-9). Im Jahr 1999 stellten von Kries et al. bei der Eingangsuntersuchung von Schulkindern in Bayern einen starken Zusammenhang zwischen Säuglingsernährung, Übergewicht und Adipositas fest (10). Kinder, die in den ersten Lebensmonaten Säuglingsanfangsnahrung statt Muttermilch bekamen hatten eine höhere Wahrscheinlichkeit, im Alter von fünf bis sechs Jahren an Übergewicht (12.6% vs. 9.2%) oder Adipositas (4.5% vs. 2.8%) zu leiden. Kinder, die in den ersten Lebensmonaten keine Muttermilch erhielten haben im Alter von neun bis zehn Jahren einen höheren Körperfettanteil als Kinder, die in den ersten Lebensmonaten gestillt wurden (11). In verschiedenen Studien korrelierte die Dauer der Stillzeit mit einer geringeren Adipositasprävalenz im späteren Leben (2;10;12-14).

Säuglingsanfangsnahrung hat einen etwas höheren Energiegehalt sowie einen zwei- bis dreifach höheren Eiweißanteil als Muttermilch (15;16). Einige Studien zeigen, dass Säuglinge mit Säuglingsanfangsnahrung eine durchschnittlich höhere Energie- und Eiweißzufuhr im Vergleich zu gestillten Säuglingen haben (15-18). Es wird angenommen, dass die hohe Eiweißzufuhr von Säuglingen, die mit Säuglingsanfangsnahrung gefüttert werden, ein starker Einflussfaktor auf die Entwicklung von Übergewicht und Adipositas ist (19;20). Weiterhin zeigten Säuglinge mit Säuglingsanfangsnahrung bei der Beikosteinführung keine Verringerung ihrer Milchzufuhr im Gegensatz zu gestillten Säuglingen (15).

Im EU Childhood Obesity Projekt (http://www.metabolic-programming.org), einer doppelt blind randomisierten Interventionsstudie mit über 1000 gesunden, reifgeborenen Säuglingen aus verschiedenen europäischen Ländern, wird der Zusammenhang zwischen der Eiweißzufuhr im Säuglingsalter und der Entwicklung von Wachstum und Gewicht bei Kindern nach der Geburt bis zum Alter von 8.5 Jahren untersucht (21). Die Rekrutierung der Teilnehmer wurde in 11 Studienzentren in fünf europäischen Ländern (Belgien,

Deutschland, Italien, Polen und Spanien) durchgeführt und schließt somit Teilnehmer mit unterschiedlichem kulturellem und geographischem Hindergrund ein (22). Anhand von Fragebögen und regelmäßigen Besuchen der Studienteilnehmer in die Studienzentren wurden Daten zur Gesundheitsgeschichte der Eltern und der Säuglinge, so wie sozioökonomische Daten und Ernährungsgewohnheiten erfasst. Das Studienkollektiv besteht aus einer Kontrollgruppe gestillter Kinder (welche mindestens bis zum Ende des dritten Lebensmonats gestillt wurden) sowie aus zwei randomisierten Interventionsgruppen mit Säuglingen mit Säuglingsanfangsnahrung mit unterschiedlichem Eiweissgehalt, die bis zur achten Lebenswoche auf eine der Studien-Säuglingsanfangsnahrungen umgestellt wurde (21). Der Energiegehalt der beiden Säuglingsanfangsnahrungen wurde mit dem entsprechenden Fettgehalt angeglichen. Der Kohlenhydrat- und Mikronährstoffgehalt war in beiden Studien-Säuglingsmilchnahrungen identisch.
Für eine möglichst genaue Ernährungsanamnese wurden monatliche 3-Tage Wiegeprotokolle im ersten bis neunten sowie zwölften Lebensmonat eingesetzt. Diese Ernährungserhebungsmethode, ist zwar zeitaufwendig und bedarf einer guten Kooperation der Teilnehmer, stellt aber auf der anderen Seite eine qualitative und quantitativ sehr aussagekräftige Methode dar (23).

Innerhalb des EU Childhood Obestiy Projektes wurde der Frage nachgegangen, ob der unterschiedliche Eiweißgehalt in den Säuglingsanfangsnahrungen Einfluss auf den zeitlichen Beginn der Beikosteinführung, die verzehrte Nahrungsmenge sowie die Nährstoffzufuhr über die Beikost hat.
In Studien wurden, vermutlich durch die höhere Eiweißzufuhr der Säuglingsanfangsnahrung ausgelöste, erhöhte Insulinwerte beobachtet (1). Hieraus ergab sich die Frage, ob erhöhte Insulinwerte zu einem gesteigerten Hungergefühl und somit zu einer verfrühten Beikosteinführung bzw. einer vermehrten Beikostzufuhr führen.

Zunächst wurde anhand der Daten der 3-Tage Wiegeprotokolle, der Zeitpunkt der Beikosteinführung bei gestillten Säuglingen im Vergleich zu nicht gestillten Säuglingen ermittelt (24). Die WHO empfiehlt sechs Monate ausschließliches Stillen mit anschließender Beikosteinführung und einer weiterführenden Stilldauer bis zum Alter von 2 Jahren (25). In vielen europäischen Ländern wurde diese Empfehlung bis heute nicht offiziell übernommen.
Die ESPGHAN (European Society for Paediatric Gastroenterology, Hepatology and Nutrition) empfiehlt eine möglichst ausschließliche Stillzeit von vier bis sechs Monaten mit einer schrittweise beginnenden Beikosteinführung (26). Beikost sollte nicht vor dem Alter von 17 Wochen und nicht nach einem Alter von 26 Wochen eingeführt werden. Diese

Empfehlungen zur Beikosteinführung gelten sowohl für gestillte Säuglinge wie auch für Säuglinge, die mit Säuglingsanfangsnahrung ernährt werden. Innerhalb der Studie waren die aktuellen, offiziellen Landesempfehlungen mit einer möglichst ausschließlichen Stillzeit von 4 bis 6 Monaten und einer anschließenden Beikosteinführung zwischen den einzelnen Ländern recht ähnlich.

Wie verschiedene Studien zeigen, wird bei Säuglingen, die mit Säuglingsanfangsnahrung ernährt werden, generell früher mit der Zufütterung von Beikost angefangen als bei gestillten Säuglingen (27;28). Weitere Faktoren, die mit einer früheren Beikosteinführung in Verbindung gesetzt werden, sind ein niedrigeres Ausbildungsniveau und ein niedrigerer sozioökonomischer Status der Mutter, ein geringeres Alter der Mutter und ihre Rauchgewohnheiten (28-31).

Weiterhin war es von Interesse, den Verzehr von energiehaltigen Flüssigkeiten bei Säuglingen zu untersuchen. Laut WHO ist Muttermilch das einzige adäquate Nahrungsmittel für Säuglinge während der ersten sechs Lebensmonate, auch die ESPGHAN empfiehlt eine möglichst ausschließliche Stillzeit in den ersten vier bis sechs Lebensmonaten. Nach heutigen Erkenntnissen benötigen gesunde Säuglinge in den ersten Monaten keine weitere Flüssigkeitszufuhr neben Muttermilch oder Säuglingsanfangsnahrung (25;26). Zusätzliche Getränke bergen die Gefahr, die Zufuhr von Muttermilch oder Säuglingsmilchnahrung zu reduzieren (32-34), dazu gehören Wasser oder einfache Teeaufgüsse oft nicht zu den bevorzugten Flüssigkeiten, die an Säuglinge verabreicht werden (34). Die Zufuhr von energiehaltigen Getränken wie Säften, Instant-Tees oder süßen Erfrischungsgetränken (Limonaden, Cola) können die Entwicklung von Übergewicht und Adipositas, Diabetes, Karies, aber auch eine ungenügende Kalziumzufuhr im Kindes- und Jugendalter fördern (32;35-40). Die Geschmacksempfindungen werden schon beim Fetus und Säugling geprägt, und praktizierte Ernährungsgewohnheiten in jungen Jahren haben einen bleibenden Einfluss auf den weiteren Lebensstil bis ins Alter (41). Somit gingen wir innerhalb des EU Childhood Obesity Projekt der Frage nach, in wieweit Säuglinge schon in ihren ersten Lebensmonaten energiehaltige Flüssigkeiten (Instant-Tees, Obst- und Gemüsesäfte oder süße Erfrischungsgetränke) erhalten.

Eine wachsende Herausforderung in der Pädiatrie sind die zunehmenden Nahrungsmittel-allergien im Säuglings- und Kindesalter. Ca. 6 % der Säuglinge und Kleinkinder leiden unter Nahrungsmittelallergien (42). Der Zeitpunkt der Beikosteinführung scheint eine wichtige Rolle in der Allergieentwicklung zu haben, Säuglinge mit frühzeitiger Beikosteinführung (vor dem vierten Lebensmonat) zeigten ein gehäuftes Auftreten von atopischen Erkrankungen (43-46). Weiterhin hat die Auswahl der Nahrungsmittel vermutlich einen Einfluss auf die Entwicklung von akuten und chronisch allergischen Reaktionen (47). Somit wurde, unter

Berücksichtigung der teilweise unterschiedlichen Landesempfehlungen, der Zeitpunkt der Einführung von potentiell allergenen Nahrungsmitteln bei gestillten und nicht gestillten Säuglingen untersucht. Aktuelle Erkenntnisse haben zu vereinfachten Empfehlungen zur Einführung von potentiell allergenen Nahrungsmitteln geführt (48). Diese Empfehlungen wurden in der Datenauswertung nicht berücksichtigt, da die vorliegende Datenerhebung zu einem früheren Zeitpunkt stattfand.

Resultate und Schlussfolgerungen

Ein erheblicher Anteil der Säuglinge erhielt schon vor Ende des vierten Lebensmonats Beikost. Obwohl für gestillte Säuglinge wie auch für nicht gestillte Säuglinge die gleichen Empfehlungen zur Beikosteinführung galten, wurde bei Säuglingen mit Säuglingsmilchnahrung ein früherer Verzehr von Beikost beobachtet. Am Ende des dritten und vierten Monats, hatten schon 6% bzw. 37.2% der Säuglinge, die mit Säuglingsmilchnahrung gefüttert wurden, im Gegensatz dazu aber nur 0.6% bzw. 17.3% der gestillten Säuglinge Beikost erhalten. Die unterschiedliche Nährstoffzusammensetzung der Studiensäuglingsmilch hatte keinen wesentlichen Einfluss auf den Zeitpunkt der Beikosteinführung. Allerdings war der Zeitpunkt der Beikosteinführung zwischen den verschiedenen Ländern signifikant unterschiedlich. Nach Anpassung eines multiplen Regressions-Modells mit Aufnahme der Variablen `Alter der Mutter´, `Ausbildungsniveau der Mutter´ und `Wohnsitz der Eltern´ fanden sich signifikante Unterschiede zwischen den Ländern. Im Vergleich zu Deutschland fand sich in Belgien bei Säuglingen, die mit Säuglingsanfangsnahrung ernährt wurden am Ende des dritten und vierten Monats ein drei- bis vierfach erhöhtes Risiko Beikost einzuführen. Bei den gestillten Säuglingen fand sich am Ende des vierten Monats sogar ein 16-fach höheres Risiko in Belgien und ein siebenfach höheres Risiko in Spanien als in Deutschland, Beikost einzuführen. Weiterhin hatten Faktoren wie das Alter der Mutter, ein niedrigeres Bildungsniveau als auch das Rauchen einen signifikanten Einfluss auf den Zeitpunkt der Beikosteinführung. Die nationalen Empfehlungen der teilnehmenden Länder zur zeitlichen Beikosteinführung sind sehr ähnlich. Wir vermuten auf Grund unserer Resultate einen starken kulturellen und individuellen Einfluss auf die Praxis der Beikostfütterung.

Bei einem hohen Anteil von Säuglingen mit Säuglingsanfangsnahrung wurden schon ab dem ersten Monat energiehaltige Flüssigkeiten verabreicht. Nicht gestillte Säuglinge erhielten signifikant früher und in einem signifikant höheren Prozentsatz energiehaltige Getränke als gestillte Säuglinge (entsprechend 43 % und 13 % am Ende des vierten Monats). Anhand einer multiplen Regressions-Analyse mit den Einflussfaktoren `Alter der Mutter´, `Ausbildungsniveau der Mutter´ und `Wohnsitz der Eltern´ zeigte sich das

Herkunftsland als ein beständiger Risikofaktor für eine frühere Einführung von energiehaltigen Flüssigkeiten bei gestillten und nicht gestillten Säuglingen.
In Polen fand sich der höchste Anteil von Säuglingen, die energiehaltige Flüssigkeiten erhielten - vor allem bei den Säuglingen mit Säuglingsanfangsnahrung - und in Belgien und Italien fand sich der niedrigste Anteil von Säuglingen, die energiehaltige Flüssigkeiten erhielten. Es gab keinen wesentlichen Unterschied im Konsumverhalten von energiehaltigen Flüssigkeiten zwischen beiden Gruppen mit Säuglingsanfangsnahrung.
Bemerkenswert war ein signifikanter Einfluss des Verzehrs von energiehaltigen Flüssigkeiten auf eine geringere Aufnahme von Flaschenmilch im Alter von zwei, drei, vier und fünf Monaten, sowie auch eine signifikant geringere Beikostzufuhr im Alter von sieben, acht, neun und zwölf Monaten. Die Säuglinge verzehrten in den ersten Monaten bevorzugt Instant-Tee und im zweiten Lebenshalbjahr Fruchtsäfte. Dabei sollte beachtet werden, dass energiehaltige Flüssigkeiten vorzugsweise Kohlenhydratlieferanten sind und wenn sie anstatt von Muttermilch oder Säuglingsanfangsnahrung getrunken werden wichtige Nährstoffe verdrängen, die für die Entwicklung und das Wachstum des Säuglings von großer Wichtigkeit sind.
Potentiell allergene Nahrungsmittel wurden signifikant früher bei Säuglingen mit Säuglingsanfangsnahrung eingeführt als bei gestillten Säuglingen. Eine Ausnahme war der Verzehr von Sojaeiweiß. Im Vergleich zu nicht gestillten Säuglingen erhielten die gestillten Säuglinge zu einem signifikant früheren Zeitpunkt und zu einem signifikant höheren Anteil Sojaeiweiß.
Im Alter von 4 Monaten verzehrten 6 % der gestillten und 13 % der nicht gestillten Säuglinge potentiell allergene Nahrungsmittel. Mütter mit Allergien verabreichten ihren Säuglingen in einem früheren Alter potentielle allergene Nahrungsmittel als Mütter ohne Allergien.
Ebenfalls zu beobachten war ein signifikanter Unterschied im Zeitpunkt der Einführung von potentiell allergenen Nahrungsmitteln zwischen den Ländern. Nach Anpassung eines multiplen Regressions-Models mit Aufnahme der Variablen `Alter der Mutter´, `Ausbildungsniveau der Mutter´, `Rauchgewohnheiten der Mutter´, `Allergien bei der Mutter´ und `Wohnsitz der Eltern´ zeigte sich das Herkunftsland als konsistenter und signifikanter Einflussfaktor.

Zusammenfassend konnte beobachtet werden, dass trotz gleicher Empfehlungen nicht gestillte Säuglinge zu einem signifikant früheren Zeitpunkt und zu signifikanten höheren Anteilen feste Beikost, energiehaltige Getränke wie auch potentiell allergene Nahrungsmittel erhielten. Weiterhin fanden sich trotz ähnlicher Empfehlungen signifikante Unterschiede zwischen den Ländern im Bezug auf die zeitliche Einführung von Beikost, ob als feste

Nahrungsmittel, energiehaltige Getränke oder als potentiell allergene Nahrungsmittel, bei den gestillten sowie nicht gestillten Säuglingen. Die unterschiedliche Nährstoffzusammensetzung der Studien-Säuglingsanfangsnahrung hatte keinen Einfluss auf das Alter der Beikosteinführung. Die Zufuhr von energiehaltigen Getränken wirkte sich signifikant auf eine geringere Aufnahme von Säuglingsanfangsnahrung in den ersten Lebensmonaten aus sowie auf eine signifikant geringere Beikostzufuhr im Alter von sieben, acht, neun und zwölf Monaten. Die Ernährung des Säuglings in seinen ersten Monaten, wie auch seine kulturellen und geographischen Hintergründe zeigten einen signifikanten Einfluss auf das Alter der Beikosteinführung. Weiterhin hatten der Ausbildungsgrad der Mutter, das Alter der Mutter wie auch ihre Rauchgewohnheiten signifikante Einflüsse auf den Zeitpunkt der Beikosteinführung. Eine gute Information und Aufklärung wie auch Begleitung an die Eltern, speziell von Säuglingen, die Säuglingsanfangsnahrung erhalten, über die zeitlich korrekte Einführung der Beikost, in fester und flüssiger Form wäre sehr wünschenswert.

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Introduction of Complementary Feeding in 5 European Countries

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ABSTRACT

Objectives: Little is known about the practice of introducing complementary feeding across Europe. We aim at describing times of solid introduction in healthy infants in 5 European countries.

Materials and Methods: Between October 2002 and June 2004, 1678 healthy term infants were either breast-fed (BF) for at least 4 months (n = 588) or study formula–fed (FF) (n = 1090) with different protein contents. Three-day-weighed food protocols were obtained at ages 1, 2, 3, 4, 5, 6, 7, 8, 9, and 12 completed months.

Results: Solids were introduced earlier in FF infants (median 19 weeks, interquartile range 17–21) than BF infants (median 21 weeks, interquartile range 19–24). Some 37.2% of FF infants and 17.2% of BF infants received solid foods at 4 completed months, which is earlier than recommended in Europe. Solids had been introduced at 7 completed months in 99.3% of FF infants and 97.7% of BF infants, respectively. Belgium had the highest percentage of solids feeding in FF infants at 3 (15.8%) and 4 (55.6%) completed months, and in BF infants at 4 (43%) and 5 (84.8%) completed months. Multiple regression showed low maternal age, low education level, and maternal smoking to predictors an early introduction of solids at 3 and 4 completed months.

Conclusions: Complementary feeding is introduced earlier than recommended in a sizeable number of infants, particularly among FF infants. Country- and population-specific approaches to adequately inform parents should be explored.

Key Words: beikost, complementary feeding, supplementary feeding—weaning

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Healthy infants should receive complementary feeding near the end of the first half-year of life, when breast-feeding or infant formula alone cannot always secure an adequate nutrient supply. Since 2001, the World Health Organization recommendation is to introduce complementary foods from the seventh month of life, rather than in the fifth or sixth month as previously recommended (1,2). Although the World Health Organization recommendation addresses all countries, advisory bodies in industrialised countries continue to recommend an age range for introduction of complementary foods. The European Society of Paediatric Gastroenterology, Hepatology and Nutrition supports exclusive or full breast-feeding for about 6 months as a desirable goal and recommends the introduction of complementary feeding not before 17 weeks and not later than 26 weeks (3). The American Academy of Pediatrics recommends that solid foods should not be introduced before 4 to 6 months of age (4).

In Germany, the recommendation at the time of recruitment is exclusive breast-feeding for the first 4 to 6 months, with the introduction of Beikost from the age of 5 to 7 months (5,6) (the full text of the recommendation is available from the Nationale Stillkommission at *http://www.bfr.bund.de/cd/922*). In Belgium, recommendations of the L'Office de la Naissance et de l'Enfance, an institution that supports and assesses the well-being of children from 0 to 12 years outside of his or her family, are not to start with the introduction of complementary feeding before the age of 4 completed months (7). In Italy, the Italian Society of Neonatology recommended in 2002 that term healthy babies can continue breast-feeding exclusively for 6 months, whereas introduction of complementary foods can be started at 4 or 5 months depending on maternal and infant circumstances (8). In Poland as well as in Spain recommendations state that complementary feeding should not start before 4 completed months of age (9–11).

Cultural and sociodemographic characteristics of families may influence infant feeding patterns. In some studies earlier introduction of complementary foods were found to be associated with lower socioeconomic status (12–14) and education level (15,16), maternal smoking (16), and younger age of the mother

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(15,17). In some studies formula-fed (FF) infants started complementary foods earlier than breast-fed (BF) infants (12,13,15,17).

We analysed data of food protocols from 5 European countries with similar infant feeding recommendations, which were collected as part of the prospective European Childhood Obesity Project, with the aim of exploring whether type of milk feeding, country of residence, or other factors were associated with the introduction of solids.

MATERIALS AND METHODS

Study Design

The data evaluated were collected as part of the European Childhood Obesity Project, a multicentre intervention trial in 5 European countries to investigate the relation of the infant diet and protein supply on early growth and later obesity risk (17a).

Eligible for study participation were apparently healthy, singleton, term infants who were born between October 1, 2002 and July 31, 2004 in Germany (Munich and Nuremberg), Belgium (Brussels and Liège), Italy (Milano), Spain (Tarragona and Reus), and Poland (Warsaw). Mothers were approached by trained study personnel in maternity hospitals before their discharge or contacted via midwives or paediatricians. Infants were enrolled during the first 8 weeks of life. Excluded were mothers with a hormonal or metabolic disease (eg, gestational diabetes) or intake of drugs during pregnancy that are known to influence infant growth (eg, thyroid hormones, antithyroid drugs, corticosteroids). Moving too far away from the study centre to come for visits was a further reason for exclusion.

Dietary Intervention, Study Formulae

Study groups included a BF reference group and 2 groups of study FF infants with exclusive FF starting between birth and week 8, which were randomized to 1 of our study formulae with either higher and lower protein content. Infant formulae had a protein content of 7.1% and 11.7% of energy (1.25 g protein/100 mL and 2.1 g protein/100 mL) and follow-on formulae 8.8% and 17.6% of energy (1.6 g protein/100 mL and 3.2 g protein/100 mL) for the lower and higher protein groups, respectively. Equal energy content was achieved by adapting fat content, whereas the intake of carbohydrates and other nutrients was not different (17a). The study formulae were provided by Bledina (Steenvorde, France) and supplied to families until the infant age of 1 year.

There was no further intervention addressing infant dietary intakes. Information on dietary intakes of infants were collected prospectively with 3-day-weighed food records which included 2 weekdays and 1 weekend day, at the age of each completed month from 1 to 9 months, and at 12 completed months. The 3-day food protocol collected information on all dietary intakes of infants, including breast milk, formula, and any other liquids or foods. The regular study visits and additional contacts by mailings and telephone calls between study personnel and parents allowed to clarify questions arising on filling out the dietary protocol, and to enhance compliance. Parents were provided with a study telephone hotline number for more information and to address any arising questions.

Data Procedure

The procedure was as follows: Dietary food records were checked by nutritionists at each study centre; to clarify any questions parents were contacted if necessary; data were introduced to the specifically developed nutrition software "NutrCalc" and transferred to a central database. Standard operating procedures were developed to harmonize the introduction of food intake data and the calculations of dieticians in the different study centres.

Complementary Foods

Complementary food items were categorised as food groups and according to their ingredients. For our analysis solids included food items such as beef, cereals or bread, egg, fat, fish, fruit, meat, milk or milk products, nuts or seeds, potatoes, poultry, pulses, sausages, soy or soy products, sweets or infant sweets, and vegetables. Each food item was classified either as a commercial infant product (CIP) if it was offered as baby food for the first year of life (excluding infant or follow-on formula), or as normal food (NF) offered for consumption not only by infants but also by children or adults.

Sociodemographic Data

We grouped mothers in 4 categories on the basis of age at birth: I: ≤25 years, II: >25 to 30 years, III: >30 to 35 years, and IV: >35 years. Maternal educational levels were categorised in 3 groups: no/low = prepreliminary to lower secondary, middle = upper secondary and postsecondary nontertiary, and high = first and second stage of tertiary education according to the standards of the International Standard Classification of Education.

Dropouts

For the formula group 1090 infants were enrolled, of whom 851 participated in the follow-up visits at 6 months and 767 at 12 months; for the observational group of BF infants 588 infants were enrolled, of whom 349 participated in the follow-up visits at 6 months, 327 at 12 months. Thus, 687 infants dropped out until the age of 12 months for the following reasons: refusal of parents/loss of contact (310 [45%]), no compliance with assigned milk feeding (250 [36%]), address unknown (51 [7%]), moving out of the study region (27 [4%]), exclusion of illness/medication (12 [2%]), and other reason/unknown (37 [5%]).

Statistics

Stata 9.2, statistical package for statistical science software, version 16.0 (SPSS Inc, Chicago, IL), and Excel were used for data analyses. χ^2 and multiple logistic regression analysis was used to adjust differences in solid introduction at each month by confounders.

Ethics

The study was approved by the ethics committees of all of the study centres. Written informed parental consent was obtained for each infant.

RESULTS

A total of 1678 infants were enrolled (1090 FF infants and 588 BF infants, 65% and 35%, respectively) in the study, and for 1366 (81.4%) infants (928 FF infants and 438 BF infants, 68% and 32%, respectively) at least 1 iterative 3 day-food protocol could be evaluated (Table 1). At the age of 1 month some 1045 three-day-food protocols were evaluated, at 2 months 1208, at 3 months 1184, at 4 months 1136, at 5 months 1128, at 6 months 1075, at 7 months 1008, at 8 months 984, at 9 months 967, and at 12 months 945 three-day-food protocols.

TABLE 1. Study participants and their sociodemographic characteristics

		FF		BF		
	N	n	%	n	%	*P*
Total	1366	928	67.9	438	32.1	
Country						
Germany	233	159	68.2	74	31.8	<0.001
Belgium	180	108	60.0	72	40.0	
Italy	370	220	59.5	150	40.5	
Poland	222	169	76.1	53	23.9	
Spain	361	272	75.3	89	24.7	
Sex	Male	475	70.1	203	29.9	n.s.
	Female	453	65.8	235	34.2	
Both parents foreigner	Yes	42	66.7	21	33.3	n.s.
Mother's education level	No/low	290	87.1	43	12.9	<0.001
	Middle	482	70	207	30	
	High	153	44.9	188	55.1	
Father's education level	No/low	305	81.6	69	18.4	<0.001
	Middle	467	71.2	189	28.8	
	High	136	43.2	179	56.8	
Smoking anytime	Yes	417	81.6	94	18.4	<0.001
Smoking during pregnancy	Yes	386	83.9	74	16.1	<0.001
Smoked up to the day pregnancy confirmed	Yes	380	83.7	74	16.3	<0.001
Smoked last 3 mo before pregnancy	Yes	416	81.7	93	18.3	<0.001
Smoked further (beyond 12 wk)	Yes	259	90.9	26	9.1	<0.001
Birth order	First child	511	65.6	268	34.4	<0.05
	Second child	306	69.7	133	30.3	
	Third child	82	71.3	33	28.7	
	>3 children	26	89.7	3	10.3	
Mother working at the end of 1 mo	Yes	40	76.9	12	23.1	<0.05

BF = breast-fed, FF = formula fed.

The sociodemographic characteristics of study participants are shown in Table 1. Except for country, we did not find differences in sociodemographic characteristics of those infants with food protocols and those without protocols. However, the proportion of filled-in protocols varied between countries ($P < 0.001$), with a lower participation rate in Belgium and a higher participation rate in Italy. Because the sociodemographic characteristics of our FF and BF infants differed in many aspects, we separated both groups in the analysis.

Solids had been introduced in 6% of FF infants at the age of 3 completed months, in 37.2% at 4, 96.2% at 6, and 99.3% at 7 completed months, respectively (Fig. 1). The median age of introduction was 19 weeks (interquartile range 17–21). Among the BF infants only 0.6% had received solids at the age of 3 completed months, whereas 17.3%, 87.1%, and 97.7% received solids at the ages of 4, 6, and 7 months, respectively, with a median age at introduction of 21 weeks (interquartile range 19–24) (Fig. 1).

A higher proportion of FF infants received CIPs than NFs during the first year of life. In contrast, fewer BF infants consumed CIP than NF (Table 2).

FF INFANTS

There were significant differences between countries at the time point of introduction of solids during the first 8 months of life (Table 3). We found an early introduction of solids in Belgium, with 15.8% and 55.6% at the ages of 3 and 4 completed months, respectively. At the age of 3 completed months, Italy and Poland had the lowest proportion of FF infants receiving solids, with only 2.4% and 3.1%, respectively. In all countries at the age of 6 completed months >90% of FF infants received some solids.

Younger mothers (younger than or equal to 25 years) of FF infants introduced solids significantly earlier during the first

FIGURE 1. Cumulative percentage of formula-fed and breast-fed children with introduction of solids, per month.

TABLE 2. Age, number, and percentage of formula-fed and breast-fed infants with introduction of CIP and NF

		FF infants			BF infants		
Age month completed	N	n	CIP (%)	NF (%)	n	CIP (%)	NF (%)
1	1045	696	27.6	22.8	349	5.4	7.7
2	1208	847	31.8	23.6	361	5.3	8.0
3	1184	847	32.0	26.1	337	6.5	8.3
4	1136	806	51.4	40.4	330	17.3	19.1
5	1128	796	77.1	63.6	332	45.2	49.4
6	1075	757	93.3	79.3	318	77.0	79.9
7	1008	705	97.0	89.6	303	93.4	93.7
8	984	695	97.4	91.9	289	95.8	97.6
9	967	682	97.2	95.5	285	97.2	98.6
12	945	658	96.7	99.2	287	93.0	100.0

BF = breast-fed, CIP = commercial infant products, FF = formula fed, NF = normal food.

4 months of life to their infant's diet (at 1, 3, and 4 completed months: $P < 0.05$). Logistic regression showed a 2.9-fold higher probability that younger mothers (younger than or equal to 25 years) start to introduce solids at the age of 3 months than mothers older than 35 years. A low maternal education had a 1.8 higher risk and maternal smoking 3 months before and during early pregnancy had a 1.5 higher risk to introduce some solids at the age of 4 months.

Applying multiple regression analysis including the effects of maternal age, education level, smoking behaviour, and country of residence on the introduction of solids in FF infants, we found a 4-fold higher probability for introduction of solids at the age of 3 completed months in Belgian FF infants (odds ratio [OR] 3.96), and a 3-fold higher risk (OR 2.86) in the youngest group of mothers (younger than or equal to 25 years).

The probability of having solids already introduced at the age of 4 completed months was 3-fold higher in Belgium (OR 3.28), 2-fold higher for low maternal educational level (OR 1.87), and 1.4-fold higher for mothers who smoked (OR 1.40) (Table 4).

The different protein and fat levels of the study formulae did not influence the time of introduction of solids. Neither were the birth weight, birth order, or sex of the FF infants related to the time point of introduction of any solid.

BF INFANTS

Between the age of 4 and 6 completed months, introduction of solids differed significantly by country. Up to 3 completed months, solids were not given to >1.4% of BF infants in any country. At the age of 4 and 5 completed months Belgium had the highest proportion (43.2% and 84.8%) and Germany (4.9% and 25.0%) and Poland (6.7% and 36.2%) the lowest proportion of BF infants receiving solids.

At 6 completed months of age at least 84% of BF infants in every country received some solids except in Germany (69.5%), and at 7 completed months >93% of all BF infants in each country had been introduced to solids (Table 5).

Low maternal education level was significantly associated with the introduction of solids at 3 and 4 completed months (3 months: $P < 0.001$, 4 months: $P < 0.05$) in univariate analysis, whereas multiple regression analysis showed an effect only at 4 months. Maternal age and smoking behaviour was unrelated to timing of introduction of solids.

Applying multiple regression analysis, including the effects of maternal age, education level, smoking behaviour, and country of residence, receiving solids at 4 completed months was 16 times more likely (OR 15.93) in Belgium and 7 times more likely in Spain (OR 6.60) compared with German BF infants. Low- and

TABLE 3. Numbers and cumulative percentage of formula-fed infants receiving solids, by age and country

	Germany		Belgium		Italy		Poland		Spain	
Age month completed	n	%	n	%	n	%	n	%	n	%
1**	1	0.0	5	5.3	0	0.0	2	3.1	2	0.9
2***	6	4.3	10	9.9	1	0.5	4	2.5	4	1.7
3***	7	5.0	15	15.8	5	2.4	5	3.1	19	7.8
4**	41	31.3	50	55.6	61	30.5	60	39.0	88	38.1
5***	85	67.5	66	75.0	162	81.4	145	94.2	184	80.3
6**	114	91.2	75	93.8	190	98.4	142	97.3	207	97.2
7**	115	96.6	69	100.0	190	100.0	127	100.0	199	99.5
8**	107	96.4	71	100.0	187	99.5	127	100.0	198	100.0
9	109	100.0	74	100.0	182	99.5	129	100.0	187	100.0
12	101	100.0	67	100.0	180	100.0	132	100.0	178	100.0

** $P < 0.01$; *** $P < 0.001$.

TABLE 4. Variable significantly associated with the timing of introduction of solids to formula-fed and breast-fed infants, at ages 3 and 4 months†

	FF infants		FF infants multiple logistic regression		BF infants		BF infants multiple logistic regression	
	N	%	OR	95% CI	N	%	OR	95% CI
Age 3 mo								
Germany‡	7	5	1.00		0	0.0	1.00	
Belgium	15	15.8	3.96	1.47–10.67*	0	0.0		
Italy	5	2.4			1	0.8		
Poland	5	3.1			0	0.0		
Spain	19	7.8			1	1.4		
Mothers' age, y								
≤25	17	11.3	2.86	1.01–8.05*	0	0.0		
>25–30	14	5.1			0	0.0		
>30–35	14	5.1			2	1.4		
>35‡	6	4.1	1.00		0	0.0	1.00	
Mothers' education level								
No/low	19	7.4			2	6.7		
Middle	25	5.7			0	0.0		
High‡	6	4.1	1.00		0	0.0	1.00	
Smoking mothers								
Yes	28	7.5			0	0.0		
No‡	23	4.9	1.00		2	0.8	1.00	
Age 4 mo								
Germany‡	41	31.3	1.00		3	4.9	1.00	
Belgium	50	55.6	3.28	1.83–5.86***	16	43.2	15.93	3.99–63.62***
Italy	61	30.5			17	14.7		
Poland	60	39.0			3	6.7		
Spain	88	38.1			18	25.7	6.60	1.80–24.26*
Mothers' age, y								
≤ 25	62	45.3			7	26.9		
>25–30	113	43.1			16	18.2		
>30–35	87	32.7			23	16.5		
>35‡	38	27.1	1.00		11	14.5	1.00	
Mothers' education level								
No/low	106	43.8	1.87	1.47–3.04*	9	28.1	3.13	1.08–9.04*
Middle	150	35.5			33	21.4	2.68	1.24–5.79*
High‡	43	30.7	1.00		15	10.5	1.00	
Smoking mothers								
Yes	149	42.6	1.40	1.04–1.92*	17	24.6		
No‡	150	33.2	1.00		40	15.4	1.00	

†Variables assessed to be included in the model were country of residence, mothers' age, mothers' educational level, and maternal smoking habit.
‡Reference group *$P < 0.05$; ***$P < 0.001$.

middle-level maternal education had a 3-fold higher association (OR 3.13 and 2.68, respectively) with an earlier introduction of solids compared with a high educational level (Table 4). Birth weight, birth order, and sex were unrelated to the time of introducing solids in BF infants.

DISCUSSION

In this sample some 37.2% of FF infants and 17.2% of BF infants already received solids at the age of 4 completed months, although the European Society of Paediatric Gastroenterology, Hepatology, and Nutrition and national recommendations in all participating countries advise not to introduce complementary foods before 4 months of age. Some 6.0% of FF infants, but only 0.6% of the BF infants, had introduced solids already at the age of 3 completed months. Although introduction of solids is recommended at the same age for FF and BF infants, FF infants received solids much earlier than BF infants, which is consistent with previous findings (13,15,17). Our findings show that higher parental socioeconomic status and educational level, as well as exclusive breast-feeding during the first months of life, are associated with later introduction of complementary foods. There are only a few infants in whom solids are introduced later than recommended; 0.7% of FF infants and 2.3% of BF infants, respectively.

Our study involved 5 European countries with different cultural traditions and food patterns. Even though guidelines for the introduction of complementary foods are similar in these countries, there are significant differences in infant feeding practice

TABLE 5. Numbers and cumulative percentage of breast-fed infants receiving solids, by age and country

	Germany		Belgium		Italy		Poland		Spain	
Age month completed	n	%	n	%	n	%	n	%	n	%
1	0	0.0	0	0.0	0	0.0	0	0.0	2	2.5
2	1	1.4	0	0.0	1	0.7	0	0.0	0	0.0
3	0	0.0	0	0.0	1	0.8	0	0.0	1	1.4
4***	3	4.9	16	43.2	17	14.7	3	6.7	18	25.7
5***	15	25.0	39	84.8	65	58.6	17	36.2	47	70.1
6***	41	69.5	46	95.8	102	92.7	37	84.1	51	89.5
7	54	93.1	48	100.0	102	99.0	39	97.5	53	98.1
8	57	100.0	41	100.0	98	97.0	42	100.0	47	97.9
9	55	100.0	44	100.0	98	99.0	41	100.0	46	100.0
12	50	100.0	46	100.0	101	100.0	41	100.0	48	100.0

***$P < 0.001$.

between the countries, both in FF and BF infants (Tables 3 and 5). We found much higher percentages of FF and BF infants with intake of solids at the age of 4 months in Belgium (Tables 3 and 5). This earlier introduction, relative to other countries, is not because of different recommendations in Belgium and remains unexplained.

Giovannini et al (18) studied infant feeding practices in Italy through the first year of life and found that 5.6% and 34.2% of the infants had introduced solids before the age of 3 and 4 months, respectively. Stated factors explaining an early introduction of solid foods were the infants' body weight at 1 month of age and maternal smoking during pregnancy. We found similar proportions for our Italian FF infants (2.4% and 30.5%, Table 3) although they had the lowest proportions of FF infants in our study with introduction of solids in the first 3 months of life.

German FF and BF infants had the lowest percentage in intake of solids at the age of 4 to 6 months. The proportion of infants at the age of 3 completed (FF infants 5% and BF infants 0.0%) and 6 completed months (FF infants 91.2% and BF infants 69.5%) were lower compared with data from an earlier prospective study in German infants by Koletzko et al (19) with 16% and 97% of German infants consuming some Beikost (solid and liquid complementary food) at 3 and 6 months, respectively, whereas the German Dortmund Nutritional and Anthropometric Longitudinally Designed study reported 5% and 97% of the BF and 33% and 80% of the non-BF infants received solids at the ages of 3 and 6 months, respectively (20).

Other studies also reported discrepancies between feeding recommendations and practice. In the Euro-Growth Study, 50%, 67%, and 95% of infants were fed some solid food at the ages of 3, 4, and 5 months, respectively (21). In the United Kingdom the Department of Health recommendations suggests starting with complementary food between 4 to 6 months of age. Similarly, the Scientific Advisory Committee on Nutrition commented that complementary food should not be introduced before the end of the fourth month (22). However, many infants receive complementary feeding earlier (13,21,23,24).

In this study, the strongest risk factors for early introduction of solids in FF infants at 3 completed months were country of residence and young maternal age, and at 4 months the country of residence, low maternal education, and maternal smoking. In BF infants, the country of residence and lower maternal education level were associated with introduction of solids at the age of 4 completed months. These findings are consistent with other studies also finding earlier introduction of complementary feeding in children of lower parental educational level (25), lower socioeconomic status (14), maternal smoking (16,26), and younger maternal age (12).

Although we found no differences in the timing of introducing complementary foods between our infants from the intervention group-fed formulae with different protein and fat contents, there were significant differences between countries in the timing of introducing complementary foods. This observation suggests far stronger effects of cultural, social, and parental factors on the time of introducing complementary foods rather than of the dietary macronutrient composition.

More NFs than CIPs were given to BF infants during the first year of life, whereas a higher percentage of FF infants consumed CIP than NF. It seems that breast-feeding mothers prefer NFs to commercial prepared or semiprepared products; however, mothers of infants who feed formula and, hence, are already using a commercial product may tend to have a lower threshold for introducing other commercial products into the infants' diet.

Conclusions

Infants given formula milk started solids significantly earlier than BF infants. There are marked differences between the 5 European countries of our study in the timing of introducing solids. The macronutrient composition of our formula milk groups did not influence the time point of introduction of complementary foods. Only a few infants start complementary feeding later than recommended. Given the increasing evidence that early nutrition and growth has marked effects both on short-term and long-term health, further studies should evaluate strategies to improve complementary feeding practices in populations of healthy infants.

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APPENDIX

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Original article

Intake of energy providing liquids during the first year of life in five European countries

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SUMMARY

Background: Intake of energy providing liquids (EPL) other than breast milk or formula to infants is discouraged because it may displace milk intake. Data on actual practice is lacking.
Aim: To describe the current practice of EPL supply to infants in five European countries.
Method: Breastfed (BF) infants and infants fed using two formulas (FF) with different protein content were recruited from October 2002 to June 2004. Three-day weighed food protocols of 1366 infants were obtained monthly at the ages of 1 to 9 and again at 12 completed months.
Results: At the age of 4 months, 13% of BF and 43% of FF infants received EPL. FF infants started EPL earlier (median 17 weeks) than BF infants (median 30 weeks). EPL intake was associated with a lower intake of formula milk and solids (kcal/d) in the first year of life. Multiple regression analysis showed significant differences in EPL introduction between the individual countries.
Conclusion: In contrast to recommendations, EPL is frequently given during the first months of life to breastfed and particularly to formula fed infants. Infants given EPL showed lower intakes of infant formula and solids. Caregivers should receive better counselling on appropriate infant feeding.

1. Introduction

Healthy infants should preferably be breastfed and should not receive complementary foods (solids and liquids other than breast milk, infant formula or follow-on formula) in addition to breast-feeding (or formula feeding) before 17 weeks nor later than 26 weeks of age.[1,2] Infants do not require additional liquids like water, tea, juices, sweetened beverages or other energy providing liquids (EPL) other than breast milk or infant formula during at least the first half year of life, with the possible exception of selected conditions such as diarrhoea, very high ambient temperatures, high fever or other excessive fluid losses, or in some selected indications occurring in the neonatal period.[3]

The provision of EPL during the first year of life is not recommended. Feeding infants with EPL may displace breast milk or infant formula intake and, thereby, may adversely affect nutrient supply.[4] Moreover, infants with regular intake of EPL might be primed to their sweet taste with a possible increased risk for later development of dental caries or obesity.[4–7] High intakes of fruit juice can exceed the capacity for fructose absorption and induce diarrhoea, abdominal pain and growth faltering.[8–10,4]

Abbreviations: AAP, American Academy of Paediatrics; EPL, energy providing liquids; BF, breast fed; FF, formula fed; ESPGHAN, European Society for Paediatric Gastroenterology, Hepatology and Nutrition.

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The American Academy of Paediatrics (AAP) concluded that fruit juices have no nutritional advantages over whole fruit; they lack fibre, are consumed more quickly and do not promote the desirable behaviour of eating whole fruits.[4] The AAP recommended to provide fruit juices only after the age of 6 months when infants can drink from a cup, and only as part of a meal in order to reduce the risk of dental caries induction,[4] whereas others recommended not providing fruit juice before the age of 9 months.[11] In contrast to these recommendations, an increasing use of fruit juices in the infant diet has been reported.[12] Sales of juices for infants in the United States increased from 9.7% of total complementary feeding products in 1971 to 16.7% in 1984 and probably further by 1992.[12]

There is a lack of current data on EPL consumption by infants. We aimed to characterize the practice of introducing EPL to infants in five European countries with similar infant feeding recommendations. Data was collected as part of the prospective European Childhood Obesity Project. We explored whether type of milk feeding, socio-demographic characteristics and the country of residence were associated with EPL use, and whether EPL consumption influences the intake of infant formula or solids.

2. Subjects and methods

2.1. Study design

Data were collected as part of the European Childhood Obesity Project, a double-blind, randomized controlled trial with one group of breastfed (BF) infants and two groups of formula fed (FF) infants randomized to formula with different protein levels as a possible risk factor for later obesity. The methodology of the study has been previously reported.[13,14] In short, eligible participants were healthy, singletons, term infants recruited between 1 October 2002 to 31 June 2004 and followed-up in 11 study centres in 5 European countries (Belgium, Germany, Italy, Poland and Spain). Mothers were contacted at maternity hospitals by trained study personnel, or after hospital discharge by midwives or paediatricians.

After receiving oral and written information of the study and providing written consent, parents were invited to the first medical visit for collection of socioeconomic data, medical history of parents and infant, and infant anthropometry. During the following months, parents and infants were followed at regular intervals in the study centres, as well as by mailed questionnaires on feeding behaviours.

2.2. Dietary intervention

A reference group of infants fully breastfed for at least 3 months (BF) was followed without any intervention. Formula fed infants (FF) were randomized not later than 8 weeks of age to receive two infant formulae and later follow-on formulae with either higher or lower protein levels for the duration of the first year of life.[14] There was no other intervention with respect to the infant diet.

2.3. Data collection

All data other than food protocols were collected by standardized questionnaires. A 3-day weighed food protocol was chosen to collect detailed information on the infant food and nutrient intake. Parents were asked to complete weighed food protocol on 3 consecutive days, including 2 week days and one weekend day, monthly at the ages of 1 to 9 completed months and again at 12 months. Volumes of milk were recorded based on the scale in the feeding bottles. Other food items were weighed on a digital food scale with an accuracy of 1 g (Soehnle unica, No. 66006, Nassau, Germany) given to the parents at the 3-month study visit. Parents were asked to record the time and place of feeding, the intake of all milk, liquid and solid food; for FF infants, the quantity (grams) of water, milk powder or cereals used for the preparation of each formula bottle, the amount (ml) of formula milk offered and the amount actually consumed by the infant. Parents were requested to note any intake of liquid other than breast or infant formula, the product and brand name of the liquid, and the time when it was first introduced. All other food items, their brand names or the recipe in case of home prepared foods, the quantity (grams) of food offered and the quantity consumed by the infant, were recorded. Trained dieticians in all study centres entered the data of the food protocols from their centre using a special software developed for this study. Nutrient content data of foods was derived from the German Food Code and Nutrient data base Bundeslebensmittelschlüssel, BLS II.3 (Federal Institute for Risk Assessment, Berlin, Germany). Nutrient contents of new food items as well as country specific foods were added to the data base as required. Standard Operating Procedures (SOPS) were developed and implemented, and dietary study staff participated in semi-annual training workshops to ensure consistent procedures and quality for data introduction and calculations in all participating centres.

We were unable to measure breast milk volume intake in the study population of the 5 countries under the conditions of the study.

The two infant formula groups with different protein levels did not differ in the intake of EPL, fruit juice, vegetable juice or instant tea. Therefore, we choose to describe the results on EPL intake for the combined group of all formula fed infants.

2.4. Definition of energy providing liquids (EPL)

Complementary foods (3281 food items) consumed during the first year of life by the infants in the 5 countries were classified by their ingredients and categorized into subgroups. For this analysis, EPL were defined as sugared instant tea, fruit juices (100% fruit juice, fruit drinks), vegetable juices provided as drinks (but not as one ingredient of a composed dish), and other sugared beverages (soft drinks, sugared water without or with flavours).

2.5. Socio-demographic data

Mothers were categorized into three education levels (low = preliminary to lower secondary, middle = upper secondary and post-secondary, and high = first and second stage of tertiary education) and by age at birth (I = ≤25, II = >25 to 30, III = >30 to 35 and IV = >35 years).

2.6. Statistics

All analyses were stratified by feeding type (breastfed/formula fed). Chi-square test and multiple logistic regression were used to analyse the time points of EPL introduction. We applied multiple logistic regression models for each month to detect associations between maternal age, education level, smoking behaviour, country of residence and times of introducing EPL. Wilcoxon rank-sum tests were performed to compare the energy intakes of infants with and without EPL consumption. Stata 9.2, SPSS 16.0 and Excel 2000 were used for data analysis.

2.7. Ethics

The study protocol was reviewed and accepted by the ethic committees at all study centres.

3. Results

At least one informative 3-day weighed food protocol was available for 1368 infants (82% of the 1678 infants recruited). Of the

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1184 children with food protocols still participating in the study at 6 months, 875 (74%) completed all 6 monthly food protocols until this age.

4. BF infants

Some 75% of BF infants received EPL during the first year of life. The median age at introduction was 30 weeks. Ten percent of breastfed infants received EPL at 9 weeks, 8% to 10% of the BF infants received EPL (mostly instant tea) during the first 3 months of life (Fig. 1A). From 4 to 6 completed months, the proportion of BF infants introduced to EPL increased from 13% to 36%.

There were marked differences in EPL consumption between countries (Fig. 2A). At the age of 1 month, 8% of BF infants in Italy, 14% in Poland and 10% in Spain, received EPL. At 3 months we found the highest proportions of infants with EPL intake in Poland and Italy and at 4 to 9 months in Poland and Spain.

Also the type of EPL consumed differed considerably between the countries. Not more than 10% of the BF infants in Germany, Belgium and Spain consumed instant tea during the first year of life, whereas 56 % of BF infants in Poland and 29% in Italy received instant tea (Table S1).

At the age of 4 completed months 7% of BF infants received fruit juice. Early introduction (mainly orange juice) was seen especially in Spain, where 23% of all infants received some at the age of 4 completed months (Table S1). The highest proportions of BF infants with an intake of fruit juice were found in the second half of the year in Poland (34% to 66%) and Spain (44% to 61%), and at the end of the first year in Germany (58%), whereas Italian infants showed the lowest proportion (13% to 29%) (data not shown). Vegetable juice (mostly carrot juice) was consumed almost exclusively by

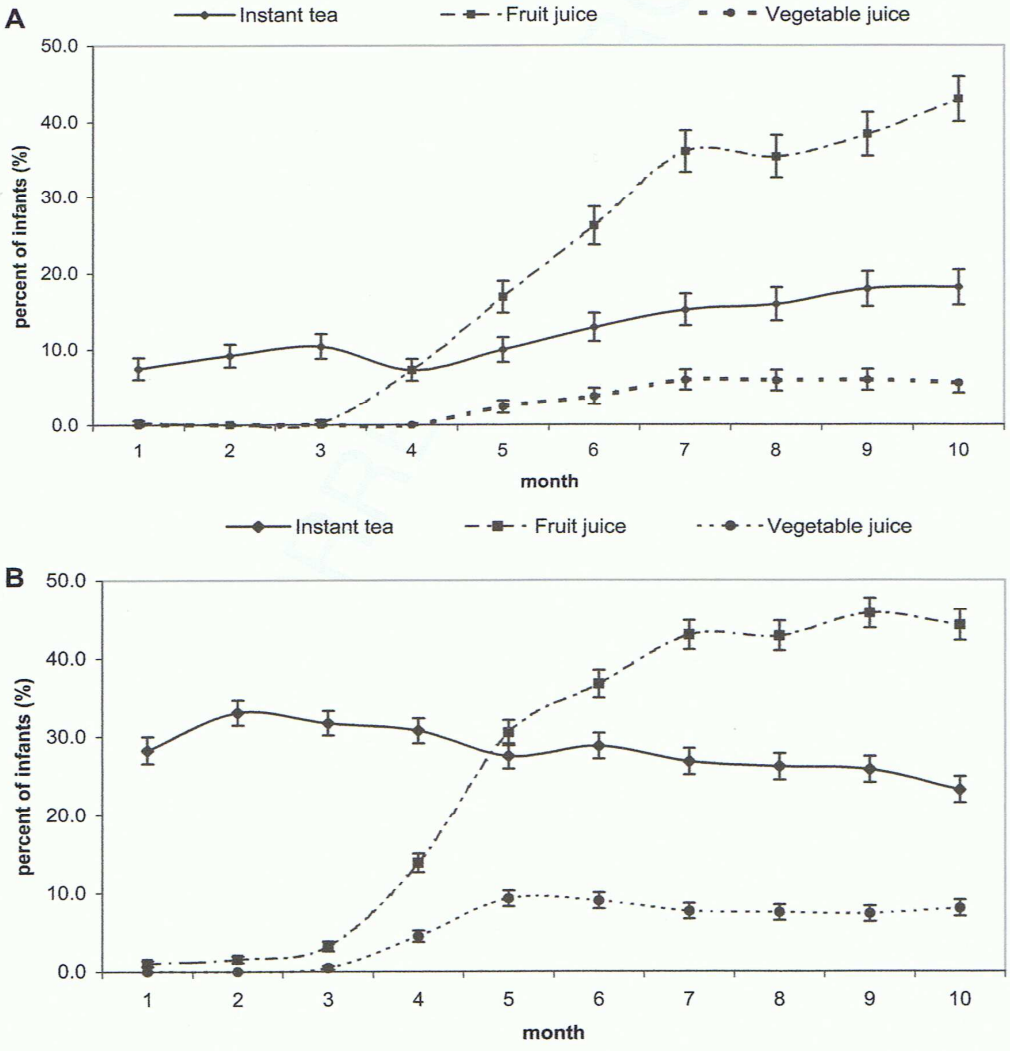

Fig. 1. Percentage (%) and standard error (SE) of breastfed (A) and formula fed infants (B) with intake of instant tea, fruit juice or vegetable juice during the first year of life.

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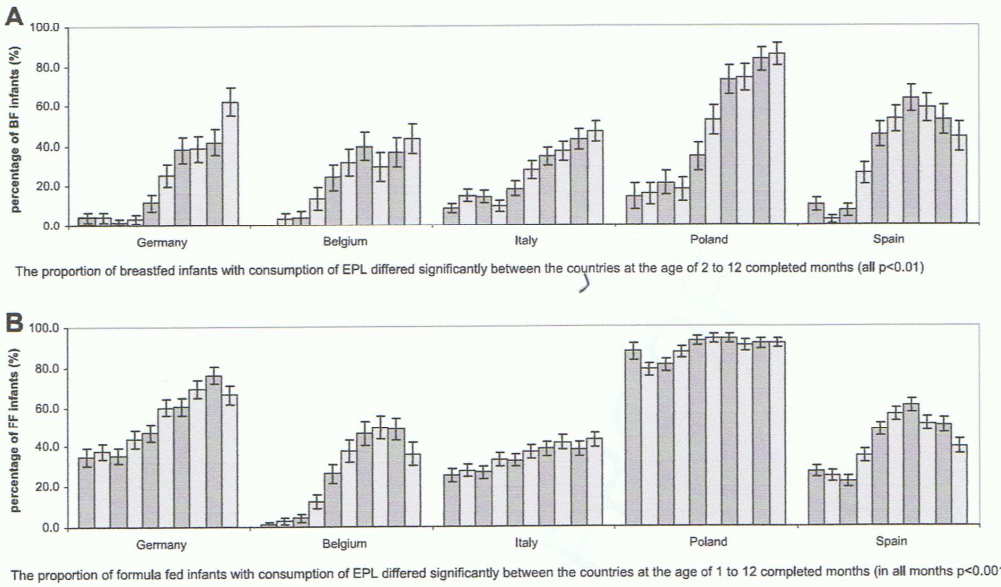

Fig. 2. Percentage (%) and standard error (SE) of breastfed (A) and formula fed infants (B) with intake of energy providing liquid (EPL) by country, at the age of 1 to 9 and 12 completed months.

Polish and German BF infants (Table S1). No BF infants had received vegetable juice until the age of 4 months while 2% of BF infants in Belgium, 7% in Germany and 16% in Poland consumed some vegetable juice at the age of 6 months.

Beverages like soft drinks or sugar-added flavoured waters were hardly consumed at all by BF infants (<0.5 %) during the first year of life.

Applying a multiple logistic regression for each month on the introduction of EPL in BF infants during the first 7 months of life, including the effects of maternal age, education level, smoking behaviour and country of residence, the main predicting factor for introduction of EPL was consistently the country of residence (Table 1). Polish BF infants had a 17-fold higher odds to consume EPL at the age of 3 months than BF infants in Germany. Also, in Italy, we found a 10-fold higher risk for BF infants to receive EPL at the age of 3 months, and in Spain at the age of 4 months, as compared to BF infants in Germany.

We repeated the same analytical approach for instant tea, fruit and vegetable juice. In addition to the effect of country of residence, a low maternal educational level was associated with introduction of EPL and instant tea at the age of 3 completed months (OR 4.3, CI: 1.3-14.0, $p = 0.17$), and maternal smoking was associated with introduction of fruit juice at 4 (OR 3.2, CI: 1.0–9.8, $p = 0.04$) and 6 completed months (OR 2.2, CI: 1.1–4.3, $p = 0.02$) (data not shown).

5. FF infants

During the first year of life, 86% of FF infants received EPL and the median age at introduction was 17 weeks. Some 30.0% of FF infants received EPL at the age of one month and 43% and 57% at the ages of 4 and 6 completed months, respectively. During the first 4 months, instant tea, with up to 33% of the infants, was the predominant EPL consumed by the FF infants (Fig. 1B). Fruit juices (mainly apple and orange juice) were given to 31% of FF infants at 5 months and up to 46% during the following months. Some 5% of all the FF infants consumed vegetable juice (mainly carrot juice or mixtures of carrot juice with fruit juice) at 4 months, and less than 10% during the rest of the year. Other sugared beverages were hardly consumed by FF infants at all (<0.5%).

We found significant differences between the countries in EPL consumption (Fig. 2B). During the first 4 months of life, infants in Poland had the highest proportion receiving EPL (79% to 88%), followed by Germany (35% to 44%), Italy (25% to 33%), Spain (22% to 35%) and Belgium (1% to 12%).

Instant teas were consumed by 88% of FF infants in Poland at the age of one month, and between 70% and 88% during the first year of life (Table S2). During the first 4 months of life, 28% to 32% of FF infants in Germany, 25% to 31% in Italy and 26% to 13% in Spain consumed some instant tea. In Spain, this proportion declined over the year and, in Belgium, less than 5% of all FF infants received instant tea.

At the age of 4 months 14% of FF infants consumed some fruit juice. Italy (0% to 29%) had the lowest proportion of infants getting fruit juice during the first year, whereas infants in Germany (2% to 3%) and Spain (2% to 8%) already received fruit juice during the first 3 months of life (Table S2). At the age of 4 months (17 weeks), 10% FF infants in Germany, 11% in Belgium, 20% in Poland and 24% in Spain consumed some fruit juice. In Italy, only 2% of the FF infants consumed fruit juice at 4 months and 10% at 6 months, as compared to 39%–54% in the other countries.

Vegetable juice was consumed by Polish and German FF infants between the ages of 3 and 12 completed months, but hardly in other countries (Table S2). Applying a multiple logistic regression model for each of the first 7 months, including maternal age, education level, smoking behaviour and country of residence as covariates for the introduction of EPL or instant tea in FF infants during the first year of life, country of residence was the only consistent predictive factor for an earlier introduction of EPL (in all months, $p < 0.001$, Table 1). Compared to Germany, FF infants in Poland had an approximately 6 to 14-fold higher risk for EPL intake. Repeating the analysis only with the introduction of fruit juice in FF infants, the country of residence was also seen to be a risk factor at

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Table 1
Odds ratios (95% confidence interval) for the introduction of energy providing liquid in the countries compared to Germany (reference). Based on logistic regression for each age group (age of 1 to 7 completed months) including maternal age, maternal education level and maternal smoking behaviour.

Age (completed months)	Belgium			Italy			Poland			Spain		
	OR	95% CI	*p*-value	OR	95% CI	*p*-value	OR	95% CI	*p*-value	OR	95% CI	*p*-value
Breastfed infants												
1												
2				**3.92**	(1.08–14.17)	0.04						
3				**9.94**	(1.26–78.51)	0.03	**17.71**	(2.06–152.62)	0.01			
4							**8.20**	(1.57–42.85)	0.01	**10.20**	(2.23–46.70)	0.003
5							**3.46**	(1.14–9.84)	0.02	**6.38**	(2.49–16.38)	<0.001
6							**3.40**	(1.40–8.28)	0.01	**3.13**	(1.41–6.95)	0.01
7							**3.53**	(1.40–8.85)	0.01	**2.74**	(1.26–5.99)	0.01
Formula fed infants												
1	**0.02**	(0.003–0.15)	<0.001				**11.77**	(5.03–27.54)	<0.001			
2	**0.05**	(0.16–0.18)	<0.001				**5.71**	(3.36–9.70)	<0.001			
3	**0.09**	(0.03–0.25)	<0.001				**7.31**	(4.22–12.68)	<0.001	**0.53**	(0.33–0.85)	0.01
4	**0.20**	(0.10–0.41)	<0.001				**8.30**	(4.54–15.17)	<0.001			
5	**0.44**	(0.24–0.80)	0.01	**0.58**	(0.36–0.93)	0.03	**14.13**	(6.85–29.16)	<0.001			
6	**0.40**	(0.22–0.72)	0.01	**0.42**	(0.26–0.67)	<0.001	**9.24**	(4.24–20.12)	<0.001			
7				**0.43**	(0.26–0.69)	<0.001	**9.06**	(3.97–20.66)	<0.001			

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the ages of 3 to 12 months ($p < 0.05$). Intakes of any EPL were not associated with protein contents of study formula, birth weight or birth order. The two formula groups also did not differ regarding the consumption of fruit juice, vegetable juice or instant tea, with the only exception being a significantly higher fruit juice intake in the high protein group at the age of 5 months ($p = 0.026$).

Applying a multiple regression for the first 4 months of life including the effect of country of residence, maternal age and educational level as well as the maternal smoking behaviour, we found that FF infants were 5 times more likely to receive EPL up to 4 months of age (OR:5.1; 95%CI: 4.1–6.3).

6. Energy providing liquid and energy intake

Table 2 shows the total energy intake (kcal/d), the energy intake from EPL, formula milk and solids of FF infants with and without EPL consumption. FF infants receiving EPL had a significantly lower energy supply through infant formula at the ages of 2 to 5 months. This is also seen in Table S3 where the median intake of EPL (ml/d), as well as the intake of infant formula (ml/d) in FF infants with and without EPL, are shown. At the ages of 4 and 5 months, infants receiving EPL consumed a significantly higher energy intake from solids than infants without EPL consumption. But infants with EPL consumption had a significantly lower energy intake from solids at the ages of 7 to 9 and at 12 completed months.

7. Discussion

This study shows that EPL are given to a very high proportion of European infants during the first months of life. Some 13% of BF infants and 43% of FF infants receive EPL by the age of 4 months, even though such a practice is not supported at all by current recommendations.[2] There is no nutritional benefit of feeding EPL or fruit juices to infants during the first months of life, but there is a possible risk of displacing nutrient intakes from breast milk or infant formula.[15–17] Our data analysis revealed a lower formula milk intake (kcal/d) in FF infants who consumed EPL during the first months of life. Furthermore, infants who consumed EPL had a lower solids intake (kcal/d) during the second half of the first year. The significantly lower infant formula intake in infants with EPL coincides with the time of the highest percentage of infants with instant tea intake as EPL. This is of concern, since instant tea provides only rapidly absorbable carbohydrates and none of the essential nutrients supplied with breast milk or infant formula.

Infants who received EPL had significantly higher energy intakes from solids at the ages of 4 and 5 months as compared to infants who did not receive EPL, suggesting that the provision of EPL is associated with an earlier solid introduction in the infant's diet.

There are markedly different feeding practices between the countries. Both in FF and BF infants, country of residence is a consistent predictive factor for the time of EPL introduction (Table 1). These country differences might be due to differences in local traditions of infant feeding or in communication to parents, but are not explained by infant feeding recommendations which are similar throughout these five countries.

Our findings also show that FF infants receive EPL and solids earlier and to a higher proportion then BF infants, although the recommendations do not differ.[18,19] Up to the age of 4 months, FF infants were 5 times more likely to receive EPL than BF infants. Parada et al. also found higher consumption frequencies of tea and juices among bottle fed than among breastfed infants in Brazil during the first months of life.[20] Similarly, Emmett et al. found a higher percentage of British FF infants than BF infants receiving additional drinks other than breast milk or infant formula, and they speculated that this could be due to FF infants being accustomed to drinking from bottles.[21]

In our study group, instant teas were the predominate form of EPL during the first months of life, whereas fruit and vegetable juices were increasingly introduced from 3 to 4 completed months onwards and consumed in higher proportions during the second half of the first year (Figs. 1 and 2). Instant teas might be used in young infants with excessive crying, based on the assumption that infants should get some liquid in addition to breast milk or formula, whereas older infants might get fruit juice as a nutritional supplement or because it may be perceived to be more similar to complementary foods given at older ages. Parada et al. found higher percentages of Brazilian infants with an intake of teas from birth to the age of 4 months (29% for BF infants and 47% for FF infants) compared to our infants, and even up to 69% of the infants with an intake of fruit juices during the second half of the first year.[20] In the Feeding Infants and Toddlers Study (FITS), Menella et al. analysed the foods fed to Hispanic and non-Hispanic infants in the United States, and found similar percentages of infants with fruit juice intake as we found for our FF infants, but a much higher proportion of infants who consumed vegetable juice, even compared to our

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Table 2
Intake of total energy (kcal/d), energy providing liquids (kcal/d), solids (kcal/d) and formula milk (kcal/d) by infants with and without intake of energy providing liquid (EPL), presented as median and interquartile range (IQR).

Age (completed months)	N	Infants with EPL intake		N	Infants without EPL intake		p Value[a]
		Total energy intake (kcal/d)			Total energy intake (kcal/d)		
		(Median)	(IQR)		(Median)	(IQR)	
1	181	**530**	(450;586)	506	**514**	(445;575)	
2	275	**560**	(487;619)	633	**548**	(489;619)	
3	277	**570**	(508;637)	642	**576**	(522;643)	
4	330	**618**	(545;682)	570	**611**	(554;674)	
5	384	**664**	(602;740)	498	**656**	(581;712)	*
6	430	**700**	(612;794)	446	**678**	(610;762)	
7	394	**743**	(656;832)	417	**747**	(645;833)	
8	371	**781**	(696;887)	387	**787**	(682;878)	
9	375	**802**	(693;908)	396	**792**	(699;903)	
12	338	**870**	(750;988)	418	**862**	(747;978)	
		EPL intake (kcal/d)					
1		**10**	(5;16)				
2		**14**	(8;22)				
3		**15**	(9;27)				
4		**21**	(13;34)				
5		**27**	(16;47)				
6		**28**	(16;50)				
7		**30**	(17;51)				
8		**31**	(18;59)				
9		**37**	(19;66)				
12		**46**	(25;72)				
		Formula milk intake (kcal/d)			Formula milk intake (kcal/d)		
1		**517**	(435;576)		**513**	(443;574)	
2		**537**	(467;599)		**544**	(487;616)	*
3		**545**	(484;608)		**574**	(520;640)	*
4		**563**	(489;625)		**591**	(530;654)	*
5		**506**	(427;601)		**562**	(474;640)	*
6		**463**	(381;537)		**468**	(365;548)	
7		**368**	(305;471)		**358**	(290;458)	
8		**350**	(273;459)		**340**	(261;429)	
9		**334**	(252;432)		**334**	(259;392)	
12		**272**	(167;361)		**256**	(167;344)	
		Solids intake (kcal/d)			Solids intake (kcal/d)		
1		–	–		–	–	
2		–	–			–	
3		–			–	–	
4		**0**	(0;43)		**0**	(0;22)	*
5		**110**	(52;175)		**65**	(0;146)	*
6		**195**	(121;267)		**207**	(116;309)	
7		**305**	(211;421)		**363**	(231;482)	*
8		**366**	(269;486)		**426**	(324;534)	*
9		**403**	(293;526)		**465**	(361;576)	*
12		**536**	(422;688)		**607**	(478;733)	*

[a] Comparison was done with the Wilcoxon rank-sum test (*$p < 0.05$).

highest percentage of infants with an intake of vegetable juice who were found in Poland.[22]

Sweet drinks are not recommended in the infant diet because they contribute few nutrients other than energy, whereas appropriate intake of breast milk or infant formula as well as complementary foods should provide the infants with an adequate nutrient intake.[2,23–26] Educational level of the caregiver, affordability of products, consumption habits of parents, guidance by health care professionals, as well as product advertising and marketing all may influence the consumption habits of sweet drinks.[27,28,15,16]

In conclusion, this study shows that, in contrast to current recommendations, EPL are provided surprisingly early and at a surprisingly high rate to infants during the first year of life, particularly in FF infants. The provision of EPL is associated with a lower energy intake from infant formula, earlier introduction of solids, and less energy intake from solids during the second half of the first year of life. Infant feeding practices should be improved by informing health care professionals, parents, and manufacturers of infant food products.

Conflict of interest

None of the authors has declared a conflict of interest. The project was granted by the Ethical Committee of the Bavarian Board of physicians.

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Appendix. Supplementary data

Supplementary data associated with this article can be found in the online version, at doi:10.1016/j.clnu.2010.04.003.

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Introduction of potential allergenic foods in the infants diet during the first year of life in five European countries

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Running title: Allergenic foods in the infants diet

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Abstract

Background: Little information is available on the ages of introduction of potentially allergenic foods as part of complementary feeding in European infants. **Objectives**: To describe the age of introduction of potentially allergenic foods in healthy term infants in five European countries. **Method**: Recruitment was conducted from October 2002 to June 2004. We analyzed the age of introduction of potentially allergenic foods (gluten, milk, egg, fish, soy and nuts) in breastfed infants (BF) and in formula fed infants (FF). A total of 1678 infants were recruited. In 1368 infants at least one 3-day weighed food diary monthly at the age of 1 to 9 and again at 12 completed months was available. **Results**: Some 6% of BF infants and 13% of FF infants consumed some allergenic foods already at the age of 4 completed month. Mothers with a history of allergy introduced allergenic foods earlier to their infants than mothers without allergy history. Introduction of allergenic foods during 4 to 6 months differed between countries (in BF infants and FF infants, $p<0.001$). **Conclusion**: The time of the introduction of allergenic foods in infants differs between countries and was earlier than recommended in a considerable number of infants. FF infants received allergenic foods earlier than BF infants. Better information and counseling of parents is desirable.

Introduction

Allergic manifestations in children have increased in both industrialized and developing countries [(1)]. Diet in infancy may affect the manifestation of allergic diseases[(1-6)]. In 2001, the WHO issued a revised global recommendation that infant populations should be exclusively breastfed during the first 6 months of life before any complementary feeding is introduced[(7)]. No advice was provided on the introduction of complementary foods considered as potentially allergenic foods containing cow's milk protein, gluten, hen's egg, fish, nuts or soy beans[(8,9)]. Very early introduction of multiple complementary foods before the age of 4 months has been associated with an increased allergy risk. A study in 1265 term infants in New Zealand found the feeding with more than 4 complementary foods at the age of 4 months associated with a significantly increased eczema risk at the age of 10 years[(4)]. Likewise, the introduction of more than 4 complementary foods at the age of 4 months was associated with an increased risk for atopic eczema at 1 years in 257 preterm infants in the UK[(10)]. In accordance with these observations, exclusive breastfeeding for 15 weeks and without provision of solid foods up to this age was associated with significant reduced respiratory illness during childhood[(11)].

Different recommendations have been given on the optimal time of introduction of potentially allergenic foods to infants. A review of the European Academy of Allergology and Clinical Immunology concluded that the most effective dietary measure for the prevention of allergic diseases even in high-risk patients is exclusive breastfeeding until preferable 6 months, but at least for 4 completed months with avoidance of solid foods and cows' milk in that time period[(9,12)]. Some organisations have recommended delayed introduction of allergenic foods after the age of 6 months or even after 12 months in infants with a family history of allergy[(13-15)]. However, some recent studies showed no association of delayed introduction of complementary foods with later allergy, or in some cases even an increased risk of allergic reactions which however might be related to reverse causation[(1,16-21)]. More recent recommendations have not supported delaying the introduction of allergenic foods beyond the age of 4-6 completed months[(1,5)].

Little is know on the current practice of introduction of such foods products in infants, which we aimed to describe in apparently healthy term infants in five European countries participating in the European Childhood Obesity Project. The study included infants from countries in central, western, eastern and southern Europe with different feeding traditions.

Subjects and Methods

Study design: We analysed the consumption of potential allergenic foods as part of the complementary feeding versus recommendations in apparently healthy infants. Data were collected as part of the EU Childhood Obesity Project (CHOP), a double blind randomized controlled clinical trial with the aim to evaluate the influence of protein intake on the weight and growth development of infants and the risk for future obesity[22,23]. In brief, recruitment of healthy infants born at term occurred between the 1st of October 2002 and the 31st of July 2004 in 11 study centres in Germany (Munich and Nuremberg), Belgium (Brussels and Liège), Italy (Milano), Spain (Tarragona and Reus) and Poland (Warsaw).

Invited for the study were healthy, singleton, term infants with mothers $\geq$ 18 years, with good knowledge of the national language and resident in the area. Exclusion criteria were mothers with hormonal or metabolic diseases or illicit addiction during pregnancy[22].

Mothers were approached by study personnel at the maternity hospitals before their discharge or via paediatricians and midwifes. After oral information and written consent, mothers and infants were invited for an initial medical visit with collection of anthropometric measurements and socio-demographic data as well as data about the medical history of parents and infants, pregnancy and delivery. In the following months, parents and infants were followed up regularly with visits in the study centres and mailed questionnaires, including 3-day weighed food diaries at the age of 1,2,3,4,5,6,7,8,9 and 12 months.

Study population: The study group comprised of two groups of infants fed formulae with different protein level and one reference group of breastfed infants[22]. Infants had to be exclusively breastfed for at least 3 completed months, and formula fed infants were randomized to one of the study formula milks before the age of 8 weeks. Infants who received a formula other than the assigned study formula for more than 5 days were excluded of the study. The study formulae were provided by Bledina, Steenvorde, France for the duration of the first year of life.

Data collection: Anthropometric data and data from standardized questionnaires were introduced at each study centre and transferred into a central data base (R.D.E. Software GmbH, Munich, Germany). At the age of 1 to 9 and 12 months (±14 days) parents were asked to complete a 3 day food protocol (including 2 week days and 1 weekend day). The food protocols were then introduced in our own software by nutritionists at the different study centres and transferred into a central data base. Standard Operating Procedures (SOPs) were developed to harmonize the calculation and introduction of food intake data.

Allergenic foods: Complementary foods (CF) consumed during the first year of life by the infants of all 5 countries (3281 food items) were classified by their ingredients experienced nutritionists in each of the study centres. We defined potential allergenic CF as any foods

containing gluten, milk protein, egg, fish, soy protein, or nuts. For the evaluation of milk introduction we included any milk or dairy product other than infant or follow-on formula. This included primarily cow's milk and products derived from cow's milk and in a few cases milk from goat, sheep or buffalo and their products.

We defined as soy product any food item containing soy (e.g. soy milk, soy yogurt, lecithin of soy, soybean oil, etc) and as soy protein any food item containing soy protein (e.g. soy milk, soy formula, soy yogurt, tofu, dessert from soy milk, etc.).

Socio-demographic data: We grouped mothers in four categories based on age at delivery: I= ≤25, II= >25 to 30, III= > 30 to 35 and IV= > 35 years. Maternal educational levels were categorised in 3 groups: *no/low* =pre-preliminary to lower secondary (no schooling to elementary education), *middle* = upper secondary and post-secondary (high school) and *high* = first and second stage of tertiary education (college, university or institutes of technology).

Statistics: To avoid cofounders, we decided to analyse BF and FF infants in separate groups. Mainly Chi square test and logistic regression analysis were used to investigate differences in the introduction of potential allergenic foods. Stata 9.2, SPSS 16.0, and Excel was used for data analyses.

Ethics: The study was approved by the ethic committees of all study centres. Written informed parental consent was obtained for each infant.

Results

A total of 1678 infants, 438 breast fed and 928 formula fed infants, and their mothers/parents were recruited and their data analyzed. At least one 3-day food diary was available for evaluation in 1368 (82%) infants. At the age of 3 completed months 1183 3-day weighed food diaries could be evaluated, at 4 completed months 1135, at 6 completed months 1074, at 9 completed months 966 and at 12 completed months 944 (**Table 1**). At the age of 2 and 3 months we analysed the food protocols from 95% (1127/1184) of all infants in the study, from 77% (983/1275) between the age of 3 to 6 months, 72% (808/1116) between 3 to 9 months and from 70% (756/1085) up to 12 months of age.

Some socio demographic characteristics of the study BF and FF infants were reported before elsewhere [22,23] and are shown divided by country in **Table S1**.

BF infants

In our study population 92% of the BF infants were breastfed until the age of 20 weeks and 75% until the age of 28 weeks.

At the age of 4 completed months, we found some 6% of BF infants consuming at least one potential allergenic food and 51% at the age of 6 completed months (**Figure 1**). The median for the introduction of potential allergenic food was at the age of 28 weeks (95% CI 27.3;28.7) for BF infant.

Data from the food protocols showed no BF infant with intake of food with **gluten** at the age of 3 completed months, 4% of BF infants at the age of 4 completed months and 32% at the age of 6 completed months received food with gluten (**Figure 1**)**.**

We found significant differences between the countries in the proportions of BF infants with intake of food with gluten (at the ages of 4 to 9 months ($p<0.001$) (**Table 2**). At the age of 4 completed months, 22% of the BF infants in Belgium, 6% in Spain and 2% in Italy consumed some food with gluten. At the age of 6 completed months we found the highest proportion of BF infants with intake of food with gluten in Belgium (58%) and the lowest in Poland (7%) (**Table 2**).

At the age of 4 and 6 completed months, 3% and 39% of the BF infants, respectively, consumed some **milk** or food with milk or milk product other than breast milk or formula milk (**Figure 1**). We found significant differences in the percentages of infants with consumption of milk or milk products between the countries at the age of 4 to 12 months ($p<0.01$)(**Table 2**). At the ages of 4 and 5 completed months we found the highest proportions of BF infants with intake of milk or food with milk or milk product in Belgium (19% and 22% respectively (**Table 2**). In the second half of the first year, Italy had the highest proportion of BF infants with milk or food with milk or milk product consumption (77% to 99%). In contrast, in Poland (0% to 59%) and Germany (20% to 56%) we found the lowest proportions of infants with intake of milk or food with milk or milk product at the age of 6 to 9 months of life.

Some 1% and 4% of the BF infants consumed some **egg** or food with egg at the ages of 4 and 6 months respectively (**Figure 1**). The time points for introduction of egg or food with egg were significantly different between the countries (4 to 12 months $p<0.005$) (**Table 2**). At the age of 4 and 5 completed months, only infants in Belgium received some egg or food with egg (5% and 7% respectively) and at the age of 6 completed months they had the highest proportion of infants with consumption of egg or food with egg (21%) while in the other countries not more than 2% of all BF infants consumed some egg or food with egg. At the age of 7 to 12 completed months, Poland (30% to 76%), Belgium (29% to 76%) and Germany (10% to 62%) had the highest proportions of infants with egg or food with egg intake, whereas in Italy and Spain no more than 10% of the BF infants had received some egg or food with egg until the age of 9 months.

No **fish** or food with fish was eaten until the age of 4 completed months, and only 2% of among all BF infants received fish or food with fish at the age of 6 completed months (**Figure 1**). Separated by country, 6% in Belgium, 4% in Spain and 2% in Italy consumed

some fish or food with fish at the age of 6 completed months (**Table 2**). At the age of 7 to 12 completed months, Italy (17% to 71%), Belgium (15% to 48%) and Spain (4% to 73%) had the highest proportions of infants with fish or food with fish intake. In Germany and Poland, no more than 10% of the infants consumed fish or food with fish during the first year of life.

Nuts or some food with nuts were consumed by less than 4% and 8% of the BF infants at the ages of 9 and 12 months, respectively. During the first year of life we found the highest proportions of infants with nut or food with nut intake in Belgium (17%) and Germany (14%) and the lowest in Italy (3%), Poland (5%) and Spain (4%).

Many infants in Belgium (up to 54%) and Germany (up to 37%) consumed **soy products** or food with soy included during the first year of life, whereas in the other countries no more than 5% of the BF infants consumed soy products or food with soy included. However, not more than 4% of the BF infants consumed **soy protein** or food with soy protein (soy formula milk, soy milk dessert, ingredient of a dish) during the first year. There were very low proportions of infants with intake of food with soy protein (**Figure 1**). In Italy we found 1 to 3% of the BF infants with intake of food with soy protein from the age of 4 to 12 months, we found the highest proportion in Belgium with up to 11% (**Table 2**).

The intake of food with gluten, milk, egg and fish was not associated with maternal age at birth, educational level and smoking habit, nor with the infant's birth weight and birth order of the infants.

Some 46% of the BF infants had a parent with a history of allergy (29% of mothers and 27% of fathers had adverse reaction to some food, doctor's diagnosis of asthma, of hay fever, of allergy or of atopic dermatitis). The proportions of mothers, but not of fathers, with a history of allergy differed between countries ($p<0.001$).

We found a higher proportion of infants of mothers with history of allergy introducing any potential allergenic food at the ages of 5 to 8 completed months (it was significant higher at the age of 5 months, $p<0.001$ and 7 months, $p<0.05$) compared to mothers without history of allergy. There was no significant association between the time point of introduction of potential allergenic foods and the history of allergy in the fathers.

FF infants

In our study cohort 249 (23%) children were exclusively formula-fed since birth, all others gradually switched from breastfeeding to formula feeding within the first 8 weeks of life. The median age was 14 days (IQR: 3-30 days) at randomization and 16 days (IQR: 2-29 days) at the baseline visit.

Some 13% of FF infants consumed at least one potential allergenic food at the age of 4 completed months and 59% at the age of 6 completed months (**Figure 1**). The median for

the introduction of potential allergenic food was at the age of 26 weeks (95% CI 25.2;26.2) for FF infant. It was significantly earlier compared to the BF infants (p<0.001).

We found 0.3% FF infants with consumption of food with **gluten** at the age of 1 month, 0.8% at 2, 2% at 3 and 11% at the age of 4 completed months. At the age of 6 completed months already 43% of the FF infants consumed some food with gluten (**Figure 1**).

There were significant differences between countries in the proportions of FF infants with consumption of products containing gluten in the first 9 months of life (p<0.001) (**Table 3**). Belgium had the highest proportions of infants with intake of food with gluten in the first 5 completed months of life (up to 38%). At the age of 4 completed months in Belgium, Germany and Italy more than 10% to 25% of FF infants had been fed some food with gluten. At 6 completed months, Germany (70%) had the highest and Poland (27%) and Spain (28%) the lowest proportions of FF infants with food intake with gluten.

Milk or any food with milk or dairy product other than infant formula was consumed by 7% and 44% of the FF infants respectively, at the ages of 4 and 6 completed months (**Figure 1**). The proportions of FF infants with intake of milk, food with milk or dairy products were significantly different between the countries (2 to 12 months of age p<0.05). At the age of 2 to 4 completed months, Belgium had the highest proportions of infants with intake of some milk other than formula milk (3% to 14%) (**Table 3**). During the age of 5 to 12 completed months Germany (39% to 96%) and Italy (88% to 100%) had the highest proportions of infants with with consumption of milk, food with milk or dairy products intake, Poland (5% to 93%) and Spain (7% to 91%) the lowest. In Italy more than 90% of the FF infants had received some milk or dairy products at the age of 7 completed months.

At the age of 5 to 8 months, we found significant higher proportions of FF infants with milk, food with milk or dairy products intake with low and middle maternal education level compared to infants of mothers with a higher educational level (p<0.05).

Less than 1% of FF infants consumed some food with **egg** during the first 4 months of life, not more than 4% at the age of 6 completed month (**Figure 1**) and less than 10% in each country (**Table 3**). In the second half of the first year, we found the highest proportions of FF infants with intake of egg or some food with egg in Poland (43% to 90%), Belgium (8% to 64%) and Germany (8% to 73%) and the lowest in Italy (1% to 42%) and Spain (0% to 30%) (**Table 3**).

No infant consumed any **fish** or some food with fish until the age of 4 completed months and not more than 2% at the age of 6 completed months (**Figure 1**). Belgium (19% to 49%), Italy (17% to 56%) and Spain (8% to 74%) had the highest proportions of FF infants with fish or some food with fish intake during months 7 of 12 of age (**Table 3**).

Nuts or some food with nuts were consumed by less than 7% of all FF infants during the first year of life. The highest proportions of infants with nut intake or of some food with nuts were in Belgium (22%; through Muesli, cookies, Nutella, pudding, syrup) and Germany (18%;%; through cakes or cookies, Müsli, Nutella, pudding, bread) and there were less than 3% in the other countries during the first year of life.

Some 2% and 6% of all FF infants consumed **soy products** or some food with soy products at the age of 4 and 6 completed months respectively. At the age of 4 and 6 completed months, 1% and 10% of FF infants in Germany consumed some soy products or some food with soy products and 12% and 43% in Belgium. In the other countries there was no food with soy products consumption during the first 6 months of life.

Less than 1% of all FF infants consumed some food with **soy protein** (soy formula, tofu, dessert from soy milk) during the first year (**Figure 1**). We found only in Germany and Belgium FF infants (not more than 3%) with intake of food with soy protein during the first year of life (**Table 3**).

We did not find any significant associations between the intake of food with gluten, milk, egg and fish and birth weight, birth order or smoking habits of the mother.

Some 39% of FF infants had a parent with a history of allergy (25% of mothers, 20% of fathers). The proportions of mothers ($p<0.001$) and fathers ($p=0.003$) with history of allergy differed between countries. A greater proportion of FF infants with a maternal history of allergy had received allergenic foods at the ages of 3 to 9 completed months (4th to 6th month, $p<0.05$ and 8th month $p<0.05$) than of infants without maternal history of allergy. In contrast, there was no association of time of introduction of allergenic foods and the father's history of allergy.

Discussion

Potentially allergenic foods containing gluten, milk and egg were introduced earlier in formula fed than in breast fed infants, and earlier in infants of mothers with some history of allergy than in those without a maternal allergy history in our study population. Large differences in the times of introducing allergenic foods existed between the five countries studied.

It is recommended not to introduce complementary foods before the age of 4 to 6 completed months [5,9], but 6% of BF infants and 13% of FF infants had received allergenic foods (mainly foods with gluten and cow's milk) already at 4 months. Some 10% and 32% of BF infants, and 26% and 43% of FF infants, received gluten containing foods at the age of 5 or 6 months, respectively. The highest proportion of FF infants with gluten intake already in the first 3 months of age was found in Belgium (up to 10%), which was due to early consumption of flour mixtures, cereals for infant porridge and cookies. Such a very early consumption of

gluten containing foods before the age of 3 months was associated with increased occurrence of islet auto antibodies[24] and with increased risk of celiac disease and wheat allergy[25,26]. The consumption of milk or dairy products as a sole food or as an ingredient of some food item other than infant formula was highest in Belgian BF infants at the ages of 4 and 5 months, as well as in the Belgian FF infants at the ages of 2 to 4 completed months, due to the consumption of milk-cereal meals, cookies, dairy products, or as an ingredient of mixed meals. From the age of 6 completed months onwards, the highest proportions of infants with consumption of milk protein was found in Italy, related to the common use of milk-porridge and the addition of cheeses to infant's meals. In the total study population, some 84% of FF infants and 76% of BF infants consumed milk other than infant formula at the age of 9 months, and about 95% at the age of 12 months. Thus, nearly all infants received some cow's milk protein during the first year of life, mostly as part of a milk-cereal meal, as milk product (yogurt, curd mixture or cheese) or as an ingredient of a product or meal.

It is recommended that cow's milk should not be given as a drink during the first 12 months of age [5], even though this recommendation appears to have little relevance for the risk of allergy. In contrast to these recommendations, at 4 and 6 months some 3% and 39% of BF infants and 6% and 44% of FF infants, respectively, received milk or dairy products. Between the ages of 5 to 8 months, mothers with an allergy history introduced milk or dairy products earlier to their BF infants than mothers without an allergy. As one might expect, we found a higher proportion of mothers with history of allergy among BF infants, who tend to have a higher socioeconomic family background that is associated with allergy risk, than among FF infants. Interestingly, mothers with a history of allergy introduced significant

earlier potential allergenic foods to the infant diet than mothers without allergenic history. Almost no food with egg, fish and soy protein was consumed during the first 6 months by BF and FF infants. Around 52% of BF infants and 56% of FF infants consumed some egg or food with egg and 48% of BF infants and 44% of FF infants consumed some fish or food with fish at the end of the first year of life. We found significant differences between countries in consumption of egg or fish during the second half of the first year of life. The highest proportion of infants getting fish were found in Italy, Belgium and Spain, which is in line with the respective national recommendations. The introduction of fish was recommended in Belgium after 6 months, in Italy not before 7 to 8 months, in Spain not before 9 to 10 months, and in Poland not before 2 years[27-30]. Regional food habits and the geographic distance of the study centres to the sea may also have influence the feeding of fish.

Infants and their families were included into this study in the areas of the participating study centres, and thus the study populations may not necessarily be representative of the total infant population in the respective countries. Moreover, only infants and their families who met the inclusion criteria, including the provision of voluntary informed consent, were included, which may have introduced a selection bias.

Three-day weighted dietary records considered as one of the most reliable methods for capturing eating habits of children or adults were used in this study. With respect to the question addressed here, one possible limitation of this method is that foods that are not regularly eaten may not be captured during the 3 days of the recording, which might lead to an underestimation of the proportion of infants with early introduction. However, food intake during the first months of life is quite uniform, and hence a 3 day food protocol is considered to be representative of the eating habits of infants. Moreover, for a high percentage of infants monthly food protocols were available (in 95% during the first months and in 70% between 3 to 12 months of age).

In conclusion, we found an introduction of allergenic foods earlier than recommended in a sizeable portion of European infants, particularly in FF infants. Better information and counselling of young families appears desirable to improve the practice of infant feeding and associated health outcomes.

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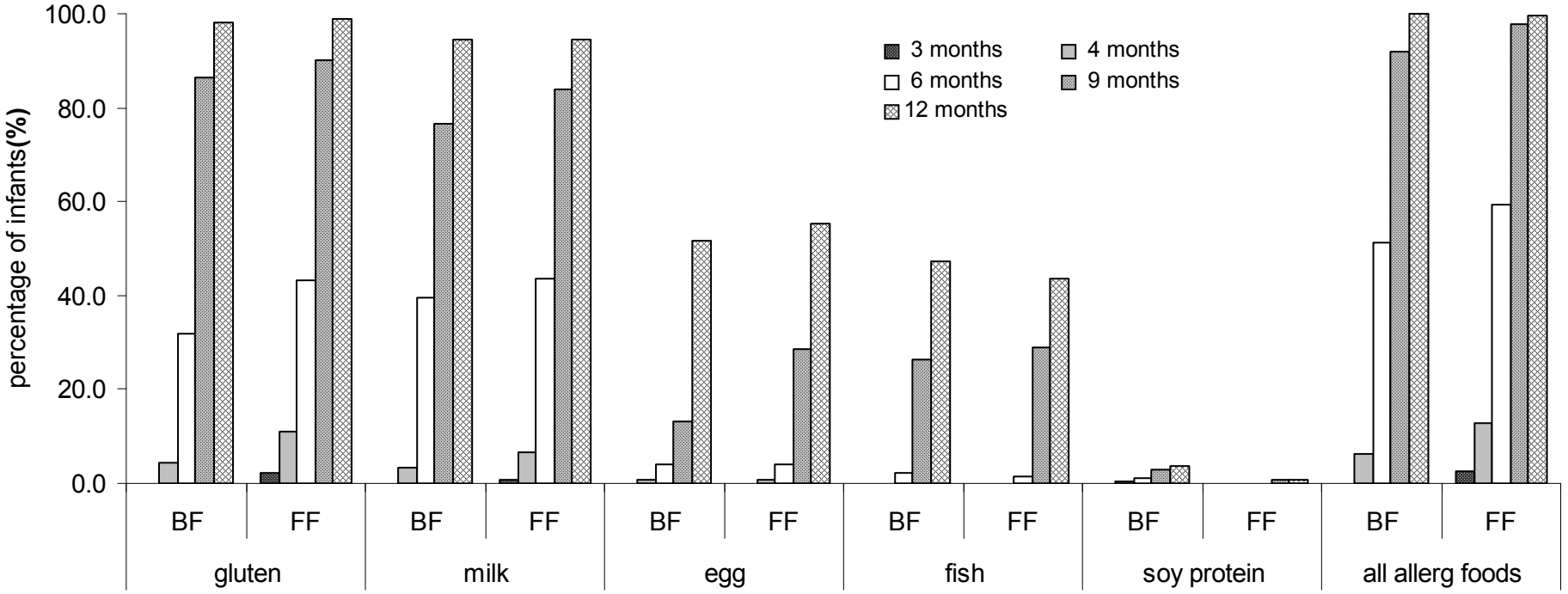
Conflicts of interest

None of the authors has declared a conflict of interest.

Table 1: Number of infants, and percentage contributions by country, of evaluated 3-day food protocols at the age of 4, 6, 9 and 12 months

	Age (completed months)									
	3		4		6		9		12	
BF infants	**N**	*%*	**N**	*%*	**N**	*%*	**N**	*%*	**N**	*%*
Germany	64	*19%*	61	*19%*	59	*19%*	55	*19%*	50	*17%*
Belgium	27	*8%*	37	*11%*	48	*15%*	44	*15%*	46	*16%*
Italy	126	*38%*	116	*35%*	109	*34%*	98	*35%*	101	*35%*
Poland	48	*14%*	45	*14%*	44	*14%*	41	*14%*	41	*14%*
Spain	71	*21%*	70	*21%*	57	*18%*	46	*16%*	48	*17%*
	336	*100%*	329	*100%*	317	*100%*	284	*100%*	286	*100%*
FF infants										
Germany	140	*16%*	132	*16%*	126	*17%*	109	*16%*	102	*15%*
Belgium	96	*11%*	91	*11%*	81	*11%*	75	*11%*	68	*10%*
Italy	207	*24%*	200	*25%*	193	*25%*	183	*27%*	180	*27%*
Poland	162	*19%*	154	*19%*	146	*19%*	129	*19%*	132	*20%*
Spain	244	*29%*	231	*29%*	213	*28%*	187	*27%*	178	*27%*
	849	*100%*	808	*100%*	759	*100%*	683	*100%*	660	*100%*

Figure 1: Percentage (%) of breastfed and formula fed infants with intake of typically allergenic foods during the first year



All allergenic foods (all allerg foods): all foods containing gluten, milk, egg, fish and soy protein

Table 2: Percentages (%) of breastfed infants with intakes of potential allergenic foods at the ages of 4, 6, 9 and 12 months

	Age (completed month)			
Gluten	**4** [a]	**6** [a]	**9** [b]	**12**
Germany	-	28.8	85.5	100.0
Belgium	21.6	58.3	90.9	97.8
Italy	1.7	34.9	94.9	100.0
Poland	-	6.8	75.6	92.7
Spain	5.7	26.3	76.1	97.9
Milk	**4** [b]	**6** [a]	**9** [a]	**12** [b]
Germany	-	20.3	56.4	84.0
Belgium	18.9	43.8	75.0	95.7
Italy	1.7	77.1	96.9	99.0
Poland	-	-	58.5	95.1
Spain	2.9	14.0	73.9	93.8
Egg	**4** [b]	**6** [a]	**9** [a]	**12** [a]
Germany	-	1.7	18.2	62.0
Belgium	5.4	20.8	43.2	76.1
Italy	-	0.9	10.2	32.7
Poland	-	2.3	53.7	75.6
Spain	-	-	8.7	37.5
Fish	**4**	**6**	**9** [a]	**12** [a]
Germany	-	-	1.8	10.0
Belgium	-	6.3	25.0	47.8
Italy	-	1.8	52.0	71.3
Poland	-	-	-	2.4
Spain	-	3.5	26.1	72.9
Soy protein	**4**	**6**	**9**	**12** [c]
Germany	-	-	-	2.0
Belgium	-	-	6.8	10.9
Italy	0.9	2.8	3.1	3.0
Poland	-	-	4.9	2.4
Spain	-	-	-	-

Chi square: [a] $p<0.001$ [b] $p<0.01$ [c] $p<0.05$

Table 3: Percentages (%) of formula fed infants with intakes of potential allergenic foods at the ages of 4, 6, 9 and 12 month

	Age (completed months)			
Gluten	**4** [a]	**6** [a]	**9** [a]	**12**
Germany	13.7	69.6	97.2	99.0
Belgium	24.4	51.3	97.3	98.5
Italy	10.5	51.3	96.7	99.4
Poland	5.2	26.7	81.4	98.5
Spain	9.1	28.2	85.6	98.9
Milk	**4** [a]	**6** [a]	**9** [b]	**12** [a]
Germany	11.5	58.4	92.7	96.0
Belgium	14.4	31.3	79.7	91.0
Italy	9.5	87.6	97.3	100.0
Poland	0.6	15.8	72.1	93.2
Spain	1.7	18.8	75.9	91.0
Egg	**4**	**6** [a]	**9** [a]	**12** [a]
Germany	2.3	8.0	32.1	73.3
Belgium	1.1	7.5	59.5	64.2
Italy	0.5	0.5	9.3	41.7
Poland	-	9.6	65.9	90.2
Spain	-	-	8.0	30.3
Fish	**4**	**6** [c]	**9** [a]	**12** [a]
Germany	-	-	5.5	8.9
Belgium	-	3.8	40.5	49.3
Italy	-	2.6	45.9	55.6
Poland	-	-	2.3	11.4
Spain	-	0.9	40.1	73.6
Soy protein	**4**	**6**	**9**	**12** [b]
Germany	-	-	1.8	3.0
Belgium	1.1	1.3	2.7	3.0
Italy	-	-	-	-
Poland	-	-	-	-
Spain	-	-	0.5	-

Chi square: [a] $p<0.001$ [b] $p<0.01$ [c] $p<0.05$

Table S1: Sociodemographic characteristics of breastfed infants and formula fed infants

		BF infants						FF infants					
		Germany	Belgium	Italy	Poland	Spain	p value	Germany	Belgium	Italy	Poland	Spain	p-value
		%	%	%	%	%		%	%	%	%	%	
Mothers age (years)	≤25	7.6	17.6	4.2	6.4	7.6	<0.001	17.5	16.1	4.7	42.3	11.0	<0.001
	>25 to 30	15.9	35.8	21.1	62.7	18.2		33.1	34.6	28.1	34.5	33.3	
	> 30 to 35	42.6	36.6	48.7	21.4	50.2		33.7	39.0	35.5	17.6	37.1	
	> 35	33.9	10.0	26.0	9.5	24.0		15.6	10.2	31.6	5.6	18.6	
Foreign parents	yes	2.3	12.8	3.0	0.0	3.5	<0.001	11.7	2.5	5.5	0.0	0.9	<0.001
Mothers educational level	low	4.8	5.6	12.6	1.7	15.6	<0.001	30.4	12.4	30.3	24.7	37.3	<0.001
	middle	40.7	43.5	63.8	35.2	33.1		58.6	54.6	57.3	51.1	46.9	
	high	54.5	50.9	23.6	63.2	51.3		11.0	32.9	12.4	24.2	15.8	
Fathers educational level	low	0.0	9.3	24.0	1.9	22.3	<0.001	26.0	10.6	35.1	26.7	45.3	<0.001
	middle	27.4	39.2	59.4	42.5	37.1		54.7	60.6	51.0	61.0	43.6	
	high	72.6	51.5	16.6	55.6	40.6		19.2	28.8	13.9	12.2	11.1	
Household size	2 members	1.8	2.0	0.0	0.0	0.0	<0.001	6.9	2.4	0.0	0.0	1.4	<0.001
	3 members	56.4	55.5	59.8	57.7	55.6		51.0	48.2	57.7	37.6	50.4	
	4 members	29.1	32.7	29.8	18.1	32.9		27.2	27.0	32.9	27.0	37.1	
	> 4 members	12.7	9.7	10.4	24.2	11.5		14.9	22.4	9.4	35.4	11.2	
Birth order	1st child	58.2	58.1	65.7	66.3	56.0	<0.001	55.8	50.6	59.6	62.7	52.5	<0.001
	2nd child	28.1	36.1	29.9	24.2	37.0		32.2	26.7	30.4	26.7	40.0	
	3rd child	12.1	3.6	4.4	9.5	7.0		9.0	18.3	6.9	8.2	6.9	
	> 3 children	1.7	2.3	0.0	0.0	0.0		3.0	4.3	3.1	2.4	0.6	

Manuscript

“Introduction of complementary feeding in five European countries”

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Introduction of complementary feeding in five European countries

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Running title: Introduction of complementary feeding in European infants

Abstract

Background: Little information is available on the practice of introducing complementary feeding across Europe.

Objectives: To describe the times of complementary feeding (CF) introduction in healthy infants in five European countries.

Methods: Infants breast fed for at least three completed months (BF, n=588) and two randomized formula fed infant groups (FF, n=1090) with formula milk of different protein contents were recruited between October 2002 and June 2004. Three-day-weighed food protocols were obtained at the ages of one to nine and again at twelve completed months.

Results: At the age of four completed months, 13% of BF and 43% of FF infants received energy providing liquids (EPL), and 17% of BF and 37% of FF infants received solids, respectively. We found significant differences between countries, with the highest proportion of FF infants consuming EPL in Poland (87%), of BF infants in Spain (26%) and for solid intake in Belgium (FF infants 56%, BF infants 43%). FF infants receiving EPL had a significantly lower formula (at ages 2 to 5 months, $p<0.05$) and solid intake (at ages seven to nine and twelve months, $p<0.05$). Multiple regressions showed the country of residence as strongest factor influencing the time of CF introduction.

Conclusions: EPL and solids were introduced earlier than recommended to a high proportion of infants, particularly among FF infants. Regional differences strongly influenced the time of introduction of CF which should be considered in parental counseling strategies.

Background

In the 1920s infants in the United States consumed sieved vegetable soup by the end of the first year and potatoes with around 18 months of age (1). From 1930 onwards, the age for the introduction of complementary foods (CF) decreased, pediatricians recommended already strained fruit and vegetables at the age of 4 to 6 months. In the 1950s solid introduction was recommended even before 8 weeks of age and there was promotion of feeding strained fruit and vegetables after some days of age. In the early 1970s there was a low initial breastfeeding rate in the United States (<25%), but worldwide tendency of increasing breastfeeding and CF introduction at around six weeks of age. In the 1980s the consumption of fruit juices increased remarkably, as source of nutrients, vitamins and simple carbohydrates but also related to dental caries. Nowadays the introduction of complementary feeding is not recommended before the age of 4 months. The population based recommendation of the World Health Organisation (WHO) suggests 6 months of exclusive breastfeeding compared to many industrialized countries where advisory boards stay with the recommendation not to start with CF before 4 to 6 months. Also, EPL are not recommended nor needed in the first months of life. The American Academy of Pediatrics (AAP) sees no nutritional indication to feed infants younger than 6 months with fruit juice and if infants get fruit juices these should be provided from a cup (2).

However, infant feeding practice is suspected to differ considerably from current recommendations. Therefore, we aimed to characterize the practice of introducing EPL and solids to infants in five European countries with similar infant feeding recommendations. Data was collected as part of the prospective European Childhood Obesity Project. We explored whether type of milk feeding, socio-demographic characteristics and the country of residence were associated with the time point of introduction of complementary feeding.

Definition of complementary feeding

The definitions for complementary feeding are not consistent. For the WHO complementary feeding is ‘any nutrient-containing foods or liquids other than breast milk’ with the aim to emphasize breastfeeding (3). For the European Society for Paediatric Gastroenterology, Hepatology and Nutrition (ESPGHAN) complementary feeding includes ‘solid and liquid foods other than breast milk or infant formula and follow-on formula’. In this definition formula milk is not considered as part of the complementary foods to avoid confusion for infants starting with formula milk from the first weeks of life. Others define complementary feeding as anything beside breast milk or formula milk given to the infant or refer to any solids introduced to the infant diet (4-6).

Some considerations

Complementary feeding should be introduced when the nutritional need is not covered anymore through breast milk. For the majority of healthy full term infants, a sufficient volume of breast milk from a well nourished mother should supply the nutrient needs of the infant until about 6 months of age (6;7). However, analysis of Reilly et al. questions if the energy transfer from mother milk is always sufficient for the infant until the age of 6 months (8). Further, micronutrients which can occasionally be deficient before 6 months of age are vitamin D, if very little sunlight reaches the infant's skin or zinc because of the physiological decline in the zinc content of human milk or vitamins like A, B_{12}, and riboflavin (6;7).

In the first months of life, infants should be exclusively breastfed or fed with infant formula and do not require liquids like water, tea, juices, sweetened beverages or other energy providing liquids (EPL) with possible exception in selected conditions such as diarrhea, very high ambient temperatures, high fever or in some special indications occurring in the neonatal period (9).

With the age of 6 months most infants reach a general and neurological stage of development (chewing, swallowing, digestion and excretion) that enables them to be fed by other foods rather than breast milk (10).

Actual recommendations

In 2001, the 54th World Health Assembly recommended the introduction of complementary foods around the 6th month of life, instead between the 4th and 6th month, as previously recommended (11). After the Expert Consultation in 2001 and the WHO-commissioned systematic review by Kramer and Kakuma the global recommendation was modified to six months exclusive breastfeeding with the introduction of complementary feeding thereafter and continued breastfeeding for the first 2 years (12). The advantages include a lower risk of gastrointestinal infection, more rapid maternal weight loss after birth, and delayed return of menstrual periods. No reduced risks of other infections or of allergic diseases have been demonstrated. No adverse effects on growth have been documented with exclusive breastfeeding for 6 months, but a reduced level of iron has been observed in developing-country settings (12). In Europe the recommendations call mostly for 4 to 6 months exclusive breastfeeding followed by a stepwise introduction of the complementary feeding. To avoid the risk that a subgroup of infants could not be covered with some micronutrients by an exclusive breastfeeding of 6 months, an earlier introduction of complementary foods would be beneficial (4). The ESPGHAN considers as desirable goal that infants are exclusively or fully breastfed for 6 months and receive complementary feeding not before 17 weeks and not later than 26 weeks of life (13). The American Academy of Pediatrics (AAP) suggests the introduction of complementary feeding after the age of 4 to 6 months (14). The

recommendations in the participating countries of the study agree that complementary feeding should not start before the age of 4 months (15).

Should the recommendations for the introduction of complementary feeding differ between BF infants and FF infants?

For breastfed infants the main micronutrients of concern are iron and zinc, compared to formula fed infants with some greater nutrient density in their standard cows' milk formula (6;7). For this reason Foote mentions the option that breast fed infants should receive foods such as meat or iron fortified foods earlier in the weaning process than formula fed infants, in whom cereals would suffice as the initial solid food (6). Dewey mentions the option to supplement exclusive breastfed infants for 6 months with iron and zinc (16;17). Further, the energy intake and expenditure for formula fed infants has been identified differently in the study of Butte (18) and the growth pattern and weight gain is also different during the first year and later (19-22). The WHO recommendations for complementary feeding take no account of the likely differing nutrient requirements of the exclusively breast fed versus the formula or mixed formula and breast fed infants. Alike, the ESPGHAN prefer to have unanimous recommendations for all infants (13).

Factors influencing an early introduction of complementary foods

Mothers' education and their social environment are known as strong factors influencing the feeding practices of their infants. Depending on the development stage of the society, these factors may favor an earlier or a later introduction of complementary feeding to the infants (4). Infants formula fed, the younger age of the mother and her smoking behavior are more factors associated with an earlier introduction of complementary feeding(23-25).

Possible consequences of an early or late introduction of complementary foods

Energy providing liquids

Feeding infants with EPL may displace breast milk or infant formula intake and thereby, may adversely affect nutrient supply (2;26). Beyond that, regular intake of EPL might prime infants to their sweet taste with a possible increased risk for later development of dental caries or obesity (2;27-29). Further, high and regular intake of fruit juices may exceed the intestine's ability to absorb the carbohydrate and favor risks of malabsorption (26;30). Excess of fruit juice consumption was also associated as contributing factor in some children with nonorganic failure to thrive and decreased stature (26).

Solids

Different studies have associated very early introduction of complementary foods with an increased risk of allergy. The intake of complementary feeding before the age of 4 months seems to increase the risk of allergies as well as if introduced after 7 months (14;31-36).

Further, a late introduction of complementary foods could be disadvantageous, because infant growth stops or slows down, the risk of malnutrition and micronutrient deficiency increases (10) and it may trigger to unwanted feeding behavior later on (37). Northstone et al. found that infants with a late introduction of lumpy solids were associated with increased difficulties in feeding in older ages (5).

Kleinman in his analysis did not find clear associations between the age of introduction of complementary foods and cancer, later obesity, hypertension, coronary vascular disease or osteoporosis (38).

Study design

Data were collected as part of the European Childhood Obesity Project, a double-blind, randomized controlled trial with one group of breastfed (BF) infants and two groups of formula fed (FF) infants randomized to formula with different protein levels as a possible risk factor for later obesity. The methodology of the study has been previously reported (39;40). In short, eligible participants were apparently healthy, singletons, term infants who were born between 1 October 2002 and 30 June 2004 and followed in 11 study centers in five European countries (Belgium, Germany, Italy, Poland and Spain). Exclusion criteria were mothers with hormonal or metabolic diseases or illicit addiction during pregnancy (40). The first medical visit included infant anthropometry measurements as well as collection of socioeconomic data, medical histories of parents and infants. During the following months, parents and infants were followed at regular intervals in the study centers, as well as by mailed questionnaires on feeding behaviors. For dietary data collection a 3-day weighed food protocol at the age of 1 to 9 and again 12 completed months was chosen (41). Trained dieticians in all study centers entered the data of the food protocols from their centre using a special software developed for this study. Complementary foods (3281 food items) consumed during the first year of life by the infants in the five countries were classified based on their major ingredients and categorized into subgroups. For our analysis solids included food items such as beef, cereals or bread, egg, fat, fish, fruit, meat, milk or milk products, nuts or seeds, potatoes, poultry, pulses, sausages, soy or soy products, sweets or infant sweets and vegetables. Energy providing liquids (EPL) were defined as sugared instant tea, fruit juices (100% fruit juice, fruit drinks) and vegetable juices provided as drinks (but not as one ingredient of a composed dish), and other sugared beverages (soft drinks, sugared water without or with flavors).

Mothers were grouped in four categories based on age at birth (I=≤25, II=>25 to 30, III= >30 to 35 and IV=>35 years) and the maternal educational levels were categorized in 3 groups (*low* =pre-preliminary to lower secondary, *middle* = upper secondary and post-secondary non-tertiary and *high* = first and second stage of tertiary education).

For data analysis Stata 9.2, SPSS 16.0 and Excel 2000 were used. Chi square and multiple logistic regression analysis were used to adjust differences in the time points of solid or EPL introduction at each month by confounders. The study protocol was reviewed and accepted by the ethic committees at all study centers.

Discussion

The data analysis shows that EPL and solids were given to a very high proportion of European infants already during the first months of life (15;41) (**Figure 1**). At the age of four months, 13% of BF infants and 43% of FF infants had already received EPL, and 17% of BF infants and 37 % of FF infants consumed solids, even though such an early introduction is not supported at all by current recommendations (11;13). Also other studies reported a discordance between infant feeding recommendations and practice. In the Euro-Growth Study, 50%, 67%, and 95% of infants were fed some solid foods at the ages of three, four, and five months, respectively (42). Giovannini et al. found around 6% of infants with solid introduction before the age of 3 months and 34% at the age of 4 months (43). Also in the United Kingdom many infants received complementary food far earlier than suggested (6;44).

There is no nutritional benefit of feeding EPL or fruit juices to infants during the first months of life, but there is a possible risk of displacing nutrient intakes from breast milk or infant formula as previously proposed (45-47). Our data analyses confirm a lower formula milk intake (kcal/d) in FF infants who consumed EPL during the first months of life (41) (**Figure 2**). Furthermore, infants who consumed EPL had a lower solids intake (kcal/d) during the second half of the first year (**Figure 3**). Thus, the provision of EPL can displace the intake of other foods and the supply of relevant nutrients with these foods. The use of EPL is also associated with early introduction of solids: infants who received EPL had significantly higher energy intakes from solids at the ages of 4 and 5 months as compared to infants who did not receive EPL. An early introduction of solids, prior to the age of 3 and 4 completed months, was associated with an increased risk of eczema, celiac disease, and allergy (35;36;48-50).

Introduction of complementary feeding is recommended at the same age for both FF and BF infants, but FF infants received both EPL and solids earlier than BF infants, which is consistent with previous findings (15;44;51-54) (**Figure 1**). In our study, FF infants were five times more likely to receive EPL by the age of four months than BF infants. Higher parental

socioeconomic status and educational level, as well as exclusive breastfeeding during the first months of life, were associated with later complementary feeding introduction.

Our study involved five European countries with different cultural traditions and food patterns. Even though guidelines for the introduction of complementary foods are similar in these countries, there are significant differences in infant feeding practice between the countries, both in FF and BF infants (15) (**Table 1**). During the first year of life, we found the highest percentages of BF infants with consumption of EPL in Poland and Spain and of FF infants in Poland (41). At the age of four months, we found the highest percentages of BF infants (43%) and FF infants (56%) with introduction of solids in Belgium (15). This earlier introduction, compared to other countries, is not due to different recommendations in Poland or Belgium and remains unexplained.

The strongest risk factors for early introduction of solids in FF infants at the age of 3 completed months were country of residence and young maternal age, and at 4 months the country of residence, low maternal education and maternal smoking. In BF infants the country of residence and lower maternal education level were associated with introduction of solids at the age of 4 completed months. These findings were consistent with other studies also finding earlier introduction of complementary feeding in children of lower parental educational level (55), lower socioeconomic status (24), maternal smoking(23;25) and younger maternal age (56).

While we found no differences in the timing of introducing complementary foods between infants randomized to the two types of intervention formulas with different protein and fat contents, there were significant differences between countries in the timing of introducing complementary foods (**Table 1**). This observation suggests far stronger effects of regional and cultural traditions, as well as social and parental factors on the time of introducing complementary foods than of dietary macronutrient composition.

In conclusion, complementary foods as EPL or solids are provided much earlier to many infants, particularly FF infants, than currently recommended. There are marked differences between the five European countries of our study in the timing of introducing EPL and solids. The provision of EPL is associated with a lower energy intake from infant formula, earlier introduction of solids, and less energy intake from solids during the second half of the first year of life. There is room for improvement in infant feeding practices, particularly in risk groups including infants fed formula and infants of mothers with lower level of education, younger age or smoking behavior.

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Authors' contributions:

SSch: enrolment of subjects, acquisition and introduction of data, data analysis and interpretation, manuscript writing. VG: data management and data analysis, contribute to manuscript writing. SSc: participated in study design and conduct of study, contribute to manuscript writing. VL, FM, AS, FV: enrolment of subjects, conduct of study, acquisition and introduction of data, contribute to manuscript writing. BK: principal investigator and guarantor of the study, contribution to manuscript writing. All authors read and approved the final version of the article.

Conflict of interest:

None of the authors has declared a conflict of interest.

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Figure 1: Percentages of breast fed infants and formula fed infants with intake of energy providing liquids (EPL) and solids during the first year of life

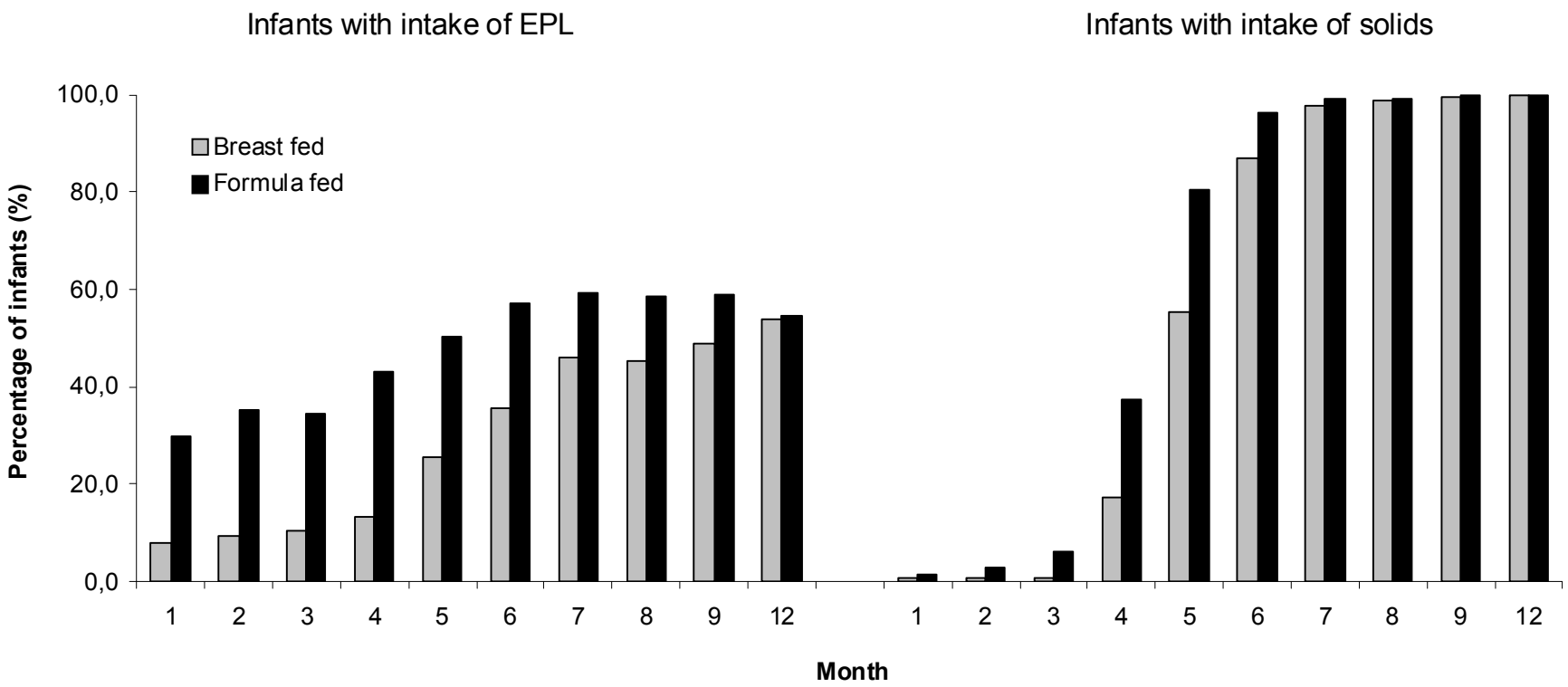
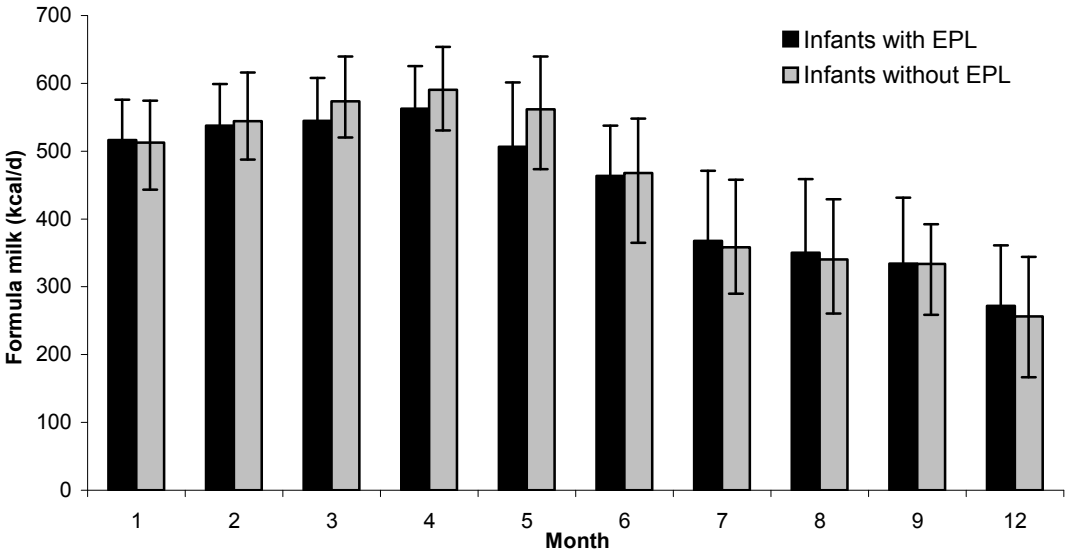
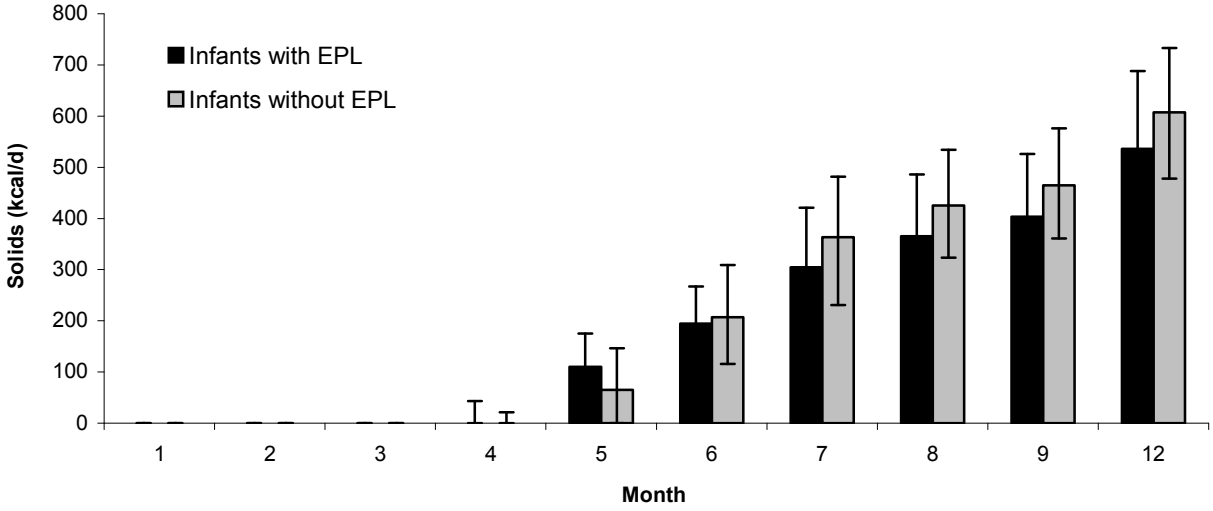


Figure 2: The median energy intake (kcal/d) from formula milk in formula fed infants with and without consumption of energy providing liquid (EPL), at the ages of 1 to 9 and 12 completed months



Kruskall-Wallis: 2nd to 5th month $p<0.05$

Figure 3: The median energy intake (kcal/d) from solids in formula fed infants with and without consumption of energy providing liquid (EPL), at the ages of 1 to 9 and 12 completed months



Kruskall-Wallis: 4th to 5th month $p<0.01$; 7th to 9th and 12th month $p<0.001$

Table 1: Percentages of breast fed infants and formula fed infants with energy providing liquids and solid introduction, divided by country at the ages 1 to 7 completed months

EPL	**Age** (completed months						
BF infants	**1**	**2**[1]	**3**[1]	**4**[1]	**5**[1]	**6**[1]	**7**[1]
Germany	4	4	2	3	12	25	38
Belgium	0	3	4	14	24	31	40
Italy	8	15	14	9	18	28	34
Poland	14	16	21	18	34	52	73
Spain	10	3	7	26	45	53	63
FF infants	**1**[2]	**2**[2]	**3**[2]	**4**[2]	**5**[2]	**6**[2]	**7**[2]
Germany	34	37	35	44	47	60	61
Belgium	1	3	4	12	26	38	46
Italy	25	28	27	33	33	37	38
Poland	88	79	81	87	93	94	94
Spain	27	25	22	35	48	56	61

Solids							
BF infants	**1**	**2**	**3**	**4**[2]	**5**[2]	**6**[2]	**7**
Germany	0	1	0	5	25	69	93
Belgium	0	0	0	43	85	96	100
Italy	0	1	1	15	59	93	99
Poland	0	0	0	7	36	84	98
Spain	3	0	1	26	70	89	98
FF infants	**1**[1]	**2**[1]	**3**[1]	**4**[1]	**5**[1]	**6**[1]	**7**[1]
Germany	0	4	5	31	68	91	97
Belgium	5	10	16	56	75	94	100
Italy	0	1	2	31	81	98	100
Poland	3	3	3	39	94	97	100
Spain	1	2	8	38	80	97	100

(1) Chi square $p \leq 0.01$, Chi square $p \leq 0.001$

Zusammenfassung

Im EU Childhood Obesity Projekt (http://www.metabolic-programming.org), einer doppelt blind randomisierten Interventionsstudie mit über 1000 gesunden, reifgeborenen Säuglingen aus fünf europäischen Ländern (Belgien, Deutschland, Italien, Polen und Spanien), wird der Zusammenhang zwischen der Eiweißzufuhr im Säuglingsalter und der Entwicklung von Wachstum und Gewicht bei Kindern nach der Geburt bis zum Alter von 8.5 Jahren untersucht. Das Studienkollektiv besteht aus einer Kontrollgruppe gestillter Säuglinge (n=588) und zwei randomisierten Interventionsgruppen nicht gestillter Säuglinge (n=1090), die bis zur achten Lebenswoche auf eine der Studien-Säuglingsanfangsnahrungen mit unterschiedlichem Eiweißgehalt umgestellten wurden.

Innerhalb des EU Childhood Obestiy Projektes wurde der Frage nachgegangen, ob der unterschiedliche Eiweißgehalt in den Säuglingsanfangsnahrungen Einfluss auf den zeitlichen Beginn der Beikosteinführung hat.

Anhand von monatlichen 3-Tage Wiegeprotokolle wurde der Zeitpunkt der Beikosteinführung bei gestillten Säuglingen im Vergleich zu nicht gestillten Säuglingen ermittelt. So auch der Zeitpunkt der Einführung von energiehaltigen Getränken und potentiell allergenen Nahrungsmitteln.

Die Resultate zeigen, dass gestillte und nicht gestillte Säuglinge in einem hohen Prozentsatz Beikost einschließlich potentiell allergenen Nahrungsmittel wie auch energiehaltige Getränke vor dem empfohlenem Alter von vier Monaten erhielten. Trotz gleicher Empfehlungen, bekamen nicht gestillte Säuglinge zu einem signifikant früheren Zeitpunkt und zu signifikant höheren Anteilen feste Beikost, energiehaltige Getränke wie auch potentiell allergene Nahrungsmittel im Vergleich zu gestillten Säuglingen. Im Alter von vier Monaten verzehrten 17% der gestillten Säuglinge feste Beikost und 13% energiehaltige Getränke. Im gleichem Alter bekamen 37% der Säuglinge mit Säuglingsanfangsnahrung feste Beikost und 43% energiehaltige Getränke. Die Zufuhr von energiehaltigen Getränken wirkte sich signifikant auf eine geringere Aufnahme von Säuglingsanfangsnahrung im Alter von zwei, drei, vier und fünf Monaten ($p<0.05$), sowie auch eine signifikant geringere Beikostzufuhr im Alter von sieben, acht, neun und zwölf Monaten aus ($p<0.05$). Im Alter von 4 Monaten verzehrten 6% der gestillten und 13% der nicht gestillten Säuglinge potentiell allergene Nahrungsmittel. Mütter mit Allergien verabreichten ihren Säuglingen in einem früheren Alter potentiell allergene Nahrungsmittel als Mütter ohne Allergien. Weiterhin fanden sich trotz ähnlicher Empfehlungen signifikante Unterschiede zwischen den Ländern im Bezug auf die zeitliche Einführung von Beikost, ob als feste Nahrungsmittel oder als energiehaltige Getränke, bei den gestillten sowie nicht gestillten Säuglingen. Die unterschiedliche Nährstoffzusammensetzung der Studien-Säuglingsanfangsnahrung hatte keinen Einfluss auf das Alter der Beikosteinführung. Der Ausbildungsgrad der Mutter, das Alter der Mutter wie

auch ihre Rauchgewohnheiten hatten einen signifikanten Einfluss auf den Zeitpunkt der Beikosteinführung. Eine gute Information und Aufklärung an die Eltern, speziell von Säuglingen, die Säuglingsanfangsnahrung erhalten, über die zeitlich korrekte Einführung der Beikost, in fester und flüssiger Form wäre sehr wünschenswert.

Summary

The European Childhood Obesity Project (http://www.metabolic-programming.org), a double blind randomized intervention trial with over 1000 healthy, term infants from five European countries (Belgium, Germany, Italy, Poland and Spain) will analyse the relation of the infant protein supply and the growth and weight development after birth up to the age of 8.5 years. The study population included one reference group of infants fully breastfed for at least three months (n=588) and two groups of formula fed infants (n=1090) randomized to the higher or lower protein formula, latest at the age of eight weeks.

As part of the prospective EU Childhood Obesity Project we aimed at analyzing if the different protein content of the formula milk had some influence of the time point of introduction of complementary feeding. With the dietary data collected by the three-day-weighed food records the time point of introduction of complementary feeding of breast fed (BF) and formula fed (FF) infants were analysed as well as for the time point of introduction of energy providing liquids and potential allergenic foods.

The results showed a high percentage of breast fed and formula fed infants with intake of solids, energy providing liquids and potential allergenic foods before the recommended age of four completed months of life. Despite similar recommendations, there was a significant earlier introduction and a significant higher percentage of formula fed infants consuming solids, energy providing liquids and potential allergenic foods compared to breast fed infants. At the age of four completed months, already 37% of FF infants and 17% of BF infants consumed solids and 43% of FF infants and 13% of BF infants consumed energy providing liquids. Formula fed infants with energy providing liquid intake had a significant lower intake of formula milk at the age of two to five months ($p<0.05$) and solid intake at the age of seven to nine and twelve months ($p<0.05$). Some 6% of BF infants and 13% of FF infants consumed some potential allergenic food at the age of four completed months. Mothers with history of allergy introduced earlier potential allergenic foods to their infants than mothers without history of allergy.

Although there are similar national recommendations, we found significant differences in the time point of introduction of solids and energy providing liquid between the countries in breast fed and formula fed infants. There was no association between the protein contents of study formula and the time point of introduction of complementary feeding. The educational level of the mother, the maternal age and her smoking habits were significantly related to the time point of introduction of complementary feeding. Improved information and education to the parents, especially in formula fed infants, on the correct timing for the introduction of complementary foods, as solids and as beverage would be desirable.

Danksagung

Mein herzlichster Dank an Prof. Dr. Berthold Koletzko für seine Einladung an mich, als Doktorandin am EU Childhood Projekt teilzunehmen. In dieser Zeit habe ich seine Ratschläge, sein Vertrauen wie auch seine freundliche und geduldige Betreuung besonders geschätzt. Durch diese Mitarbeit habe ich viel über selbstständiges, wissenschaftliches Arbeiten im internationalen Rahmen gelernt, wie auch über Datenanalyse und die Daten und Texte kritisch zu beurteilen.

Ein großen Dank an Dr. Hans Demmelmair für seine praktische Hilfen und analytisches Mitdenken, ebenso für seine Geduld und große Hilfsbereitschaft.

Sehr froh und dankbar war ich über die ausdauernde Hilfe von Dr. Veit Grote bei der Zusammensetzung der Datensätze und seiner Unterstützung in der Auswertung der Datenbank.

Den interessanten und wertvollen Austausch mit meinen Studienkollegenin möchte ich nicht missen und danke allen besonders für ihre Hilfe und ihren Einsatz bei der Zusammenstellung der Beikostliste.

Ganz besonders möchte ich mich bei unseren Studienteilnehmern, Säuglingen und Eltern, für ihre Zeit und Ihren Einsatz bedanken, bei ihren regelmäßigen Besuchen in die Studienzentren wie auch durch das Ausfüllen der vielen Fragebögen und Ernährungsprotokolle. Ohne ihren Einsatz wäre diese Studie gar nicht möglich gewesen.

Sehr geschätzt habe ich den Austausch mit meinen Arbeitskollegen/in, es war eine wertvolle Zeit und danke auch allen für ihre vielseitige Hilfsbereitschaft.

Zum Schluss auch noch ein großes Dankeschön an meine Familie und Freunden, für all ihr Verständnis und ihre Unterstützung während dieser Jahre.

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Medizinische Fakultät

Kumulative Dissertation

Bestätigung gem. § 4a Abs. 3 und 5 Promotionsordnung

Sonia A. Schiess
Doktorand

Einführung von Beikost in fünf europäischen Ländern
Titel der Dissertation

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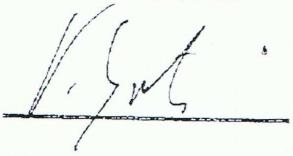
1. Veit Grote	data management and data analysis, contribute to manuscript writing	
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2. Berthold Koletzko	principal investigator and guarantor of the study, designed study protocol, contributed to writing of the manuscript	
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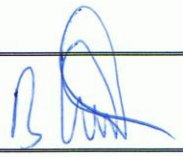
2. Berthold Koletzko	principal investigator and guarantor of the study, designed study protocol, contributed to writing of the manuscript	
3.		
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Beitrag der Doktorandin Sonia A. Schiess

- Rekrutierung der Teilnehmer in München.
- Betreuung von den Müttern/Eltern im Bezug auf die 3-Tage Wiegeprotokolle.
- Eingabe der 3-Tage Wiegeprotokolle für München und Nürnberg (ca. 1523 x 3-Tage Wiegeprotokolle).
- Besuch der verschiedenen Studienzentren (study visits) mit dem Ziel eine möglichst standardisierte Datensammlung und Dateneingabe zu gewährleisten (Entwicklung und Durchführung von Beispiel-Ernährungsprotokollen und ihre Auswertung).
- Entwicklung einer „Beikostliste“ für die Datenauswertung über die verzehrten Nahrungsmittel (4186 Nahrungsmittel wurden in 29 mögliche Zutaten-Kategorien aufgeteilt). Mit Beihilfe der Kollegen für die Ausländische Produkte.
- Die Datenauswertung erfolgte vorzugsweise mit SPSS (Datensatz ca. 360000 Zeilen x 80 Spalten) und mit Excel.
- Literaturrecherche und Redaktion der vier Publikationen/Manuskripte.
- Teilnahme an den halbjährigen Studientreffen.

Publikationen and Präsentationen

Prävention der kindlichen Adipositas durch die Säuglingsernährung. Koletzko B, Grote V, Schiess S, Verwied-Jorky S, Brands B, Demmelmair H, von Kries R. Monatsschrift Kinderheilkunde 2010; 158: 553-563.

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Is the crying behaviour in infants up to the age of 3 months influenced by the type of early feeding ? S.Schiess, D.Oberle, I.Broekaert, A.Reith, S.Verwied-Jorky, B.Koletzko. ESPGHAN Nutrition Summer School, Anavyssos, Greece. September 2005. Oral presentation.

Is the crying behaviour in infants up to the age of 3 months influenced by the type of early nutrition ? S.Schiess, D.Oberle, I.Broekaert, A.Reith, S.Verwied-Jorky, B.Koletzko. World Congress of Paediatrics, Gastroenterology, Hepatology and Nutrition, in Paris, France. July 2004. Poster presentation.

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Beeinflusst die Ernährung des Säuglings das Vorkommen der Dreimonatskolik ? S.Schiess, D.Oberle, I.Broekaert, A.Reith, S.Verwied-Jorky, B.Koletzko. Ernährung 2004, Munich, Germany. May 2004. Poster presentation.

Liebe Mutter!

Um die Verzehrsgewohnheiten Ihres Kindes bewerten zu können, ist es notwendig ein Ernährungsprotokoll über drei aufeinanderfolgende Tage zu führen. Bitte führen Sie das Protokoll an zwei Werktagen und einem Wochenendtag (z.B. Sonntag, Montag, Dienstag). Es ist wichtig, dass Sie alles genau aufschreiben, was Ihr Kind gegessen und getrunken hat!

Wenn es Ihnen zu bestimmten Zeitpunkten nicht möglich ist, dass Protokoll selbst auszufüllen, bitten Sie die gerade betreuende Person Ihres Kindes (z.B. Oma, Tagesmutter) die genauen Mengen der Milchmahlzeiten oder der anderen Lebensmittel aufzuschreiben, die von Ihrem Kind verzehrt wurden.
Bei auftauchenden Fragen oder Problemen steht Ihnen unsere CHOPIN-Hotline **089/5160-7707** oder **0911/398-5436** gerne jederzeit zur Verfügung!

Wie füllen Sie das Protokoll richtig aus?

→ Bitte notieren Sie die Stillmahlzeiten und/oder den Verzehr von Säuglingsmilchnahrung oder anderen getrunkenen Flüssigkeiten (wie z.B. Tee, Säfte...) in den dafür vorgesehenen Tabellen.

→ Tragen Sie sofort die genaue Uhrzeit ein, wann Ihr Kind eine Milchmahlzeit bekommen oder etwas anderes getrunken hat.

→ Formula-Nahrung:
- Notieren Sie die Art und den Handelsnamen der Milchnahrung.
- Schreiben Sie die Menge an Wasser und die Anzahl der Messlöffel mit Pulver auf, die Sie für die Zubereitung der Milchfläschen verwenden.
- Notieren Sie bitte die Sorte und den Handelsnamen der Getreide oder der anderen Zutaten, die Sie für die Zubereitung der Milchfläschen verwenden.
  Machen Sie die Angaben in Tee- (TL) oder Esslöffel (EL), in Gramm (g) oder Milliliter (ml).
- Schreiben Sie bei jeder Mahlzeit die Menge an Milch auf, die Sie Ihrem Kind in der Flasche gegeben haben sowie das Volumen, das Ihr Kind tatsächlich getrunken hat.
- Tragen Sie bitte die Dauer jeder Mahlzeit ein.

→ Sonstige Flüssigkeitsaufnahme:
- Notieren Sie die Sorte, den Handelsnamen, die Menge der angebotenen Flüssigkeit sowie das Volumen, das Ihr Kind tatsächlich getrunken hat (z.B. Apfelsaft, Albi, 50 ml).
- Tragen Sie das Alter Ihres Kindes ein, wann es zum ersten Mal die jeweilige Flüssigkeit bekommen hat.

→ Feste Nahrung (Beikost):
- Falls Ihr Kind schon feste Nahrung bekommen sollte, tragen Sie bitte die Lebensmittel in die entsprechende Tabelle ein und fragen Sie im Studienzentrum nach.

Vielen Dank für Ihre Hilfe und Ihre tolle und aktive Unterstützung!

Ihr Chopin -Team.

	Childhood Obesity-Programming by Infant Nutrition	**Verzehrsprotokoll am Ende von Monat 1**
Alter des Kindes: **4 Wochen**	Initialen des Kindes: ___ Screening Nummer: **GE -** __ - ____ Geburtsdatum des Kindes: __ __ ____ (Tag Monat Jahr)	In die Datenbank eingegeben am: __ __ ____ von: _____

Wann haben Sie dieses Protokoll ausgefüllt? __ __ ____ (Tag 1)
Tag Monat Jahr

Milchzubereitung & Milchverzehr										
Uhrzeit	Art der Milch (Sorte, Handelsname)	Wasser (ml)	Pulver (Anzahl der Löffel)	Getreidesorte		Sonstiges		angebotene Menge (ml)	verzehrtes Volumen (ml)	Dauer der Mahlzeit (Minuten)
				(Sorte, Handelsname)	(Anzahl der Löffel)	(Sorte, Handelsname)	(g, ml oder Löffel)			

Sonstige Flüssigkeitsaufnahme*				
Uhrzeit	Art der Flüssigkeit (Sorte, Handelsname)	angebotene Menge (ml)	verzehrtes Volumen (ml)	Alter, wenn zum ersten Mal gegeben (Woche)

* wie z.B. Tee, Wasser, Säfte, Wasser + Zucker, Kuhmilch, Sojamilch, sonstiges

Verzehr von fester Nahrung					
Uhrzeit/ Mahlzeit	wo wurde die Mahlzeit eingenommen? (zu Hause, Oma...)	Angaben zu verzehrten Lebensmitteln (inkl. Zubereitungsart, Sorte, Eigenschaften, Handelsname)	angebotene Menge	nicht verzehrte Menge	Code (bitte nicht ausfüllen)

Beschreibung des Rezeptes: _____

Menge	Lebensmittel + Zutaten (inkl. Zubereitungsart)

Beschreibung des Rezeptes: _____

Menge	Lebensmittel + Zutaten (inkl. Zubereitungsart)

Wann haben Sie dieses Protokoll ausgefüllt? Tag Monat Jahr (Tag 2)

Milchzubereitung & Milchverzehr										
Uhrzeit	Art der Milch (Sorte, Handelsname)	Wasser (ml)	Pulver (Anzahl der Löffel)	Getreidesorte		Sonstiges		angebotene Menge (ml)	verzehrtes Volumen (ml)	Dauer der Mahlzeit (Minuten)
				(Sorte, Handelsname)	(Anzahl der Löffel)	(Sorte, Handelsname)	(g, ml oder Löffel)			

Sonstige Flüssigkeitsaufnahme*				
Uhrzeit	Art der Flüssigkeit (Sorte, Handelsname)	angebotene Menge (ml)	verzehrtes Volumen (ml)	Alter, wenn zum ersten Mal gegeben (Woche)

* wie z.B. Tee, Wasser, Säfte, Wasser + Zucker, Kuhmilch, Sojamilch, sonstiges

Verzehr von fester Nahrung					
Uhrzeit/ Mahlzeit	wo wurde die Mahlzeit eingenommen? (zu Hause, Oma...)	Angaben zu verzehrten Lebensmitteln (inkl. Zubereitungsart, Sorte, Eigenschaften, Handelsname)	angebotene Menge	nicht verzehrte Menge	Code (bitte nicht ausfüllen)

Beschreibung des Rezeptes: _____

Menge	Lebensmittel + Zutaten (inkl. Zubereitungsart)

Beschreibung des Rezeptes: _____

Menge	Lebensmittel + Zutaten (inkl. Zubereitungsart)

Wann haben Sie dieses Protokoll ausgefüllt? Tag . Monat . Jahr (Tag 3)

Milchzubereitung & Milchverzehr										
Uhrzeit	Art der Milch (Sorte, Handelsname)	Wasser (ml)	Pulver (Anzahl der Löffel)	Getreidesorte		Sonstiges		angebotene Menge (ml)	verzehrtes Volumen (ml)	Dauer der Mahlzeit (Minuten)
				(Sorte, Handelsname)	(Anzahl der Löffel)	(Sorte, Handelsname)	(g, ml oder Löffel)			

Sonstige Flüssigkeitsaufnahme*				
Uhrzeit	Art der Flüssigkeit (Sorte, Handelsname)	angebotene Menge (ml)	verzehrtes Volumen (ml)	Alter, wenn zum ersten Mal gegeben (Woche)

* wie z.B. Tee, Wasser, Säfte, Wasser + Zucker, Kuhmilch, Sojamilch, sonstiges

Verzehr von fester Nahrung					
Uhrzeit/ Mahlzeit	wo wurde die Mahlzeit eingenommen? (zu Hause, Oma...)	Angaben zu verzehrten Lebensmitteln (inkl. Zubereitungsart, Sorte, Eigenschaften, Handelsname)	angebotene Menge	nicht verzehrte Menge	Code (bitte nicht ausfüllen)

Beschreibung des Rezeptes: _____

Menge	Lebensmittel + Zutaten (inkl. Zubereitungsart)

Beschreibung des Rezeptes: _____

Menge	Lebensmittel + Zutaten (inkl. Zubereitungsart)

Lebenslauf

Persönliche Daten

Name	Sonia A. Schiess
Nationalität	Deutsch
Geburtsdatum	19. August 1962
Geburtsort	Santiago de Chile

Berufliche Erfahrungen

03/2005 – 06/2010	Wissenschaftliche Mitarbeiterin bei Prof. Dr. B.Koletzko, Dr. von Haunerschen Kinderspital, Ludwig-Maximilian-Universität München. Promotion innerhalb EU Childhood Obesity Projekt. *„Einführung von Beikost in fünf europäischen Ländern“*
10/2002 – 02/2005	Abschluß-Studie innerhalb des EU Childhood Obesity Projects zum Magister in Humanernährung, INTA (Instituto de Nutrición y Tecnología en Alimentos), Universidad de Chile, Santiago de Chile. *„Beeinflusst die Ernährung des Säuglings das Vorkommen der Dreimonatskolik ?“*
12/1991 - 05/2002	Geschäftsführerin von “Alimentación Integral Ltda”, Santiago /Chile. U.a. Ernährungspraxis (Klinische Ernährungsberatung, Lehrküchen, Vortragsreihen in Klinik, Schuleinsätze und Sportfakultät (Universidad Gabriela Mistral), Organisation und Sprecherin eines 3-tägigen Seminars im Ernährungsinstitut (INTA), Universidad de Chile.
08/1991 - 11/1991	Buchinger Klinik, Marbella/Spanien, Diätassistentin.
03/1990 - 07/1991	Hôpital de Rolle, Lausanne/Schweiz, Ernährungsberaterin.
10/1987 - 12/1989	Buchinger Klinik, Überlingen, Diätassistentin.
10/1986 –09/1987	Universitätsklinik, Zürich, Schweiz. Stagiaire.
03/1984 - 08/1984	Bircher-Benner-Klinik, Zürich/Schweiz, Ernährungspraktikum.

Aus- und Fortbildung

01/2005	Magister in Humanernährung, INTA (Instituto de Nutrición y Tecnología en Alimentos), Universidad de Chile, Santiago/ Chile.
09/1993	Nutricionista (Ernährungswissenschaftlerin), Universidad de Chile, Santiago/Chile.
08/1984 - 07/1986	Diätassistentin, Universitätskrankenhaus Eppendorf, Hamburg.
03/1983 - 12/1983	Ernährungswissenschaften und Diätetik, Universidad de Chile, Santiago/Chile.
03/1982 – 12/1982	„Cordon Blue“, Silwood Kitchen, Kapstadt/Südafrika.
04/1981 – 03/1982	Hotelfachschule D. Speiser, Tegernsee und Bad Wiessee.
03/1968 - 12/1980	Deutsche Schule, Santiago de Chile.

München, 9. April 2010