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Determinants of complementary feeding behaviour

Part 1: Review of European literature

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Summary

The first two years of life are regarded as a "window of opportunity" to positively influence children's health. As quality-assured nutritional information, national recommendations on complementary feeding should assist parents in providing their child with the best possible start in life. The question of what factors influence parental behaviour in relation to complementary feeding are examined in this study. Through research of the relevant literature, factors that influence unfavourable complementary feeding behaviour were identified, i.e. behaviour that deviates from the recommendations in the guidelines. The research focused primarily on European findings. In addition to level of education, a low socio-economic status and/or a migrant background were identified as primary risk factors for unfavourable complementary feeding behaviour.

Keywords: infant nutrition, complementary feeding, migration, socio-economic status, health behaviour

Recommendations for timing the introduction of complementary food

The 2001 recommendation of the World Health Organization (WHO) to breastfeed exclusively until the end of the 6th month of life [1] was supplemented in 2008 by the European Society for Paediatric Gastroenterology, Hepatology and Nutrition (ESPGHAN), which specified an optimum window for the introduction of complementary food[1]: earliest at the beginning of the 5th month (17th week) and latest at the end of the 6th month (26th week) [2].

The Austrian and German recommendations for complementary feeding leave the ESPGHAN recommendations slightly open by also taking into account the individual development of the infant [3, 4]. However, the 2014 S3-Guideline on Allergy Prevention recommends introducing complementary food immediately after the end of the 4th month. From the perspective of allergy prevention, there is currently no verified evidence in support of an early introduction of complementary food before the 17th week of life or a delayed introduction after the beginning of the 5th month. Infants should be breastfed exclusively during the first 4 months of life [5]. According to a statement by the German *Nationale Stillkommission* (National Breastfeeding Committee), this disagreement in the recommendations leads to uncertainty for health professionals and parents. The National Breastfeeding Committee rejects the fixed timing for the introduction of complementary food as specified in the S3-Guideline on Allergy Prevention [6].

All organisations recommend that mothers continue breastfeeding along with the introduction of complementary food. Breastmilk and infant formula remain an important source of nutrients in the first year of life even after the introduction of complementary food [1–5].

According to ESPGHAN, the actual timing of the introduction of complementary food varies significantly due to different food traditions within Europe [2]. An intervention study by Schiess et al. [7] of 1,678 children from five European countries reported a median age of 19 weeks for the introduction of complementary food. A comprehensive cohort study of 401 children from Ireland by Tarrant et al. [8] revealed similar results for the median age at which complementary food was introduced (16th week). Data from a cohort in Bavaria showed that approx. 16% of the 3,103 children studied received complementary food before the 4th month (< 17th week) [9]. In an Austrian national survey by Esberger [10], 19% of the mothers questioned began introducing complementary food before

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[1] Complementary food is defined as all fluid, pureed or solid foods, except mother's milk, infant formula and follow-on formula [2].

the end of the 4th month and 9% of mothers introduced complementary food beginning with the 8th month.

Influence of timing and choice of complementary foods on health

Timing

There is a consensus that by about the end of the 6th month, a child's energy and nutrient requirements can no longer be exclusively met by breastfeeding or by infant formula [2]. According to reviews by Przyrembel [11], there is in particular a risk of deficiencies in iron, zinc and Vitamin D.

There are controversial results relating to the correlation between overweight and the time at which complementary foods are introduced [12–14]. A Danish cohort study of 5,068 children by Schnack-Nielsen et al. [14] showed that the early introduction of complementary food before the 4th month had no influence on increased overweight as an adult (Odds Ratio [OR]: 1.10; 95%-confidence interval [95%-CI]: 0.97–1.26). In 2011, a European multi-centre study by Grote et al. [12] examined the influence of the introduction of complementary food on the growth of 687 children fed with infant formula. Introducing complementary food before the 14th week (7% of children) led to a significantly higher body mass index (BMI) at 6 months, compared to the group which received complementary food from the 22nd week. However, the effect was no longer significant after 24 months. In 2013 Pearce et al. [13] prepared a systematic review in which the authors examined the timing of the introduction of complementary food in relation to an increased BMI. The results were very heterogeneous and the authors estimated that socio-economic status, level of education and birth weight had a greater influence on BMI than the time at which complementary food was introduced.

Food choice

According to the Austrian recommendations on complementary food [3], published in 2010 as part of the project *Richtig Essen von Anfang an* (healthy eating from the start), the following were found to be unsuitable as complementary foods:

- honey due to the risk of botulism
- raw egg, raw fish or raw meat due to the risk of a foodborne infection
- salt and foods containing salt
- unground nuts due to the risk of aspiration
- sausages and processed meat products with salt and nitrate/nitrite
- reduced-fat foods
- hot spices
- sugar as well as foods and drinks containing sugar

The German recommendations do not go into detail about inappropriate complementary foods, but they do recommend avoiding salt and sugar [4].

According to a current meta-analysis by Griebler et al. [15], the consumption of cow's milk by infants before the 6th month may be accompanied by an increased risk of iron deficiency: as calcium and casein impede the intake of non-haem iron. The Austrian and German recommendations largely agree regarding the consumption of cow's milk [3, 4]. According to Austrian recommendations [3], cow's milk should not be given as a drink before the 12th month; amounts up to 200 mL per day can be tolerated in the preparation of pureed food. Dairy products such as yoghurt and buttermilk as an ingredient in a milk-grain-porridge may be consumed to a maximum of once a day instead of cow's milk [3]. Koletzko et al. [4] recommend the use of cow's milk only in small amounts for the preparation of pureed food. Additional snacks containing dairy products such as yoghurt, quark, etc., are discouraged.

According to German recommendations, the avoidance or later introduction of potent food allergens does not provide protection from allergies, but may even have a negative effect on the development of tolerance [4]. The S3-Guideline on Allergy Prevention concludes that to date, the preventive effect of restricting certain foods is not verifiable [5]. The avoidance of more potent food allergens such as fish or eggs in the first year has no preventive influence on allergies. With respect to its protective effect against allergies, a Mediterranean diet rich in omega-3 fatty acids, including fish, is firmly recommended as complementary food [5].

In 2014 a comprehensive cohort study of 856 children from five European countries by Roduit et al. [16] reported that a high level of food diversity in the child's first year seemed to have a protective effect against asthma and food allergies up to the 6th year of life. However, the results of two German cohort studies (GINIplus and LISAplus) indicate that the time at which complementary food is introduced is particularly important [17]. A high level of food diversity before the end of the 4th month can increase the risk of later allergies and eczemas [17]. Another advantage of food diversity in complementary food after the first 4 months is that it encourages children's acceptance of new foods [4].

The concurrent introduction of gluten with breastfeeding is linked to a 50% reduction in the risk of developing coeliac disease [18]. According to complementary feeding recommendations from Germany and Austria, low amounts of grains containing gluten should therefore be included in complementary food after the end of the 4th month along with breastfeeding [3, 4]. This recommendation has been questioned by several studies. The Italian cohort study CELIPREV in 2014 by Lionetti et al. [19] observed that neither the time at which foods containing gluten were introduced nor breastfeeding were factors which influenced the risk of coeliac disease among 707 children with a familial predisposition.

A European randomised double-blind multi-centre study by Vriezinga et al. [20] of children with a high risk of coeliac disease came to the same conclusion.

Question and methodology

European and national guidelines on infant and child nutrition emphasise the importance of the time at which complementary food is introduced as well as the choice of food [2–4]. This study examines which factors unfavourably influence complementary feeding behaviour in terms of the time of introduction and the choice of food. In this case, "unfavourably" means "not compliant with guidelines". This enables us to identify target groups for nutrition initiatives and to develop research questions for the second part of the publication in the forthcoming issue of Ernährungs Umschau. A search was carried out in PubMed using the keywords infant nutrition, child health, complementary feeding and health behaviour, with a focus on complementary feeding and data from Europe. The findings are illustrated in tables by means of the PICO model (P = population, I = intervention, C = control, O = outcome). As this was not a systematic review, but was intended only to examine the background of the research field for a survey, no specified inclusion and exclusion procedures were applied.

Results

Socio-economic factors and complementary feeding behaviour

A prospective cohort study by Aronsson et al. [21] showed a significant correlation between the mother's low level of education, young age, smoking behaviour and the early introduction of complementary food before the 4th month. This study examined children with an increased genetic risk of developing diabetes mellitus type 1 (DMT1); the parents' complementary feeding behaviour may therefore have been influenced by this. Findings from Norway by Lande et al. [22] showed similar results: socio-economic factors such as the mother's young age and low level of education unfavourably influenced a too early introduction of complementary food (◆ Table 1).

Migrant background and complementary feeding behaviour

The findings concerning the influence of a migrant background on complementary feeding behaviour are very heterogeneous. According to Castro et al. [23], mothers with a migrant background were 51% less likely to introduce complementary food too early in comparison to Irish mothers. A British cohort study by Santorelli et al. [24] came to the same conclusion: mothers with a migrant background rarely introduced complementary food too early. However, 60% of mothers with Pakistani and South Asian origins included sugary food and drink in complementary feeding, in comparison to 37% of women without a migrant background [24]. In a British study by Moore et al. [25], young mothers, women with a migrant background and socio-economically-disadvantaged families were significantly less likely to abide by the recommendations and introduced complementary food before the 17th week. The authors of the study assumed that the recommendations were not well understood [25]. In a Dutch cohort study by De Hoog et al., 10% of mothers with an African migrant background introduced complementary food too early (< 17th week); the lowest rate of a too early introduction was observed among Turkish mothers at 1.2% [26] (◆ Table 2).

Author [Source], Year	Study Type	Study Description: PIC	Study Description: O
Aronsson et al. [21], 2015	CS	P: Children (3 months to 2 years) from 3 European countries and 3 US-American states (Finland, Germany, Sweden, Colorado, Florida, Washington) with an increased genetic risk of DMT1 I: Questionnaire on breastfeeding, complementary food introduction and genotype screening for risk of DMT1 C: Influence of socio-economic factors on early introduction of complementary food and food choice **n = 6,404**	The introduction of complementary food before the 4th month was associated with smoking during pregnancy, the mother's young age and a low level of education.
Lande et al. [22], 2003	CS	P: Children (aged 6 months) from Norway I: Questionnaire on food frequency C: Survey on infant nutrition up to the age of 6 months in comparison to recommendations **n = 2,383**	Mothers younger than 24 years of age with less than 10 years of education gave their children complementary food before the 4th month more frequently. Boys received complementary food before the 4th month more often than girls.

Tab 1: **Socio-economic status and influence on complementary feeding behaviour**
CS = cohort study; DMT2/1 = diabetes mellitus type 2/1; PICO: P = population; I = intervention; C = control; O = outcome

Author [Source], Year	Study Type	Study Description: PIC	Study Description: O
Castro et al. [23], 2014	CS	P: Mothers from Ireland with/without a migrant background, children aged nine months I: Questionnaires on breastfeeding and complementary feeding; measurement of parents' body weight and body height C: Survey of breastfeeding and complementary food determinants among mothers with/without a migrant background (Caucasia, China, Africa) **n = 11,134**	Significant factors influencing the introduction of complementary foods < 17th week are: the mother's age, level of education, BMI and ethnicity of mother, duration of residence in Ireland and acculturation, marital status, household income and duration of exclusive breastfeeding.
Santorelli et al. [24], 2014	CS	P: Mothers from Great Britain, Caucasian origin I: Questionnaire on breastfeeding, complementary feeding, ethnicity C: Mothers from Great Britain, non-Caucasian origin **n = 1,327**	Britons introduced complementary food earlier than mothers with Pakistani or South Asian origins; however, Pakistani and South Asian mothers included sugary foods in complementary feeding.
Moore et al. [25], 2011	CSS	P: Parents from Great Britain I: Questionnaire on understanding complementary food recommendations and factors influencing complementary feeding behaviour C: British recommendations on infant nutrition **n = 3,607**	Young mothers, mothers on welfare, mothers with a low level of education and from ethnic minorities were significantly less informed about complementary feeding recommendations and decidedly more likely to wean before the 17th week.
De Hoog et al. [26], 2011	CS	P: Full-term babies from the Netherlands, 6 months old I: Questionnaire, health data on duration of breastfeeding, use of formula and complementary feeding in relation to growth of children C: Children with different ethnic origins (Netherlands, Africa, Turkey, Morocco, other countries) **n = 2,998**	Early introduction of complementary food before the 17th week among African children (10.3%); lowest among Turkish children (1.2%).

Tab 2: **Migrant background and influence on complementary feeding behaviour**
CS = cohort study; CSS = cross-sectional study; PICO: P = population; I = intervention; C = control; O = outcome

Information sources and complementary feeding behaviour

Two studies in Ireland and Scotland determined that the source of information on child nutrition had an influence on the time at which complementary food was introduced (◆ Table 3). Young mothers and mothers with a low level of education often obtained information on child nutrition from other family members [8, 27]. According to Alder et al., mothers who obtained information on child nutrition from grandmothers and close friends introduced complementary food significantly earlier [27]. This study also revealed a link between the earlier introductions of complementary food with a lack of knowledge about the recommendations concerning the introduction after the end of the 4th month, a lack of encouragement from friends and family and the receipt of free samples of industrial foods from manufacturers [27]. A cohort study by Tarrant et al. [8] showed that 59% of mothers introduced complementary foods before the 12th week if the grandmother was a source of complementary food information.

Use of infant formula and complementary feeding behaviour

Two studies found that the use of infant formula affected the time at which complementary food was introduced (◆ Table 4). A cohort study in Ireland [28] examined the factors which influence complementary feeding behaviour. Women who did not breastfeed at all or who used infant formula before the 2nd month, introduced complementary food significantly earlier than those who exclusively breastfed. This was also confirmed by Schiess et al. [7]: a study in five European countries revealed that 37% of children on infant formula were given complementary food in the 17th week, compared to only 17% of breastfed children. The authors of the study hypothesised that the hunger/satiation mechanism was influenced by infant formula, and as a supplement to infant formula, the children were therefore given additional complementary food earlier.

Other factors influencing complementary feeding behaviour

The mother's BMI and the child's birth weight as well as gender have also been shown to have an influence

Author [Source], Year	Study Type	Study Description: PIC	Study Description: O
Tarrant et al. [8], 2010	CS	P: Mothers at 6 months postpartum, Ireland I: Questionnaire, medical records on weaning behaviour of Irish mothers C: WHO recommendations to exclusively breast-feed for 6 months **n = 401**	22.6% of children were weaned at the 12th week. Influencing factors: mother's knowledge before birth, use of infant formula, type of information source (esp. grandmother), nicotine consumption and mother's age
Alder et al. [27], 2004	CS	P: First-time mothers from Scotland, 12 weeks after birth I: Questionnaire, interview to survey influence factors on the time at which complementary food is introduced C: WHO recommendations **n = 338**	Early introduction of complementary food is associated with the grandmother's opinion on weaning, living in a disadvantaged neighbourhood, the mother's personal attitude, lack of support from friends, free samples of industrially-manufactured foods.

Tab 3: **Information sources used and influence on complementary feeding behaviour**
CS = cohort study; PICO: P = population; I = intervention; C = control; O = outcome

on the breastfeeding duration and the introduction of complementary food. Two studies revealed that overweight and obese mothers are less likely to breastfeed and breastfeed for a shorter period of time. They also tend to introduce complementary food earlier [28, 29]. A European study found that boys were given complementary food significantly earlier than girls. Infants with a low birth weight were more often given complementary food before the 13th week [30].

A sound knowledge of complementary feeding recommendations contributed to the introduction of solid food according to the recommendations [25, 26]; particularly peer support and/or support from a trained health professional had a positive effect on parents' complementary feeding practices [31].

Conclusion

According to studies available thus far, the factors influencing early introduction of complementary food before the 4th month or more precisely before the 17th week were primarily: the mother's low level of education, low socio-economic status [26, 32] and/or a migrant background [18, 23–26]. The use of infant formula also had an effect on the earlier introduction of complementary food.

The studies discuss a possible relationship between the premature introduction of complementary food and diet-related diseases such as overweight, obesity and DMT2 [32]. According to a report by the *Arbeiterkammer* (Chamber of Labour) on the topic of *"Migration und Gesundheit"* („Migration and Health") in 2015, there is a

Author [Source], Year	Study Type	Study Description: PIC	Study Description: O
Schiess et al. [7], 2010	CCS	P: Breastfed and formula-fed children (1 month to 1 year) I: Questionnaire, 3-day weighed food protocol to survey the introduction of complementary food in five European countries C: Formula-fed children with a standardised diet **n = 1,366**	Children fed with infant formula received complementary food earlier than breastfed children. A higher socio-economic status, mother's age >25 years, forgoing smoking as well as exclusive breastfeeding during the first few months were positively associated with the introduction of complementary food in accordance with recommendations.
Castro et al. [28], 2014	CS	P: Children aged 9 months from Ireland I: Questionnaire to survey factors associated with the early introduction of complementary food, measurement of body height and body weight C: Irish recommendations on introduction of complementary food (FSAI), in accordance with ESPGHAN **n = 11,134**	Factors influencing the early introduction of complementary food before the 17th week are: the use of infant formula, age of the caregiver ≤ 24 years, the mother's BMI ≥ 25 kg/m², low level of education, child's gender (male), marital status (unmarried) and smoking habits of the mother. Non-Irish descent is negatively associated with early introduction of complementary food.

Tab 4: **Infant formula and influence on complementary feeding behaviour**
CCS = case-control study; CS = cohort study; ESPGHAN; European Society for Paediatric Gastroenterology, Hepatology and Nutrition; FSAI = Food Safety Authority of Ireland; P = population; I = intervention; C = control; O = outcome

higher prevalence of overweight and DMT2 among some migrant groups [33]; overweight and obesity are also often related to low socio-economic status [33].

According to an EU Report (2013), migrants are more likely to exhibit a low level of education and a low socio-economic status and often experience disadvantages in the job market [34]. The WHO promotes health programmes targeting these groups of migrants with low socio-economic status [35]. Young mothers, women with a migrant background and socio-economically-disadvantaged families abide by complementary food recommendations less often. Among migrants, this could be ascribed to a lack of understanding of the recommendations due to language barriers [25]. It is also possible that migrants act accordingly to recommendations from their country of origin; this is not apparent in the literature. For instance, some migrants include more sugary foods in complementary feeding [24]. The question is whether this occurs due to a lack of knowledge or due to cultural traditions; as for example, in some religions, honey or dates are applied to the infant's palate shortly after birth [24].

Knowledge of complementary food recommendations [25, 26], peer support or support from trained health professionals had a positive effect on parents' complementary feeding practices [31]. For this reason, according to the aims of the European 2020 strategy to fight discrimination, access to services in the healthcare sector for migrants and socio-economically-disadvantaged population groups needs to be improved and new information channels in prevention and health need to be found [36]. This also means: training medical professionals for better understanding the needs of migrants, a better response to these vulnerable groups by the therapeutic and medical fields and the development of special programmes for this purpose. There is currently insufficient communication about empathetic and culturally-sensitive counselling approaches in the training of health personnel [31].

Due to different eating cultures and food availability, the findings of this European literature research cannot be unconditionally transferred to Austria and Germany. Knowledge of national complementary feeding recommendations forms the basis for optimum complementary feeding behaviour. The question therefore arises as to whether families in at-risk groups (migrant background, low socio-economic status, low level of education) are provided with sufficient reliable and understandable knowledge.

It is for this reason that the second part of the publication (Ernährungs Umschau 7/2016) will examine data from a survey in Austria which was collected as part of the "Babycouch" project (www.babycouch.at). The data analysis will focus particularly on answering the question of whether and how the socio-economic status and migrant background of the study population influences complementary feeding behaviour; since, based on this literature research, these factors are especially relevant.

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