

Evaluation of complementary feeding practices and mothers' nutritional knowledge in reference to current Polish recommendations

Agnieszka Koziol-Kozakowska¹, Anna Stochel-Gaudyn¹, Edyta Łuszczki²

¹Department of Pediatrics, Gastroenterology and Nutrition, Institute of Pediatrics, Jagiellonian University Medical College, Krakow, Poland

²Institute of Health Sciences, Medical College of Rzeszów University, Poland

ABSTRACT

Introduction: The method of feeding, the appropriate time of introduction of complementary foods (CF) or the responsive method of feeding is one of many factors that may decide the child's future eating habits and health. The aim of the study was to evaluate complementary feeding practices and mothers' knowledge of early childhood nutrition in reference to current recommendations.

Material and methods: The study was performed between January and March 2022 and included 399 healthy mothers of a healthy child aged 12-24 months, who completed an online questionnaire. The average age of children was 16.3 ± 11.0 months.

Results: In the study group 50.2% of the children were breastfed (5% exclusively breastfed) in the first 6 months of life. Fifteen percent (15.7%) of mothers decided to stop breastfeeding for non-medical reasons. Forty seven percent (47.1%) of women introduced complementary foods at the age of 5-6 months (17-26 week), 15% before the recommended time and 27.8% after. Mothers with higher education introduced earlier into their child's diet such products as vegetables, dairy products like yogurt and cottage cheese, finger foods, and baby cereal but later gluten and fish. In the study 31% of mothers had a high level of knowledge of current infant nutritional recommendations. The lowest rate of proper answers in the knowledge test was given to questions regarding sugar added to baby products (19.8%) and the benefits of using baby cereal (23.6%) and timing of introducing dairy products to the diet (29.1%). The main source of nutrition knowledge reported by the mothers was the Internet; only 14% of them consulted a physician on this issue.

Conclusions: The mothers' knowledge about current recommendations regarding appropriate infants' nutrition is not sufficient. The complementary feeding practices should be improved, especially as regards the low percentage of exclusively breastfeeding mothers, the delayed time of expanding the diet and too many meals consumed during the day.

KEY WORDS: infant, complementary feeding, breastfeeding, diet, nutritional knowledge.

ADDRESS FOR CORRESPONDENCE: Agnieszka Koziol-Kozakowska, Department of Pediatrics, Gastroenterology and Nutrition, Institute of Pediatrics, Jagiellonian University Medical College, 265 Wielicka St., 30-663 Krakow, Poland, e-mail: agnieszka.koziol-kozakowska@uj.edu.pl

INTRODUCTION

Adequate nutrition of children in their first year of life is crucial to their healthy growth and development. It also may prevent disease development in the future [1]. A woman's breast milk is rich in components that positively stimulate the immune system starting right after

birth; thus breastfeeding is beneficial and recommended at least for the first 6 months of life [2]. Once breast milk is no longer sufficient in fulfilling infants' nutritional needs complementary feeding should be introduced to prevent deficiencies and secure the appropriate growth and development of a child. The portions, textures and

types of complementary feeds should be adjusted to the child's psychomotor skills as well as to their health condition, and family and local eating habits. The most advantageous time and order of complementary feeds' introduction is still a source of ongoing discussion causing variations of existing guidelines [3]. According to the recommendations by the Polish Society of Gastroenterology, Hepatology and Child Nutrition, which were published in 2014 and updated in 2021, complementary feeds should be introduced not earlier than in the 17th week and not later than in the 26th week [4]. Diet modification should not lead to discontinuation of breastfeeding, which should be maintained until the second year of life, which is in line with the European Society for Pediatric Gastroenterology, Hepatology and Nutrition (ESPGHAN) [3]. Even though there is no one best age at which every child should receive complementary feeds, since it depends on the child's individual features and development, it is important to present a variety of textures and flavors to an infant in a correct time window. Early exposure to different meals may modify and influence a child's future nutritional preferences [5, 6]. The introduction of potentially allergenic foods in the second half of the first year of life is as important, thus minimizing the risk of developing a food allergy in the future [7]. Appropriate parental knowledge of existing guidelines and recommendations related to infant feeding is extremely important since mistakes made in this key period of life may directly affect a child's health and development.

The aim of the study was to evaluate the complementary feeding practices and mothers' knowledge of early childhood nutrition in reference to current recommendations. To the best of our knowledge, this is the first study after the revision of the Polish children's nutrition recommendations.

MATERIAL AND METHODS

STUDY DESIGN AND POPULATION

This cross-sectional study was conducted via the Internet. Mothers of healthy children aged 12 months to 24 months were eligible to participate. The following inclusion criteria for the study were used: healthy mothers of a healthy child aged 12-24 months. The exclusion criteria were: prematurity, diseases affecting the child's diet (allergies, heart disease, kidney disease, diseases of the nervous and digestive systems), pregnancy with complications. Four hundred and nine mothers completed the online questionnaire. Finally the inclusion criteria were fulfilled by 399 participants. Completing the questionnaire was tantamount to consenting to participation in the study.

Target recruitment was a minimum of 350 mothers collected via convenience sampling in the south-east part of Poland (Podkarpackie and Malopolskie Voivodships). Mothers of the children in the defined age group

who resided in the region were eligible to participate. Participants were recruited through social media advertising and by snowball sampling. Passive recruitment via social media sites involved distributing recruitment materials (ads, posters, flyers) with the aim of attracting potential participants to contact the research team for more information and for consideration of enrollment.

The participants were assured of their voluntary participation and of the anonymity of the study. Assuming a 5% error threshold and a test power of 0.95 for this population size, the number of participants was sufficient and representative of the population of mothers from the south-eastern region of Poland.

The questionnaire was validated in a pilot study with a group representing 10% of the calculated group size. As a result of the pilot, changes were made to the knowledge test. Finally the questionnaire (Google survey form) consisted of three parts containing 48 questions altogether. The first part consisted of sociodemographic information such as sex, age, level of education and place of residence of the mothers. The second part concentrated on such data as the source of information on infant nutrition, method of infant feeding, time, and method of complementary feeding introduction. Exclusive breastfeeding was defined based on the WHO definition as giving no other food or drink – not even water – except breast milk with the exception of oral rehydration solution, drops, syrups of vitamins, minerals or medicines. The third part of the questionnaire presented a test for mothers containing 16 questions regarding knowledge of infant nutrition in reference to current recommendations, with possible answers: true, false, do not know. Each correct answer was awarded 1 point. If the respondents did not know the answer to a question or gave an incorrect answer, they received 0 points. Based on the summed number of points groups were created regarding the level of their nutritional knowledge. Mothers who answered 50% or less of the items correctly (≤ 8 questions) were classified as having low nutritional knowledge, those who answered between 51 and 75% correctly (between 9 and 12 questions) were classified as having medium nutritional knowledge, while mothers with 75% (between 13 and 16 questions) correct answers were classified as having high nutritional knowledge.

In the analyses of the feeding practices and the distribution of correct answers in the knowledge test the level of mothers' education (medium, higher) and age (younger vs older mothers) was taken into account. The study group was divided according to age and education as follows: younger mothers (< 30 years old), older mothers (≥ 30 years old), level of education: medium and higher; higher doctoral school. In the studied group, only 2% of mothers had primary education; therefore no separate category was distinguished for this level of education. The research tool is available from the authors.

TABLE 1. Characteristics of the study group depending on mothers' level of education

Variable	Total (%), N = 399	Level of mothers' education		p-value
		Medium (44%), n = 176	Higher (56%), n = 223	
Gender of children				
Boys	54.2	53.9	53.7	NS ^a
Girls	45.8	46.1	46.3	
Age of mothers (years)				
< 19	2.5	2.0	0.0	0.0203 ^b
19-30	42.0	43.0	40.0	
31-40	52.5	51.2	58.1	
> 41	3.0	3.8	2.0	
Place of residence				
Village	22.2	32.3	17.1	0.0014 ^a
Town	77.8	67.7	82.9	

^a – result of χ^2 test, ^b – result of Mann-Whitney U-test

Level of education: medium – high school; higher – university, PhD; NS – statistically insignificant.

DATA ANALYSIS

All the collected data were analyzed statistically with Statistica 13.0 software (StatSoft). Due to the lack of a normal distribution of quantitative data (the Shapiro-Wilk statistic test for testing the normality was used), we used the Mann-Whitney U test or the Kruskal-Wallis test, which were used to check the association between infant feeding practices and sociodemographic variables. If the Kruskal-Wallis test was significant, a post-hoc analysis was performed to determine which groups differed from each other group. A chi-square test was used to check the association between categorical variables. A p-value less than 0.05 was considered to indicate a statistically significant result.

ETHICS

The research was conducted following the Declaration of Helsinki for medical research [8]. The study was approved by the institutional Bioethics Committee at the University of Rzeszów (Resolution No. 15/12/2015) and all appropriate administrative bodies.

RESULTS

The average age of children was 16.3 ± 4.30 months. The studied group's characteristics are presented in Table 1.

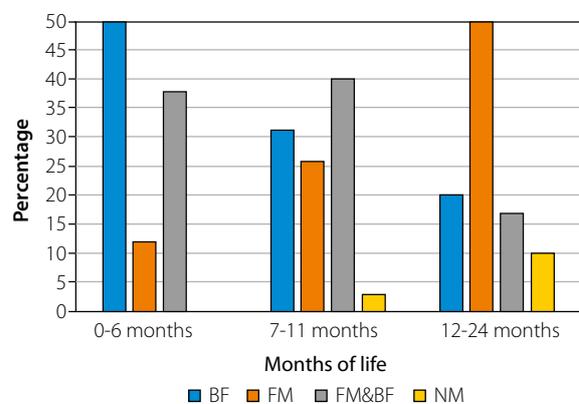
In the studied group, 69.6% of mothers declared good knowledge of current guidelines regarding infant nutrition, 14.9% of mothers declared medium knowledge of recommendations and 15.5% of mothers were not familiar with the current guidelines at all. A greater knowledge of guidelines was declared by older mothers (> 31 and 40 years old) and those with higher education ($p < 0.05$).

The main source of knowledge about infant nutrition reported by the mothers was the Internet (81%), physicians

were placed second (14%), third were friends and family (3%) and fourth were nurses (1.4%) and dietitians (0.6%).

In the studied group, 50.2% of infants were breastfed for the first 6 months, whereas the proportion of children exclusively breastfed in that period was 5.0%. Between 7 and 12 months 31.1% of children were breastfed in parallel with expanding the diet, and 20% after 12 months.

In the first six months of life, 12% of children were baby milk formula fed, between 7 and 12 months 25.9% of children and after one year 53%. Combining breastfeeding and formula feeding was also practiced; in the first six months 37.8% of women were using these two methods, 40.1% in the second half of the year and after one year it was 17%. Between 7 and 12 months old 3% of children were fed with unmodified cow's milk, after one year of life 10% (Figure 1). The main reason given for breastfeeding discontinuation was health issues (42.1%) such as medications taken by the mother, child's allergies, breast inflammation, birth com-



BF – breast feeding, FM – formula milk, FM & BF – mix formula and breast feeding, NM – non formula milk (not modified cow or goat milk)

FIGURE 1. Feeding practices in reference to the age of infant

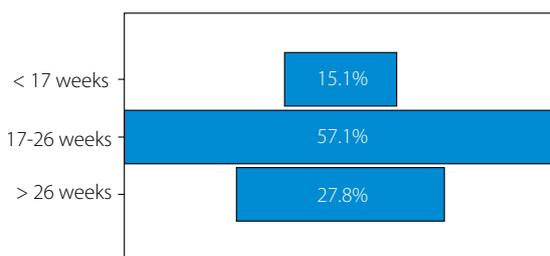


FIGURE 2. Timing of complementary feeding introduction

plications or mother’s depression. Lack of breast milk was placed second as a reason for breastfeeding discontinuation (39.2%), while 15.7% of mothers decided to stop breastfeeding for non-medical reasons. The method of complementary feeding introduction was assessed in reference to the mother’s nutritional knowledge. Mothers with higher nutritional knowledge breastfed their children longer ($p = 0.023$).

In the study group 47.1% of women introduced CF at the age of 17-26 weeks, 15% before 17 weeks, 27.8% after 26 weeks (Figure 2). Vegetable pulp was the most frequently chosen first complementary food (64%), fruit pulp placed second and was chosen by 12.3% of mothers, 8.6% of mothers chose baby cereal and 1.5% chose different products. The mean age in months of complementary food introduction was 6.2 (1.2 SD). Eggs, 8.7 (2.69 SD), as well as iron-fortified baby cereal, 8.1 (2.8 SD), and “finger food” products, 9.3 (3.27 SD), were introduced into the diet the latest Table 2.

The timing of type of complementary food introduction into infant diet varied significantly regarding the age and education of the mother. Mothers with higher education introduced earlier into their child’s diet such

products as vegetables, dairy products like yogurt and cottage cheese, finger foods, and baby cereal but later gluten and fish. Older mothers introduced later to their children’s diet such products as fish, eggs, dairy products, and baby cereal, whereas they introduced gluten earlier on (Table 2).

The first vegetable that was most frequently introduced to the child’s diet was carrot (60.6%), and among fruit it was apple (86%). Turkey was most frequently chosen by mothers as the first meat meal for their children (59.4%), and chicken was placed second (57.2%). Among fat sources, butter was the most frequently chosen (62%). Ninety one percent of the infants received water as a drink: 54.7% received boiled tap water and 45.3% spring water. The number of meals during the day was reduced with age from 7 or more in the first months to 5 by the age of 9-12 months (Figure 3). Eighty-five percent (85.5%) of mothers supplemented their children with vitamin D₃. It was supplemented either as drops or twist-off capsules.

The survey included a question regarding the way of complementary feeding introduction. Seventy five percent of respondents reported the traditional method of complementary food introduction (by spoon) whereas 35% of mothers reported using the “baby-led weaning” method (BLW). Mothers with higher education more frequently chose the BLW method ($p = 0.001$). Over half of the questioned mothers prepared complementary foods (CF) themselves (53%), whereas 47% of the mothers used commercial ready-to-eat products.

In the nutritional knowledge test the distribution of answers was as follows: the largest group consisted of mothers with medium nutritional knowledge (42.8%), the second group in numbers consisted of mothers with high

TABLE 2. Average age (in months) of introducing products into the diet by level of education and age of the mothers

Variable	Total, N = 399	Mother’s age		p-value	Level of education		p-value
		< 30 years, n = 263	≥ 30 years n = 136		Medium, n = 176	Higher, n = 223	
Age of introduction of CF	6.2 (1.2)	5.9 (0.8)	6.3 (1.2)	NS	6.9 (1.4)	7.1 (1.6)	NS
Fruits	5.2 (2.1)	5.0 (2.0)	5.5 (2.4)	NS	5.0 (2.2)	5.1 (2.4)	NS
Vegetables	4.9 (2.0)	4.9 (1.9)	5.1 (1.1)	NS	5.3 (1.1)	4.8 (1.1)	< 0.05
Fish		6.4 (2.4)	8.4 (2.4)	< 0.001	6.7 (1.9)	7.7 (2.3)	< 0.001
Meat	5.9 (2.3)	6.5 (1.3)	6.9 (2.2)	NS	6.0 (1.2)	6.4 (2.1)	NS
Eggs	8.7 (2.7)	8.6 (1.7)	9.7 (1.0)	< 0.05	8.6 (1.7)	8.7 (1.2)	NS
Dairy products	7.0 (2.9)	7.2 (1.8)	8.0 (1.0)	< 0.05	7.2 (1.7)	8.2 (1.2)	< 0.001
Iron-fortified baby cereal	8.1 (2.8)	8.0 (2.4)	8.1 (1.8)	NS	8.0 (1.4)	8.2 (1.5)	NS
Baby cereal	5.6 (2.4)	4.6 (2.1)	5.7 (2.1)	< 0.001	5.0 (2.0)	5.8 (2.1)	< 0.05
Finger foods	9.3 (3.3)	8.1 (3.2)	8.9 (2.9)	NS	9.0 (2.2)	8.2 (1.9)	< 0.001
Solid foods	7.7 (2.1)	7.9 (1.8)	8.1 (1.2)	NS	7.8 (2.4)	7.2 (2.4)	NS
Gluten	6.5 (2.1)	7.2 (2.2)	7.6 (1.4)	NS	6.7 (1.4)	8.2 (2.2)	< 0.001

Data are shown as mean (standard deviation); p – Mann-Whitney U-test.

Mother’s age: younger (< 20 and 20-29 years old), older mothers (30-39 and > 40 years old).

Level of education: medium – high school; higher – university, PhD; NS – statistically insignificant.

nutritional knowledge (31%), and the smallest group consisted of mothers with low nutritional knowledge (26.2%). The highest rate of proper answers was given to questions about the time breastfeeding in the first six months (92.7% of answers correct), the difference between mother's milk and cow's milk (95%), and timing of introducing eggs (85.8%). The lowest rate of proper answers was given to questions regarding sugar added to baby products (19.8%) and the benefits of using baby cereal (23.6%) and timing of introducing dairy products to the diet (29.1%). The answer distribution is given in Table 3. For every question, a higher rate of correct answers was given by mothers with higher education. Those mothers more frequently gave correct answers to questions regarding the safety and ingredients of baby food products. There was no difference regarding the correct answer rate in reference to mother's age.

DISCUSSION

Adequate nutrition of children in their first year of life is crucial to their healthy growth and development, and it may also prevent disease development in the future [1, 2]. Exclusive breastfeeding in the first 6 months of an infant's life together with appropriate complementary feeding is an optimal and recommended way of feeding according to both the World Health Organization (WHO) and many nutrition societies [3, 4, 9, 10].

In our study, 50.2% of mothers breastfed their children for 6 months and only 5% of mothers decelerated exclusive breastfeeding, whereas the rest of the mothers used either combined breastfeeding with baby formula, switched to baby formula after a short period of breastfeeding or started feeding with baby formula straight after birth. Similar results were found in the previous Polish study PITNUTS, where 54.1% of examined infants were breastfed for the first 6 months, whereas the proportion of children exclusively breastfed in that period was 5.9% [10, 11]. Similarly, Del Mazo-Tome *et al.* in a Spanish study observed that the rate of exclusive breastfeeding was lower than recommended [12]. The most common reason in our research for discontinuing breastfeeding was health issues such as maternal diseases, medications taken by the mother, or lack of breastmilk. That observation is consistent with other studies [13, 14]. In addition, Gianni *et al.* in an Italian study observed that over 70% of mothers reported breastfeeding difficulties such as cracked nipples, perception of insufficient amount of milk, pain, and fatigue in the first weeks after birth, which often led to breastfeeding discontinuation [15]. In our study we observed that quite a high percentage (14.6%) of mothers made the decision of breastfeeding discontinuation based on non-medical reason. These data are supported by other studies where the mother's personal beliefs were also a common reason for breastfeeding cessation [13, 14].

After the first six months of life, infants' nutrient demands start to exceed what breast milk alone can pro-

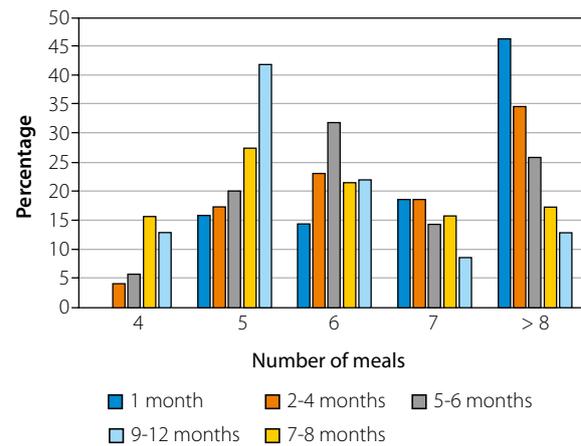


FIGURE 3. Numbers of meals in reference to the age of the infant

vide and this leaves them vulnerable to malnutrition; thus it is crucial to introduce proper complementary feeding at that point of life [3, 4, 6, 16]. Current Polish and European recommendations state that the best time for introducing complementary feeding is between the 17th week and 26th weeks, with emphasis on the fact that no complementary food (or fluids such as baby formula or solid food) should be introduced before the fourth month of life and the introduction should not be delayed beyond the 7th month of the infant's life [3, 4, 10]. In line with that recommendation, available studies show that the majority of mothers introduce complementary feeding between 5 and 6 months [17-19]. Previous Polish studies differ regarding the timing of introducing complementary feeding. In one study it was observed that 61.1% of children received complementary foods earlier than recommended (before the 17th week) and only 30.2% of infants received their first complementary food at the appropriate time, which is between the 17th and 26th weeks, 8.7% later than in the recommendations [9]. In contrast, in another Polish study, more than half of the children (65.0%) were exposed to complementary food between 5 and 6 months of age, whereas introduction after 7 completed months was observed in 32.1% and early introduction (< 4 months) in 3.0% of children [20]. Compared to the PITNUTS study, in our study the number of mothers starting complementary feeding below the recommended time decreased. An increased number of women began complementary feeding after the infant turned 7 and 8 months (almost 30%), which is in line with the study of Zielinska *et al.*, and this is still of concern. Diversity in sociodemographic factors among mothers in reference to the introduction of complementary feeding was observed in a Polish study [20]. Parents who introduced complementary feeding earlier were younger and had a lower education level, which is in line with the results from our study. We observed that older mothers and better educated ones started complementary feeding later than recommended. According

TABLE 3. Level of knowledge and distribution of correct answers in the knowledge test in the studied group

Level of knowledge	Total (%), N = 399	Level of education (%)		Mother's age (%)	
		Medium, n = 176	High, n = 223	< 30 years, n = 263	≥ 30 years, n = 136
Low	26.2	24.8	26.2	27.2	25.1
Medium	42.8	43.2	39.8	39.9	43.1
High	31.0	32.0	34.0	32.9	31.8
Questions	% of correct answers				
Ready-to-eat baby products contain preservatives. (F)	59.1	43.1	59.1*	55.1	54.1
Ready-to-eat baby products are microbiologically safe. (T)	68.4	48.4	68.4*	68.1	67.0
Ready-to-eat baby products are free from sugars and sweeteners added during production. (T)	19.8	18.8	19.8	18.8	17.8
Ready-to-eat baby products have a high nutritional value. (T)	40.9	40.3	41.9	42.9	40.5
According to the recommendations for the first 6 months the baby should be breastfed. (T)	92.7	93.7	95.2	91.2	94.7
The minimum period of breastfeeding is 3 months. (F)	69.7	62.7	69.5	69.1	69.3
According to the recommendations complementary products should be introduced between 17 and 26 weeks of age. (T)	59.1	59.0	66.1*	55.5	54.1
Formula milk has the same nutrient composition as cow's milk. (F)	95.0	94.0	96.0	94.0	97.1
Children aged 9-12 months should eat 5 meals a day. (T)	48.4	48.2	49.1	48.4	47.2
A child may eat an egg for the first time at 12 months old. (F)	85.8	84.8	89.2	83.5	84.7
Dairy products like yogurt or cheese may be introduced into a child's diet from 12 months of age. (F)	29.1	27.1	30.0	26.1	27.1
Fruit juices (100%) can be introduced into the child's diet after the age of 7 months. (F)	41.1	40.7	42.3	42.1	45.1
The permitted amount of juice consumed by an infant is 250 ml per day. (F)	59.6	59.4	61.6	64.6	66.6
The recommended dose of vitamin D supplementation in infants after 6 months of age is 400-600 IU/day. (T)	59.9	54.3	64.3	56.9	62.8
If the infant is not breastfed in the second half of its life it may receive unmodified cow's milk alternately with its mother's milk or infant formula. (F)	77.2	76.1	78.3	72.2	75.3
Baby cereal fortified with iron should be introduced to the diet if the mother continue breastfeeding after 6 months of life (T)	23.6	22.3	33.3*	25.5	27.6

* $p < 0.05$, $p - \chi^2$ test

Mother's age: younger (< 20 and 20-29 years old), older mothers (30-39 and > 40 years old).

Level of education: medium – high school; higher – University, PhD.

F – false, T – true.

to Polish recommendations, the number of meals a day should be from 7 or more in the first month of a child's life to 4-5 meals a day at the age of 9-12 months. It is important that children eat a constant number of meals at regular times to prevent the development of obesity. In our study, we found that 58% of mothers were giving the correct

number of meals to children aged 9-12 months, but that 13% of children in that age ate more than 7 meals a day, which makes us concerned.

Infants' and toddlers' meals can be either homemade or "ready to eat" commercial products. Prepared baby products are under strict sanitary supervision and have

a composition that is defined by the European Commission Directive, whereas home-cooked meals may deviate in terms of nutritional content and differ from children's needs [21]. This was shown in Bernal *et al.*'s study, where homemade meals were significantly lower in energy and had higher fiber and protein content than commercial meals [22]. On the other hand, Carstairs *et al.* in their research found that home-cooked meals provided 26% more energy, 44% more protein and total fat than commercial products but commercial products provided more "vegetable" variety per meal [23]. Having that in mind, we examined the way that mothers prepare meals for their children. The results show that over half of the mothers surveyed prepared baby food by themselves. An interesting observation was made in a German study which showed that a wider variety of vegetables was accepted by children who were fed with commercial meals in the first year of their life compared to those who received home-cooked meals. A lack of consistent and specific international guidelines about homemade meals' portions and content was observed in that study [24].

According to current guidelines potentially allergenic food can and should be introduced to the child's diet in the same time window as other complementary food. Postponed exposure and introduction of such products may increase the risk of developing food sensitivity, allergies, asthma, or eczema, which was shown in studies [1, 5, 7, 11]. In our study such products as eggs, dairy and fish were introduced into the children's diets after six months of age. The same observation was made in another Polish study [9]. In reference to the dietary sources of protein, in our study we observed that the main meat that was used to prepare infant meals was chicken and turkey. Mesch *et al.* in their study observed that different types of poultry and beef were most used, whereas fish was scarcely used [25]. In our study gluten was introduced usually around 6 months, but better educated mothers tended to postpone gluten introduction until the 8th month after birth.

Iron storage with which infants are born usually lasts until the 6th month of their life. After that time breast milk is not sufficient to fulfill a child's requirements for that micro-nutrient, so iron-fortified foods such as cereal products and foods that are natural sources of iron such as meat should be introduced to infants' diets [16, 26]. A systematic review conducted by Obbagy *et al.* in 2019 presented strong evidence that introduction of complementary food containing iron helps maintain adequate iron status and prevents iron deficiency anemia [27]. In our study iron-fortified baby cereal was introduced mostly in the 6th month of age, meat in the 6th month and eggs were introduced in the 8th month, which was later than recommended. Food group diversity is associated with improved linear growth in young children [28]. A diet lacking in diversity can increase the risk of micronutrient

deficiencies, which may have a damaging effect on children's physical and cognitive development. Little or no consumption of nutrient-dense foods such as eggs, dairy products, fruits and vegetables between 6 and 23 months of age in one study was associated with stunting [29].

Food group diversity is also important for developing the acceptance of different products. Acceptance of solid foods develops in an infant together with the development of oral skills. The highest capability of learning chewing skills is present between the 6th and 10th months of a child's life [16]. Snacks given to the hand, so-called finger foods, can be presented to an infant approximately around the 8th month whereas by the 12th month a child should be able to eat every food texture. In our study finger foods were given to the children around the 9th month and solid foods were presented approximately around the 8th month, which was too late and may lead to feeding difficulties later on in life [30]. An interesting observation was made in Rogers' study: infant birthweight and the degree to which mothers perceive them to smile and laugh are key predictors of when they will be introduced to solid food rather than current recommendations [31].

The most traditional way of introducing other textures of complementary foods such as purees is spoon-feeding, which usually is followed by the introduction of semisolid and solid as well as finger foods approximately by the time an infant reaches the 8th month [28]. On the other hand, "baby-led weaning" (BLW) has emerged in the last 10-15 years as an alternative way of infant feeding where a child is feeding himself with hand-held food. This approach enables family food sharing during a meal [32, 33]. It also has other benefits such as encouraging responsive parenting, improvement of the child's autonomy and gaining control over the volume of food and energy intake, which may transfer to overweight and obesity reduction in later life [34]. The same recent studies even show that there is no difference in choking frequency, energy intake or body mass index between the BLW method and the traditional method of feeding [35-37]. In our study, 35% of mothers chose to introduce complementary feeding into their child's diet using the BLW methods, which is more than in another Polish study (16.3%) [20]. Nevertheless, mean time of semisolid or solid food introduction in the whole examined group was rather late, the 8th month for solid foods and the 9th month for finger foods.

A positive observation was made in our study regarding water consumption among the studied group. Ninety one percent of the infants received water as a drink: 54.7% received boiled tap water and 45.3% spring water. Similar results were observed in Heller *et al.*'s study where water consumption among infants of different race and ethnicity was assessed [38].

According to previous studies, 80% of parents declared having knowledge of children's feeding recommendations,

but only one-third of mothers followed them [39, 40]. Similar observations were made in our study, where 70% of mothers regarded themselves as familiar with existing guidelines but only 31% had a high level of knowledge of current recommendations. Only 60% of surveyed mothers in our study answered questions about the time of proper introduction of complementary feeding correctly, while analogous observations were made by other researchers regardless of caregivers' education [38]. The knowledge test we conducted among mothers shows the greatest deficiencies of knowledge in such fields as safety, adequate usage and content of commercial baby foods. This may be due to the fact that over half of the mothers prepared baby food by themselves and 1/3 of examined mothers used the BLW method, which by definition does not use ready-to-eat commercial products.

The main source of knowledge about proper infant nutrition reported by mothers surveyed in our study was the Internet, which complies with results from another Polish study, where only 18.5% of responders referred for recommendations to a physician [41]. This survey also shows that physicians do not discuss in detail topics related to the nutrition of children due to the limited and too short duration of a medical consultation. Lack of time per patients' visit may be one of the reasons why the nutritional information is so scarcely given to patients' parents. In addition, a systematic review of the literature has shown that nutritional topics are insufficiently considered in the medical education system, regardless of the country of medical education, and it does not enable physicians to provide patients with high-quality and effective nutritional care [42]. The necessity of better education of both mothers and fathers, to support exclusive breastfeeding for 6 months, is emphasized. On the other hand, given the increasing amount of evidence that early nutrition has an essential effect both on short- and long-term children's health, this education should focus on improving complementary feeding practices, especially with regard to the age at which complementary feeding should be introduced. This cannot be achieved without better education of healthcare professionals in terms of infant nutrition.

The limitation of this study was the place where the survey was conducted, which is the Internet. This might reduce the representativeness of the group with regard to age and level of education. Younger and better educated people use the Internet more often. However, in our study, the age distribution of the respondents is consistent with the average childbearing age among Polish women. Most children are born in Poland by women between 30 and 34 years old; women giving birth after the age of 40 represent only 2% of the childbearing population [43]. In many studies conducted via the Internet, the tendency to participate in the survey is low, mainly due to the lack of time but also due to the fact that it is simple enough to ignore the invitation, which is not

associated with a feeling of discomfort normally present in a face-to-face refusal.

CONCLUSIONS

Our study shows that mothers' knowledge about current recommendations regarding proper infants' nutrition was not sufficient and the complementary feeding practices were not in line with this recommendations. Particularly worrying is the low level of knowledge in the field of safety of using "ready-to-eat products", the diversity of the diet and the time of introduction of new products into the diet. With regard to nutritional practices, the low percentage of exclusively breastfeeding mothers, the delayed time of expanding the diet (especially eggs, iron fortified products as well as finger food products) and too many meals consumed during the day caused our concern. A positive observation was made regarding more frequent consumption of water among children. Altogether the results of our study lead to the conclusion that greater efforts should be made to ensure a bigger role of health care specialists such as dietitians and pediatricians in nutritional knowledge distribution among parents, regarding infants' feeding. This is the first published study regarding this topic in the Polish population after the update of children's nutritional recommendations in Poland in 2021.

DISCLOSURE

The authors report no conflict of interest.

References

1. Leon DA, Ronalds G. Breast-feeding influences on later life-cardiovascular disease. *Adv Exp Med Biol* 2009; 639: 153-166.
2. Abbass-Dick J, Dennis CL. Breast-feeding coparenting framework: a new framework to improve breast-feeding duration and exclusivity. *Fam Community Health* 2017; 40(1): 28-31.
3. Fewtrell M, Bronsky J, Campoy C, et al. Complementary feeding: a position paper by the European Society for Paediatric Gastroenterology, Hepatology, and Nutrition (ESPGHAN) committee on nutrition. *J Pediatr Gastroenterol Nutr* 2017; 64(1): 119-132.
4. Szajewska H, Socha P, Horvath A, et al. Nutrition of healthy term infants. Recommendations of the Polish Society for Paediatrics Gastroenterology, Hepatology and Nutrition. *Standardy Medyczne/Pediatrics* 2021; 50(8): 1-21.
5. Venter C, Greenhawt M, Meyer RW, et al. EAACI position paper on diet diversity in pregnancy, infancy and childhood: Novel concepts and implications for studies in allergy and asthma. *Allergy* 2020; 75(3): 497-523.
6. Birch LL. Development of food preferences. *Ann Rev Nutr* 1999; 19: 41-62.
7. Greer FR, Sicherer SH, Burks AW, Committee on Nutrition; Section on Allergy and Immunology. The effects of early nutritional interventions on the development of atopic disease in infants and children: the role of maternal dietary restriction, breastfeeding, hydrolyzed formulas, and timing of introduction of allergenic complementary foods. *Pediatrics* 2019; 143(4): e20190281.

8. Puri KS, Suresh KR, Gogtay NJ, Thatte UM. Declaration of Helsinki, 2008: implications for stakeholders in research. *J Postgrad Med* 2009; 55(2): 131-134.
9. Weker H, Brudnicka E, Barańska M, et al. Dietary patterns of children aged 1-3 years in Poland in two population studies. *Ann Nutr Metab* 2019; 75(1): 66-76.
10. Koletzko B, Hirsch NL, Jewell JM, et al. National recommendations for infant and young children feeding in World Health Organization European Region. *J Pediatr Gastroenterol Nutr* 2020; 71(5): 672-678.
11. Greer FR, Sicherer SH, Burks AW, American Academy of Pediatrics Committee on Nutrition; American Academy of Pediatrics Section on Allergy and Immunology. Effects of early nutritional interventions on the development of atopic disease in infants and children: the role of maternal dietary restriction, breastfeeding, timing of introduction of complementary foods, and hydrolyzed formulas. *Pediatrics* 2008; 121(1): 183-191.
12. Del Mazo-Tome P, Suarez-Rodriguez M. Prevalence of exclusive breastfeeding in healthy newborn. *Bol Med Hosp Infant Me* 2018; 75(1): 49-56.
13. Olang B, Heidarzadeh A, Strandvik B, Yngve A. Reasons given by mothers for discontinuing breastfeeding in Iran. *Int Breastfeed J* 2012; 7(1): 7.
14. Odom EC, Li R, Scanlon KS, et al. Reasons for earlier than desired cessation of breastfeeding. *Pediatrics* 2013; 131(3): e726-e732.
15. Gianni ML, Bettinelli ME, Manfra P, et al. Breastfeeding difficulties and risk of early breastfeeding cessation. *Nutrients* 2019; 11(10): 2266.
16. Domellöf M, Braegger C, Campoy C, et al. Iron requirements of infants and toddlers. *J Pediatr Gastroenterol Nutr* 2014; 58(1): 119-129.
17. Zutavern A, Brockow I, Schaaf B, et al. Timing of solid food introduction in relation to eczema, asthma, allergic rhinitis, and food and inhalant sensitization at the age of 6 years: results from the prospective birth cohort study LISA. *Pediatrics* 2008; 121(1): e44-e52.
18. Shrestha S, Pokhrel M, Mathema S. Knowledge attitude and practices among mothers of children 6 to 24 months of age regarding complementary feeding. *JNMA J Nepal Med Assoc* 2020; 58(230): 758-763.
19. Harton A, Myszkowska-Rygiak J. Types of milk and/or its substitutes are given to Children (6-36 Months) in nurseries in Poland: data from the research and education project "eating healthy, growing healthy". *Int J Environ Res Public Health* 2018; 15(12): 2789.
20. Zielinska MA, Rust P, Masztalerz-Kozubek D, et al. Factors influencing the age of complementary feeding a cross sectional study from two European Countries. *Int J Environ Res Public Health* 2019; 16(20): 3799.
21. Directive 2006/125/EC of 5 December 2006 on processed cereal-based foods and baby foods for infants and young children:2006/125/EC (2006). Available from: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32006L0125> (accessed: 19 June 2022).
22. Bernal MJ, Roman S, Klerks M, et al. Are homemade and commercial infant foods different? A nutritional profile and food variety analysis in Spain. *Nutrients* 2021; 13(3): 777.
23. Carstairs SA, Craig LC, Marais D, et al. A comparison of prepared commercial infant feeding meals with home-cooked recipes. *Arch Dis Child* 2016; 101(11): 1037-1042.
24. Hilbig A, Foterek K, Kersting M, Alexy U. Home-made and commercial complementary meals in German infants: results of the DONALD study. *J Hum Nutr Diet* 2015; 28(6): 613-622.
25. Mesch CM, Stimming M, Foterek K, et al. Food variety in commercial and homemade complementary meals for infants in Germany. Market survey and dietary practice. *Appetite* 2014; 76: 113-119.
26. Agostoni C, Canani RB, Fairweather-Tait S, et al. EFSA Panel on Dietetic Products, Nutrition and Allergies (NDA). Scientific opinion on nutrient requirements and dietary intakes of infants and young children in the European Union. *EFSA Journal* 2013; 11(10): 3408.
27. Obbagy JE, English LK, Psota TL, et al. Complementary feeding and micronutrient status: a systematic review. *Am J Clin Nutr* 2019; 109 (Suppl 7): 852S-871S.
28. Onyango AW, Borghi E, de Onis M, et al. Complementary feeding and attained linear growth among 6-23 month old children. *Public Health Nutr* 2014; 17(9): 1975-1983.
29. Aguayo VM, Nair R, Badgaiyan N, Krishna V. Determinants of stunting and poor linear growth in children under 2 years of age in India: an in-depth analysis of Maharashtra's comprehensive nutrition survey. *Matern Child Nutr* 2016; 12 Suppl 1 (Suppl 1): 121-140.
30. Remy E, Issanchou S, Chabanet C, Nicklaus S. Repeated exposure of infants at complementary feeding to a vegetable puree increases acceptance as effectively as flavor-flavor learning and more effectively than flavor-nutrient learning. *J Nutr* 2013; 143(7): 1194-1200.
31. Rogers SL, Blissett J. Infant temperament, maternal feeding behaviours and the timing of solid food introduction. *Matern Child Nutr* 2019; 15(3): e12771.
32. Jones S. A history of baby-led weaning: the evolution of complementary feeding trends. *J Health Visit* 2016; 4(10): 524-530.
33. Brown A, Jones SW, Rowan H. Baby-led weaning: the evidence to date. *Curr Nutr Rep* 2017; 6(2): 148-156.
34. Taylor RW, Williams SM, Fangupo LJ, et al. Effect of a baby-led approach to complementary feeding on infant growth and overweight: a randomized clinical trial. *JAMA Pediatr* 2017; 171(9): 838-846.
35. Brown A. No difference in self-reported frequency of choking between infants introduced to solid foods using a baby-led weaning or traditional spoon-feeding approach. *J Hum Nutr Diet* 2018; 31(4): 496-504.
36. Kumar G. Baby-led weaning did not significantly impact body mass index when compared with traditional spoon-feeding. *Arch Dis Child Educ Pract Ed* 2018; 103(4): 222.
37. Morison BJ, Taylor RW, Haszard JJ, et al. How different are baby-led weaning and conventional complementary feeding? A cross-sectional study of infants aged 6-8 months. *BMJ Open* 2016; 6(5): e010665.
38. Heller KE, Sohn W, Burt BA, Feigal RJ. Water consumption and nursing characteristics of infants by race and ethnicity. *J Public Health Dent* 2000; 60(3): 140-146.

39. Berisha M, Ramadani N, Hoxha R, et al. Knowledge, attitudes and practices of mothers in Kosova about complementary feeding for infant and children 6-24 months. *Med Arch* 2017; 71(1): 37-41.
40. Vitta BS, Benjamin M, Pries AM, et al. Infant and young child feeding practices among children under 2 years of age and maternal exposure to infant and young child feeding messages and promotions in Dar es Salaam, Tanzania. *Matern Child Nutr* 2016; 12 Suppl 2 (Suppl 2): 77-90.
41. Dembiński Ł, Banaszkiewicz A, Dereń K, et al. Exploring physicians' perspectives on the introduction of complementaryf to infants and toddlers. *Nutrients* 2021; 13(10): 3559.
42. Crowley J, Ball L, Hiddink GJ. Nutrition in medical education: a systematic review. *Lancet Planet Health* 2019; 3(9): e379-e389.
43. Statistical Yearbook of the Republic of Poland. Available from: <https://stat.gov.pl> (accessed: 26 June 2022).

AUTHORS' CONTRIBUTIONS

AKK, ASG generated data and made analyzes of the data. AKK, ASG, EŁ worked of the concept and design of the publication. AKK, ASG, EŁ wrote and revises the publication. All authors have their final approval to the final version of the paper.