

Defecation patterns of the infants mainly breastfed from birth till the 12th month: Prospective cohort study

Aysu Duyan Çamurdan¹, Ufuk Beyazova¹, Seçil Özkan², Vildan Taylan Tunç³

¹Department of Social Pediatrics, Gazi University Faculty of Medicine, Ankara, Turkey

²Department of Public Health, Gazi University Faculty of Medicine, Ankara, Turkey

³Department of Pediatrics, Gazi University Faculty of Medicine, Ankara, Turkey

ABSTRACT

Background/Aims: Studies about defecation patterns have been mostly conducted on infants who were breastfed in a short term but were fed predominantly with formula. In this study, defecation patterns of 125 infants, most of them being breastfed during 12th month were evaluated.

Materials and Methods: Frequency, consistency and color of the stool were analyzed in relation to the feeding pattern at the 15th day and at the 1st, 2nd, 3rd, 4th, 5th, 6th and 12th months.

Results: Frequency of defecation was highest in 15th day with a median of 6/day. It decreased with age ($p=0.0001$), being 4/day and 3/day in 1st and 2nd months respectively, and 2/day between 3rd-12th months. During first 5 months, the stool frequency was higher in infants who were exclusively breastfed compared to those being fed with breastfed and formula ($p<0.05$). The effect of the feeding pattern on stool frequency disappeared in the following months ($p>0.05$). Stool frequency decreased by half at the 2nd month when the rate of less than once/day attained its highest value (24.8%). In those who had a rate of less than once/day, stool frequency stayed low until the 6th month and exclusively breastfed rate was also found lower ($p<0.05$).

Conclusion: Besides the age, exclusive breastfeeding was also effective on stool frequency. It points out that infants who are fed with formula in addition to breastfeeding may defecate less than once per day hence should not be diagnosed as having constipation depending solely on defecation frequency and should not receive unnecessary treatments.

Keywords: Stool, stool frequency, stool consistency, stool color, defecation, breastfeeding, feeding pattern

INTRODUCTION

The parents who apply to the Well-Child Clinics usually inquire about stool characteristics of their babies. In order to differentiate the normal from the abnormal; physicians should be informed about the frequency, consistency, and color of the stool of the healthy infant and factors related with these characteristics (1). On the other hand diarrhoea and constipation are frequent complaints of the childhood period. This information is essential also to diagnose diarrhoea and constipation correctly. Previous studies on the defecation patterns of infants were mostly cross sectional and thus they do not show the changes that occur in the same infant's

stool by time. Moreover, most of them have been performed on infants who were breastfed for a brief period and on formula or on complementary feeding (2-4). In this prospective cohort study; we observed a group of chiefly breastfed infants at regular intervals during their first year of life. Through acquiring sequential data stool frequency, consistency, color and the relationship of the feeding patterns with the stool characteristics have been determined.

MATERIALS AND METHODS

This study which was performed in Gazi University Faculty of Medicine Well-Child Clinic in Turkey; includ-

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Address for Correspondence: Aysu Duyan Çamurdan, Department of Social Pediatrics, Gazi University Faculty of Medicine, Ankara, Turkey
E-mail: aysucamurdan@yahoo.com

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ed 125 infants who met the inclusion criteria. Inclusion criteria were: being at term or nearterm (>35 week), singleton, having no defects necessitating the infant to be treated in newborn intensive care unit (NICU), having no congenital defects or neurological injuries and being healthy enough to be discharged from the hospital together with their mothers. Twelve infants were not included in the study because they had been admitted into NICU and 21 were excluded because they were lost to follow-up. The parents were informed that their babies would be followed at the Well-Child Clinic, they would be given periodic appointments, and information about the infant's stool pattern must be collected for one week before the date of appointment, and that they could consult with this clinic at any time if the stool pattern of the infant changes. None of the parents objected giving written informed consent. Information including the infant's gestational age, gender, birth weight and first meconium time were noted. All infants were seen at the end of their 15th day. After the first visit, the infants were followed-up at the last week of each month for 6 months and once again at the 12th month. Every visit included the physical examination of the infants, recording the anthropometric measurements and the feeding patterns. Breastfeeding definitions were adapted using World Health Organisation (WHO) 2008 guidelines as described: Exclusive breastfeeding (EBF) defined as breast milk and any drops, vitamins, or medicines (5). The complaints about the stool frequency, color, consistency or any other defecation problems during the last week before the visit were inquired. The definition of stool frequency was assumed as: the mean number of stools that occurred during the last week. The stool color was categorized as green, yellow or brown. The evaluation of the stool consistency was done by the parents as: "hard" if the stool was discrete and formed, "soft" if it was at a puree consistency and "watery" if it was in a liquid state. Constipation was defined as a delay or difficulty in defecation, presented for 2 or more weeks (6) and diarrhoea was defined as "looser or more frequent" stools than is normal for the individual (7). None of the infants was diagnosed with gastrointestinal disease during the time of the one year follow-up.

The local ethics committee has approved the study.

Statistical analysis

Data were analysed using SPSS version 11.5 package program. Quantitative variables were presented as mean \pm standard deviation, median and range, qualitative variables as percent distribution. To test the normality of the stool frequency, the "Kolmogorov Smirnov" test was performed and because it was not normally distributed, non-parametric tests were applied. For statistical analyses Bonferroni corrected Wilcoxon test and Friedman analysis of variance in related samples and Mann-Whitney U test were used for continuous variables. Categorical variables were compared using Chi-square test. Kendall's tau-b non-parametric correlation analyses were performed. $p \leq 0.05$ value was considered as statistically significant.

RESULTS

The cohort was consisted of 125 infants (65 of them were girls). Forty six (37%) of them were born with normal delivery, and seven (6%) of them were nearterm. Mean gestational age of the infants was 38.7 ± 1.3 weeks (range: 35-41 weeks), mean birth weight was 3295.6 ± 513.3 g (range: 1840-4555 g). The mean age of the mothers and fathers were 30.6 ± 4.4 years and 34.7 ± 5.3 years and possessing university degrees by 61% and 70% respectively. The median of the first meconium time was the fifth hour (range: at birth - 100th hour).

Feeding patterns of the infants from birth till the 12th month are presented in Table 1. Overall, the rate of EBF is high at the 15th day (86%), showing a progressive decrease afterwards (43% at the 6th month). At the 6th month all infants, and at the 12th month 80 (77%) of them were still being breastfed. None of the weight percentile curves declined under the 50th percentile at visits from birth till the 12th month.

Stool frequency

Median defecation frequency per day during the follow-up dates is shown in Figure 1. The highest frequency was observed at the 15th day and after that the stool frequency showed a steady decline between the 2nd and 5th months ($p=0.0001$). As shown in Figure 2, median stool frequency per day was higher among the infants being on EBF during the first 5 months of life compared to the infants being formula in addition to breastfed ($p<0.05$). This difference disappeared at the 6th month ($p>0.05$). During study period, stool frequency did not change with gender ($p>0.05$).

At the second month, stool frequency sharply declined by half (Figure 1). Moreover at this time the ratio of the infants defecating less than once per day was at its highest rate (24.8%, $n=31$)

Table 1. Feeding patterns of infants

Follow-up dates	EBF n (%) [*]	BF+F n (%)	BF+OF n (%)	OF n (%)	Total n
15 th day	107(86)	18 (14)	-	-	125
1 st month	98 (78)	27 (22)	-	-	125
2 nd month	92 (74)	33 (26)	-	-	125
3 rd month	88 (71)	36 (29)	-	-	124
4 th month	83 (67)	38 (30)	3 (3)	-	124
5 th month	64 (52)	30 (24)	30 (24)	-	124
6 th month	53 (43)	8 (7)	63 (50)	-	124
12 th month	-	-	80 (77)	14 (23)	104

^{*}row %

EBF: exclusive breastfeeding (defined as breast milk and any drops, vitamins, or medicines); BF+F: formula in addition to breastmilk; BF+OF: other foods (solid or semi-solid) in addition to breastmilk;

OF: other foods

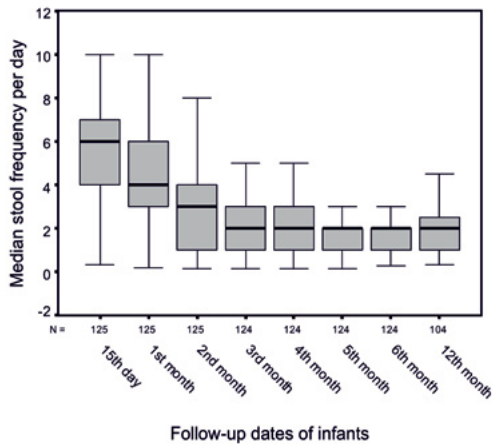


Figure 1. Median stool frequency of infants during their first year of life. The highest frequency was observed at the 15th day and after that the stool frequency showed a steady decline between the 2nd and 5th months ($p=0.0001$)

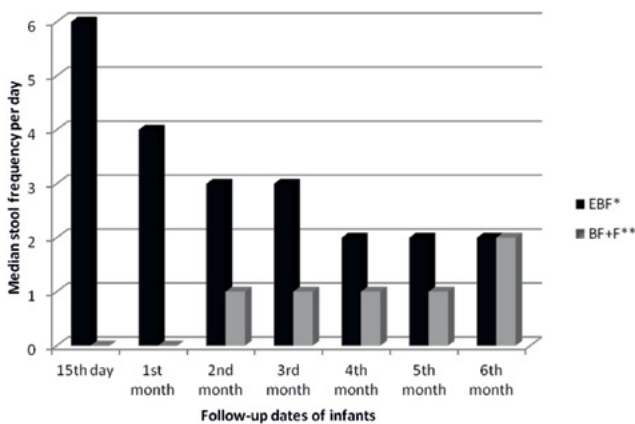


Figure 2. Median stool frequency of infants according to their feeding patterns. Median stool frequency per day was higher among the infants being on EBF during the first 5 months of life compared to the infants being on formula in addition to breastfed ($p<0.05$)

*EBF: Exclusive breastfeeding

**BF+F: Formula in addition to breastmilk

(Table 2). No relationship was observed between defecating less than once per day and the first meconium time ($p=0.491$), gestational age ($p=0.758$), birth weight ($p=0.276$) or method of delivery ($p=1.00$). Only the feeding pattern showed an important effect: the rate of EBF was lower among infants defecating less than once per day between the 2nd- and 5th months ($p<0.05$).

Eight (26%) of the 31 infants defecating less than once per day were defecating once weekly, seven of them were two times per week and sixteen of them three times per week.

Median stool frequency per day until the end of the 6th month stayed lower in infants defecating less than once per day at the 2nd month ($p<0.05$) (Table 3).

Table 2. Distribution of the infants according to defecation frequency

Follow-up dates	Median stool frequency per day	
	<1 n (%)*	≥1 n (%)*
15 th day	1 (1)	124 (99)
1 st month	5 (4)	120 (96)
2 nd month	31 (25)	94 (75)
3 rd month	24 (19)	100 (81)
4 th month	21 (17)	103 (83)
5 th month	21 (17)	103 (83)
6 th month	11 (9)	113 (91)
12 th month	4 (4)	100 (96)

*% row

Table 3. Defecation patterns of the infants according to their stool frequencies at the second month of life

Follow-up dates	Median stool frequency per day in the second month		p
	<1/day* n=31	≥1/day* n=94	
3 rd month	0.5	3	0.0001#
4 th month	0.5	2	0.0001#
5 th month	1	2	0.0001#
6 th month	1	2	0.001#
12 th month	2	1.5	0.474#

*Infants defecating less than once per day at the 2nd month

**Infants defecating once per day or more frequently at the 2nd month

#Mann-Whitney U test performed

Stool consistency and color

Stool consistency changed from watery to hard with increasing age ($r=0.452$, $p=0.0001$). Stool consistency did not change during the first 6 months of life in infants on EBF or on formula in addition to breastfeeding ($p>0.05$). Occurrence of hard stools among infants till the 6th month was quite rare as can be seen in table 4. However, its rate increased to 35% at the 12th month ($n=36$) (Table 4). No relationship was observed between the rate of hard stool at the 12th month and discontinuation of breastfeeding ($p=0.824$).

Stool consistency of the 31 infants defecating less than once stool per day at the 2nd month remained soft during all the follow-up period.

Stool color became darker as the age increased ($r=0.259$, $p=0.0001$). However, in general alteration of the stool color from yellow to brown took almost 12th months (Table 4).

The rate of defecating brown stools, was higher in infants being complementary fed compared to infants on EBF at the 6th month ($p<0.05$).

Table 4. Stool consistency and color of the infants in the study cohort

Follow-up dates n=125	Stool consistency			Stool color			Total n
	Watery n (%)	Soft n (%)	Hard n (%)	Yellow n (%)	Green n (%)	Brown n (%)	
15th day	70 (56)	55 (44)	-	97 (78)	24 (19)	4 (3)	125
1st month	60 (48)	65 (52)	-	96 (77)	27 (21)	2 (2)	125
2nd month	33 (26)	90 (72)	2 (2)	104 (83)	18 (14)	3 (3)	125
3rd month	19 (15)	104 (84)	1 (1)	117 (94)	7 (6)	-	124
4th month	15 (12)	109 (88)	-	121 (97)	2 (2)	1 (1)	124
5th month	7 (6)	116 (93)	1 (1)	93 (76)	21 (17)	8 (7)	124
6th month	1 (1)	122 (98)	1 (1)	76 (61)	29 (24)	19 (15)	124
12th month	1 (1)	67 (64)	36 (35)	19 (18)	37 (36)	48 (46)	104
r* and p	r=0.452, p=0.0001			r =0.259 p=0.0001			

*r: Kendall's tau-b correlation

DISCUSSION

The data presented in this study were obtained through the parents' self reports. These data are believed to be highly accurate since the parents were informed regularly about the fact that they would be asked for information about the infant's stool pattern. Corazziari et al showed that there is no difference between the information about the stool pattern when it is gained from the parents or by 3 days of prospective observation, which leads to the fact that the parents do remember their infants' stool patterns accurately (8).

As was shown in many studies, the stool frequency decrease after the first month and, we also observed similarly that the stool frequency at the first 15 days of life was reduced by half at the end of the 2nd month (2,9-12). The age-related reduction in the frequency of stools points towards a maturation of water-conserving capacity of the gut. Bowel habit is a function of composition of diet and its handling during passage through the gastrointestinal tract (4,13). Contrary to the previous studies, we found that the highest rate of "defecating-less frequently-than once-per-day" took place at the second month. Although the stool consistency was not hard, its frequency decreased till the 6th month when complementary feeding was started. The infants that were defecating less frequently than once per day at the second month maintained this pattern during the following months. In this prospective study we observed that the stool frequency after the first month is a significant determinant for the stool frequency during the first 6 months of life.

Remarkably, the rate of EBF among the infants who were defecating less than once a day was lower than the others. Previous studies on the relationship between the feeding pattern and the bowel habit showed that stool frequency was higher among infants who were being breastfed (3,4,9,12-16). In most of these studies, the breastmilk and formula in the first month have been

compared (3,4). Seventy seven percent of the infants comprising our cohort were still being breastfed at the 12th month and thus in our study the long-term effect of breastfeeding on the stool pattern is well reflected. Since the stool frequency was higher among infants on EBF than the ones who were on formula in addition to breastfeeding during the first 5 months, and the disappearance of the difference between the groups after the 6th month - when the complementary feeding had started unanimously - supports the effect of the feeding pattern on the stool frequency. There can be various reasons for this: the infants on EBF may have been defecating more frequently due to the gastro-colic reflex (9) or due to the water soluble nondigestive carbohydrate content of the breastmilk (17).

Stool consistency was found to be correlated with age as was noticed previously in some other studies (2,8,13). However, in our study, a significant change in the stool consistency did not occur until the 12th month. Breast fed infants were shown to pass softer stools compared to those on formula in addition to breastmilk (12) or on formula exclusively (8,11,13,14,17). The fact that the hardening of the stool in general didn't occur until the 12th month and the lack of difference in the stool consistency of the infants that were breastfed or not at the 12th month supports the fact that breastfeeding protects the infant from defecating a hard stool during early childhood. It has been suggested that infants who are breastfed have a different stool composition particularly in relation to lipid, mineral and carbohydrate fractions. Calcium and fatty acid content of the stool is positively related with stool hardness. The reason of the paucity of fatty acid soaps in the stool of the infants who are being breastfed is the fact that the bile salt-stimulated lipase provides high digestibility to the fats'. Feeding pattern being more important, both the diet and the soaps are independently related to stool hardness. Another significant factor is the strong affinity of the water-soluble complex carbohydrates for water - which are the major components of stools of breastfed infants - contributing to stool softness (17).

Loening-Baucke et al pointed out that 35% of the infants diagnosed with functional constipation are in fact defecating every other day or less than 3.5 per week (18). Defecation frequency and hard stool are good indicators for characterizing constipation in infancy (3,18). In our study, half of the infants that were defecating less frequently than once per day at the second month were the infants that were defecating at a rate of less than or equal to 2 per week and since there wasn't any organic problem, it would be wrong to diagnose these infants as constipated and to start a treatment. During the survey none of the infants were approached in relation to constipation and they manifested the same features of growth, development and health as their peers who were defecating more frequently. This study encouraged us to suggest that constipation criteria for children under the age of two should be elaborated and separate criteria should be generated especially for the infants on EBF. Bekkali et al pointed out that from the 2nd week till the age of 2, the infants defecate at least once a day and thus some of the items of the Rome III criteria for constipation needs to be changed such as; instead of defecating less than three times a week defecating less than once a day should be adopted in addition to other symptoms such as hard stools or straining (3). Even though in our previous cross-sectional study we also found that the median stool frequency between the 2nd and 24th month was once per day (12). In this present study in which the infants were followed prospectively it was clearly shown that, actually, there exists a group of infants defecating less than once a day at a soft consistency so that these infants have their own ongoing stool patterns and thus they don't deserve to be diagnosed wrongly as experiencing constipation. Although this result supports Bekkali et al's suggestion that diagnosis of constipation should not be reached only by the stool frequency but the stool consistency should also be taken into consideration, our findings differ from Bekkali et al's (3) in regard to the suggested defecation frequency for the diagnosis of constipation.

According to our study, although the stool color gets darker with age, contrary to the results of the other studies in general the stool color didn't change from yellow to brown till the 12th month (2,13). The main reason for this may be the fact that the infants in our study group were breastfed predominantly and 77% of the infants' continued breastfeeding till the 12th month. In their large-population-based cohort study Steer et al reported that the most common stool color at the 6th month was brown and the possible reason for this may be the introduction of solids. Since in their study at the 4th week 41% of the infants were on EBF and 45% of them were fed with formula, with great probability, the major feeding pattern of these infants was not EBF at their 6th month (2).

In this prospective cohort study, we observed that stool frequency after the first month is a significant determinant of it during the first 6 months of life, and showed that together with the age factor EBF is effective on stool frequency. Our results point out that healthy infant with ample growth rate which are fed with formula in addition to breastfeeding may defecate less

than once per day hence they should not be diagnosed as having constipation depending solely on defecation frequency and should not receive unnecessary treatments.

Conflict of Interest: No conflict of interest was declared by the authors.

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