

BOWEL MOVEMENTS OF NORMAL THAI INFANTS

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Abstract. The aim of this study was to define the bowel movements of healthy Thai infants up to 12 months of age. Fifty infants were evaluated at 1, 2, 4, 6, 9 and 12 months of age. Data regarding bowel habits was recorded by parents daily for 2 days before coming to the hospital at each visit. The mean frequency of bowel movements per day was maximal (3.16 stools) during the newborn period and declined (1.59 stools) by the age of 12 months. At birth stool consistency was mostly runny, and became consistently more solid by 4 months of age. With increasing age, infants produced larger stools: mean volume of stool was 32.7 ml at 1 month of age and increased to 45.34 ml at 12 months. Infants started to have regular bowel movements at 4 months of age, most of them stopped having bowel movements at night by 3 months.

INTRODUCTION

Data regarding the normal patterns of adult bowel habits is found from all over the world (Heaton *et al*, 1992; Levy *et al*, 1993; Olubuyide *et al*, 1995; Chen *et al*, 2000; Fang *et al*, 2001; Bassotti *et al*, 2004; Cummings *et al*, 2004; Sanjoaquin *et al*, 2004). They show the frequency of defecation for most adults is one stool a day (Heaton *et al*, 1992; Chen *et al*, 2000; Bassotti *et al*, 2004; Cummings *et al*, 2004) with most people passing stool between three times a day and three times a week (Olubuyide *et al*, 1995; Chen *et al*, 2000; Cummings *et al*, 2004). Most published information regarding bowel movements in

infants and children is reported from Western countries (Colon and Jacob, 1977; Bloom *et al*, 1993; Sievers *et al*, 1993; Hyams *et al*, 1995; Corazzian *et al*, 2005). There was some information from Africa (Lewis and Kale, 1978; Akinbami *et al*, 1995), the Far East (Myo-Khin *et al*, 1994; Chen *et al*, 2002) and a few from Thailand (Osatakul *et al*, 1995). The study from Thailand was done more than 10 years ago in southern Thailand. Since then there have been some changes in diet and the daily life of Thai infants.

Previous studies have shown stool frequency declines with age (Lemoh and Brooke, 1979; Weaver and Steiner, 1984; Weaver *et al*, 1988; Fontana *et al*, 1989; Akinbami *et al*, 1995; Osatakul *et al*, 1995; Tham *et al*, 1996; Cummings *et al*, 2004) and infancy is the period with the maximum frequency in stools, with large variations in bowel movements. With increasing age, the stools became larger (Lemoh and Brooke, 1979; Osatakul *et al*, 1995) and harder (Weaver and Steiner, 1984) which may be due to maturation of the child's gastrointes-

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tinal tract, a change in diet or both. There is no data in those studies about what age children start to have regular bowel movements and stop having bowel movements at night.

Most previous studies were cross-sectional. In our longitudinal study, we were interested in the changes in bowel habits of infants over time by observing and recording the bowel movements at different ages in order to establish an accurate age when children begin to have regular bowel movements. The information may benefit in helping parents understand their children's gastrointestinal physiology and the timing at which children can start toilet training.

This study was undertaken with the objectives of: (1) characterizing stool patterns in the majority of Thai infants who were fed and taken care of in a traditional way, (2) the age at which infants began to have regular bowel movements, and (3) the age infants stopped having bowel movements at night.

MATERIALS AND METHODS

Subjects

Fifty infants born at Princess Maha Chakri Sirindhorn Medical Center, Srirachulwirot University, Nakhon Nayok, Thailand were followed until 12 months old. They were recruited from the well baby clinic at 1 month of age. All were healthy infants with normal growth and development. The infants were evaluated 6 times, at 1, 2, 4, 6, 9 and 12 months. The data was collected from July 2003 to May 2005.

Methods

Ethical approval was obtained from the Research Ethics Committee of the Srirachulwirot University prior to commencing the study. Informed consent was obtained from the parents of each child. Parents were asked to record the number of stools passed per day, two days before coming for a fol-

low-up at the well baby clinic. Other information concerning bowel habits composing of (1) the consistency of stools (2) volume of stools (3) the age of regular bowel movements (4) the age the infants stopped having bowel movements at night (from 8:00 PM until 6:00 AM) (5) the age when parents started feeding solid food and (6) the types of milk, were obtained by interviewing the parents at the well baby clinic. A set of stool models of different sizes was used to help parents judge the size of their infants' stools. These stool model sizes were of 5, 15, 25, 40 and 60 ml. Before being asked about the consistency of the stools, parents were verbally given the full details of each stool-consistency item, to ensure that the interviewer and parents shared a common understanding. The consistencies of stools were described as watery, runny, soft, formed and hard stools. Regular bowel movements meant the infant had a bowel movement nearly the same time each day, where the mothers could predict when her child would have a bowel movement.

RESULTS

Characteristics of the studied population

A total of 50 infants were studied, comprised of 28 males (56%) and 22 females. The predominant occupation of infants' fathers was "employee" (57.1%) and mothers' was "unemployed housewives" (46.9%). The average income of the fathers was 11,059.18 THB/month (0, 50,000) and mothers' was 4363.27 THB/month (0, 30,000). Sixty percent of infants were taken care of by their mothers and 34% by their grandmothers.

Dietary history

A dietary history revealed breast-feeding was maximum in 26% (13 of 50) of infants age 4 months. As age increased, this percentage declined to 6.82% (3 of 44) at the age of 12 months (Table 1).

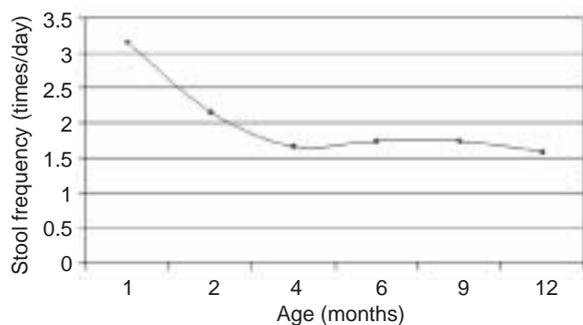


Fig 1—Mean stool frequencies in infants age 1 to 12 months.

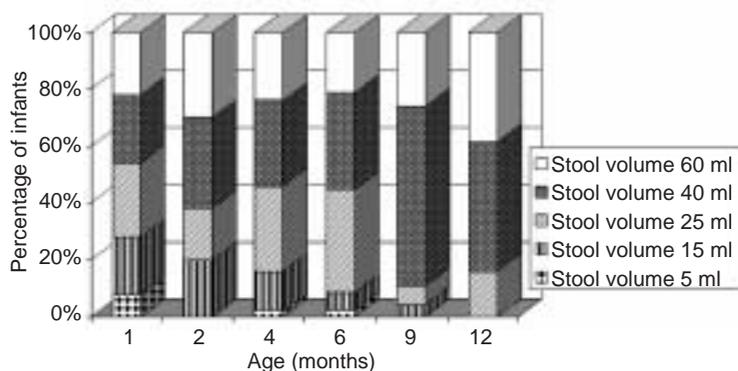


Fig 2—Percentages of infants with stool volumes of 5, 15, 25, 40 and 60 ml at each age from 1 to 12 months.

Solid food was first introduced in 81.6% (40 of 49) of infants at the age of 4 months and in all infants by 6 months of age.

Bowel habits

Stool frequency. The mean frequency of stools in each age group is shown in Fig 1. Stool frequency during the newborn period was highly variable, ranging from one stool per day to 10 stools per day. The mean frequency of stools was maximal during the newborn period, (3.16 per day) and declined significantly with increasing age to 1.59 stools per day at 12 months as shown in Table 2.

Volume of stools. The mean volume of stools was 32.7 ± 17.96 ml at 1 month of age and increased to 45.34 ± 12.87 ml at 12 months (Table 2). Most children at ages 9 and 12 months old produced stools of 40 and 60 ml, respectively, as shown in Fig 2.

Table 1
Type of milk intake in normal Thai infants.

Age (months)	Number of patient with data	Type of milk		
		Breast milk No. (%)	Formula milk No. (%)	Mixed breast milk and formula No. (%)
1	50	12 (24)	11 (22)	27 (54)
2	50	12 (24)	22 (44)	16 (32)
4	50	13 (26)	30 (60)	7 (14)
6	47	9 (19.1)	34 (72.3)	4 (8.5)
9	46	4 (8.7)	38 (82.6)	4 (8.7)
12	44	3 (6.8)	38 (86.4)	3 (6.8)

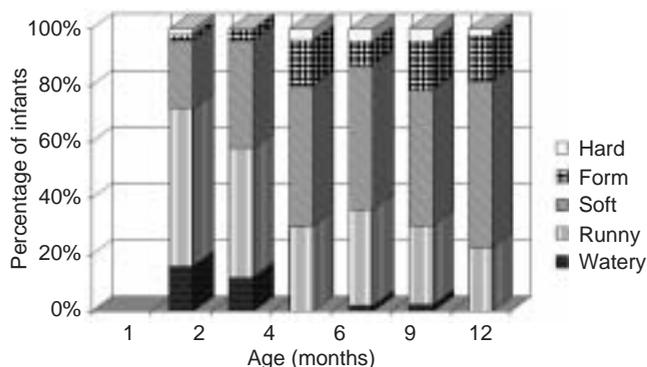


Fig 3—Percentages of infants at each age passing watery, runny, soft, form or hard stools.

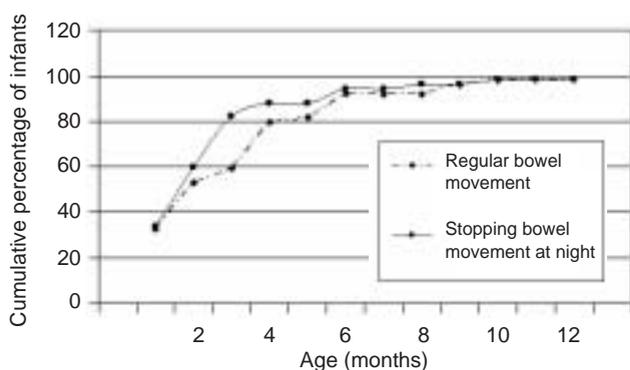


Fig 4—Cumulative percentage of infants who had regular bowel movement (N=49) and stopped having bowel movements at night (N=50), from 1 to 12 months of age.

Consistency of stools. Runny stools were found in most infants aged between 1 and 2 months. At 4 months or older, most infants produced mainly soft stools as shown in Fig 3.

Age of having regular bowel movements and stopping bowel movements at night. We found that 79.6% (39 of 49) of infants had regular bowel movements by age 4 months and nearly all infants (98%) had regular bowel movements by 10 months (Fig 4). Solid food introduction had no statistically significant association with regularity of

bowel movements ($p = 0.172$). Infants with regular bowel movements before or at the age of 4 months were defined as the group with early regular bowel movements. We found this group of infants had less formed and hard stools (17.9%) compared to the group with late regular bowel movements (30%) as described in Table 3 ($p = 0.405$). Eighty-two percent (41 of 50) of infants stopped having bowel movements at night by 3 months of age and only 2% (1 of 50) continued having bowel movements at night by the age of 8 months as shown in Fig 4.

DISCUSSION

Our results show the mean stool frequency was maximal among infants age 1 month at 3.16 times per day with variations, and declined with increasing age to 1.59 times per day at 12 months. The stool volumes increased from 32.7 ml at 1 month to 45.3 ml at 12 months. Most infants age 9 to 12 months had stools ranging from 40 to 60 ml. Infants age 1 to 2 months had mostly runny stools. However, by 4 months, the infants produced mostly soft stools.

In comparison with previous studies, our study had the same findings regarding stool frequency declining with increasing age (Lemoh and Brooke, 1979; Weaver and Steiner, 1984; Weaver *et al*, 1988; Fontana *et al*, 1989; Akinbami *et al*, 1995; Osatakul *et al*, 1995; Tham *et al*, 1996; Arias *et al*, 2001; Cummings *et al*, 2004) with stool volume increasing (Lemoh and Brooke, 1979; Osatakul *et al*, 1995) and stool consistency being mainly soft (Weaver and Steiner, 1984;

Table 2
Stool frequency and volume in normal Thai infants.

Age (months)	Number of patient with data	Mean stool frequency (time/day) \pm SD	Stool volume, ml (%)					Mean stool volume (ml) \pm SD
			5 ml	15 ml	25 ml	40 ml	60 ml	
1	50	3.16 \pm 2.39	4 (8)	10 (20)	13 (26)	12 (24)	11 (22)	32.7 \pm 18.0
2	50	2.26 \pm 1.79	0 (0)	10 (20)	9 (18)	16 (32)	15 (30)	38.3 \pm 17.0
4	50	1.66 \pm 0.72	1 (2)	7 (14)	15 (30)	15 (30)	12 (24)	36.1 \pm 16.3
6	47	1.74 \pm 1.22	1 (2.1)	3 (6.4)	17 (36.2)	16 (34)	10 (21.3)	36.5 \pm 15.0
9	46	1.74 \pm 1.02	0 (0)	2 (4.3)	3 (6.5)	29 (63)	12 (26.1)	43.2 \pm 11.8
12	44	1.59 \pm 0.95	0 (0)	0 (0)	7 (15.9)	20 (45.5)	17 (38.6)	45.3 \pm 12.9

Table 3
Comparison of stool consistency at 4 months of age between early and late regular bowel movements ^a.

Consistency of stool at age 4 months	Early regular bowel movements No. (%)	Late regular bowel movements No. (%)
Runny	11 (28.2)	3 (30)
Soft	21 (53.8)	4 (40)
Formed	5 (12.8)	3 (30)
Hard	2 (5.1)	0

^aLate regular bowel movement means infants who had regular bowel movements at an age older than 4 months.

Osatakul *et al*, 1995). Our findings are comparable with a previous study in Thailand in 1995 (Osatakul *et al*, 1995), except for larger mean stool volume. Osatakul *et al* (1995) found a mean stool volume at 1 month of age was 16.1 ml and increased to 35.4 ml by 48 to 72 months old. The same patterns of stool frequency and consistency across several studies from the past until now probably reflect the normal physiology of infant gastrointestinal tract development that has not changed much over time.

Most infants in our study (79.6%) had regular bowel movements by age 4 months

and 82% of infants by age 3 months stopped having bowel movements at night. We did not find data from any source regarding the age when infants have regular bowel movements and stop their bowel movements at night. There are two hypotheses to explain the regularity of bowel movements. Firstly, most of the infants in our study (81.6%) were given solid foods by the age of 4 months. It is known that bowel habits are influenced by dietary intake and nutrient composition of meals (Brown *et al*, 1990; Rao *et al*, 2000; Sanjoaquin *et al*, 2004; Elia and Cummings, 2007; Zutshi *et al*, 2007). The change of diet

may have caused the bowel habits to become regular. However, we did not find any association between solid foods introduction and regularity of bowel movements in our study. This may be caused by the small study population. Secondly, there is evidence suggesting the intestines of infants continue to develop after birth (Thompson *et al*, 1998; Donovan, 2006). Infants change from irregularity in daily life in regards to sleeping and eating to becoming more predictable. Thus, the bowel movements of infants follow the gastrointestinal tract development, and become regular over time. Therefore, we propose that most infants start to have bowel movements more regularly and predictably at 4 months of age. Although the data in this study does not show an association between having hard stools with later ages of having regular bowel movements, further studies with more subjects are needed before making further conclusions.

We hypothesized that most infants in our study stopped their bowel habits at night by the age of 3 months because of changes in their sleeping and feeding patterns. Previous data show that infants can sleep through the night until morning by the third month (Jaffa *et al*, 1993) because of more organized central nervous system maturation (Stein, 1992). The evidence also shows that bowel movements decrease during sleep (Kumar *et al*, 1990; Christensen, 1994). Bowel movements stop at night when the sleeping period is longer through the night. In general pediatric practice, parents are recommended to start skipping the night feeding at around 3 months of age in order to let infants sleep through the night which may also affect the bowel movements at night. Unfortunately, we have no data regarding the feeding schedule to prove this association.

Our longitudinal study has limitations. Firstly, the size of the studied population was small. This makes comparison using statis-

tical analysis difficult. Secondly, the stools were not weighed. We used models of stools in order to estimate stool volume. We used a diary for recording the stool frequency. The longitudinal study has more accurate information regarding the age at which infants begin having regular bowel movements and stop having bowel movements at night than recalled data in cross-sectional studies. We also observed changes in the bowel movements of the same infants.

We observed an increasing trend in stool weights and a decrease in stool frequencies with increasing age in normal Thai infants. The stools were mostly soft. By 4 months of age, most infants started having regular bowel movements and by 3 months of age most of them stopped having bowel movements at night.

Our results contribute to data regarding bowel habit in infants, and should be beneficial for understanding the normal physiology of bowel habits of infants.

ACKNOWLEDGEMENTS

The authors are grateful to the families who made this research possible. The study was supported by the Faculty of Medicine, Srinakharinwirot University.

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