ORIGINAL ARTICLE

Longitudinal study of sphincter control in a cohort of Brazilian children

Denise M. Mota,[1] Aluisio J. D. Barros,[2] Alicia Matijasevich,[3] Iná S. Santos[4]

Abstract

Objective: To analyze sphincter control acquisition in a birth cohort.

Method: 4,231 children born in 2004 in Pelotas, Brazil, were included in a longitudinal study. During home visits at the ages of 12, 24 and 48 months, the mothers answered a questionnaire about sociodemographic questions and characteristics of their children's voiding and bowel habits, with special attention to toilet training.

Results: At 48 months, most children were off diapers during the day (98.5%) and by night (83%), with no difference between sexes. The average age for starting toilet training was 22 months, with earlier initiation in girls. The training was, on average, 3.2 months long, showing no difference between sexes. Children with developmental delay had late voiding and bowel control; the higher the deviation from normality, the later the child was off diapers. Medical advice was given to 15.9% of mothers. The training initiated before the age of 24 months was inversely correlated with an older age of sphincter control and longer training. Premature and low birth weight children showed no significant difference in training time and age of acquisition of sphincter control.

Conclusions: At the age of 48 months, most children, including premature and low birth weight ones, acquired sphincter control regardless of external factors and sex. The beginning of training (before 24 months) did not anticipate sphincter control, but only prolonged the duration of training.

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Introduction

In the first years of life, children go through progressive stages of growth and development, which do not occur in a linear or regular fashion. During such period, children go through sensitive learning phases, in which several developmental stages are more easily acquired – mainly those related to stimulus and training.[1]

Sphincter control requires proper development of the urinary tract and of the central and peripheral nervous systems (bladder and sphincter muscle control) for its acquisition. Voluntary control is only possible after this initial maturation stage, requiring that the child be aware about his/her own body and about the action itself, in addition to training.[2,3]

Between the 24th and 30th months of life, most children have the necessary abilities to be introduced to daytime sphincter control training,[4-6] and at the age of 48 months, they should have achieved continence and been adapted to local cultural patterns. Bowel and voiding habits are acquired at this stage and maintained in adult life. Between the transition from an immature bladder to

urinary control, there is greater risk of development of dysfunction symptoms, which increase if this period of transition is lengthened, delayed or if inadequate voiding habits or positions are used.[7,8]

Nighttime voiding habit is naturally acquired; therefore, it does not rely on learning, and it should take place around the age of 5 and a half years among girls and around the age of 6 years in boys.[9]

The aim of this study is to assess sphincter control in the first four years of life in a birth cohort and to describe the factors (family, environmental, maternal, and those inherent to the child) that may be associated with it.

Method

This study originated from the follow-up of a birth cohort in 2004 in Pelotas, a town in the state of Rio Grande do Sul, Brazil. The mothers, who lived in the town, were interviewed during their hospital stay before delivery, and their babies were measured (length and weight) and examined for determination of gestational age. The initial cohort consisted of 4,231 children recruited for a perinatal study (0.8% losses to follow-up and refusal to participate). The children were followed up in their households at the ages of 3, 12, 24 and 48 months, with follow-up rates of 95.7, 94.3, 93.5 and 92%, respectively, and the mothers were interviewed. Details about the birth cohort from Pelotas (2004) are available in another publication.[10]

For the sake of this analysis, data on the visits at 24 and 48 months were used.[6,11] During the first four years of life, there were 94 deaths, 6.8% of losses to follow-up and 1.2% of refusal to participate, totaling 3,799 children (92% of the original cohort) assessed at 48 months.

With regard to the exclusion criteria, children with neurological malformations, cerebral palsy, and born from multiple pregnancies were excluded. Thus, seven children with myelomeningocele, one with cerebral palsy and 40 twin pairs were excluded. One child for whom no information was available on diaper weaning and another one who had never worn diapers were excluded from the study as well, totaling 3,627 children.

At the 48 month's visit, the variables related to sphincter control included use or not of diapers during the day and during the night; age in months at which diapers were weaned off; duration of training; place where the child urinates and defecates; guidance on how to wean children off diapers, among others.

Child's development was assessed by Battelle's screening test,[12] which is divided into five areas. For this study, the overall assessment with categorization into standard deviations was used. The test result is classified as positive (suspected developmental delay) or negative (normal), using the cutoff point of -1 standard deviation used as population reference.

The following outcomes were investigated: "wearing no diapers during the day" and "wearing no diapers during the night," which were obtained from the answers to the following questions: Does your child wear diapers during the day?; At what age did you begin to wean your child off daytime diapers?; At what age did your child stop wearing diapers during the day?; At what age did your child stop wetting his/her pants during the day?; Does your child wear diapers during the night?; At what age did your child stop wearing diapers during the night?.

Other variables included in this study were: i) children's characteristics: sex, gestational age in weeks (preterm up to 36 weeks, full term 37 to 41 weeks and post-term 42 weeks or older), low birth weight (< 2,500 g) (yes or no); ii) maternal characteristics: schooling and age (in full years), parity and work outside the home; iii) economic level in reference quintiles for Pelotas based on the National Economic Indicator (IEN).[13]

The analysis was made using the Stata® software, version 9 (Stata Corp, College Station, USA). The chi-square tests were used to compare the prevalence rates for dichotomous data whereas the chi-square test for linear trend was used for ordinal data.

The interviewers were especially trained following the cohort method.[10]

The study protocol was approved by the Research Ethics Committee of the School of Medicine of Universidade Federal de Pelotas. A written consent was obtained from participants after the mothers were informed about the aims of the study and after confidentiality of the information was guaranteed.

Results

At the age of four years, the cohort of children had the following characteristics: the most frequent groups were those consisting of mothers aged 20 to 39 years (49.4%), primiparous women (38.1%); those with 5 to 11 years of schooling (72.5%) and those belonging to the two lowest income quintiles (43.9%). Most mothers worked outside the home (65.7%). At birth, the prevalence rates for prematurity and for low weight were 14.7 and 10%, respectively.

The assessment of suspected developmental delay revealed that 93.2% of the children had scores greater than or equal to 0; 4.5% had scores between -1 and 0; 1.1% between -1 and -1.5; and 1.3% showed more than -2 standard deviations from the mean. Higher prevalence rates were observed among boys (respectively 6, 1.4 and 1.7%) than among girls (2.9, 0.8 and 0.9%).

At the age of four years, the prevalence of children who were not wearing diapers during the day corresponded to 98.5% compared to 83.0% for those who wore diapers during the night, without any difference between sexes.

Table 1 describes the characteristics of sphincter control training in the sample as a whole and according to sex. The mean age at the beginning of sphincter control training was 22 months [girls started at 21.7 months and boys at 22.3 months (p = 0.004)]. The median at the beginning of sphincter control was 24 months for boys and 22 months for girls. The mean duration of training (between the diaper weaning and no diaper use during the day) was 3.2 months, but many children still wetted their pants even though they were not wearing diapers. The time necessary for weaning children off diapers and for them to stop wetting their pants corresponded to 4.8 months.

The assessment of the age at which the child was introduced to training (before or after 24 months) showed a difference in duration of training: those who began to be trained earlier (before 24 months) had a longer training period, without difference in the mean age of acquisition of sphincter control compared to those who started to be trained later (Table 1). Previous failures to train the children did not increase the duration of training, neither did the fact that they had been born prematurely or with low weight (data not shown).

The mean age for the complete weaning of overnight diapers was 27.4 months, and that occurred earlier among girls (p < 0.001). Despite the fact that they no longer wore diapers, 13% still wet the bed; 14.7% among boys and 10.9% among girls (p = 0.002). The start of training during the day before 24 months influenced the weaning off overnight diapers, which took place earlier.

Table 2, which describes the initial age at which diapers were weaned off, shows that 49.5% began to be trained before 24 months of life versus 20.9% before 18 months of life. Only 45.4% of those whose diapers were weaned off before 24 months of life and did not wear diapers at that age did not wet their pants (data not shown).

About one fourth of the mothers (23.7%) had already tried to wean their children off diapers, but were not successful. The duration of the first attempt corresponded to less than one month in 32.5%, from 2 to 3 months in 26.9%, and from 4 to 6 months in 31.8% of the cases. Only 15.9% of the mothers received medical guidance about the training during the first four years of life of their children. The major reasons reported by mothers to start diaper weaning were child's age (56.1%), child's request

Table 1 - Characteristics of sphincter control training according to sex

Variable	Total Mean (SD)	Male Mean (SD)	Female Mean (SD)	p-value*
Age at which diapers began to be weaned off during the day (months)	22 (6.8)	22.3 (6.9)	21.7 (6.8)	0.004
Age at which diapers were no longer necessary during the day (months)	25.2 (7.1)	25.5 (7.1)	24.9 (7.1)	0.01
Age at which the child stopped wetting his/her pants during the day (months)	26.6 (7.4)	26.9 (7.3)	26.3 (7.5)	0.02
Age at which the child stopped soiling the diapers during the day (months)	24.4 (7.2)	24.8 (7.2)	23.8 (7.1)	< 0.001
Duration of training (diaper weaning and no diaper wetting during the day) (months)	4.8 (5.0)	4.6 (4.7)	4.8 (5.2)	0.27
Duration of training (diaper weaning and no diaper wetting during the day) (months)				
Training started before 24 months	5.4 (5.3)	5.4 (5.2)	5.4 (5.0)	< 0.001
Training started at 24 months	4.1 (4.5)	4 (4.2)	4.2 (4.8)	< 0.001
Duration of training (diaper weaning and no diaper wetting during the day) (months)	3.2 (3.8)	3.2 (3.8)	3.2 (3.8)	0.78
Duration of training (diaper weaning and no diaper wetting during the day) (months)				
Training started before 24 months	3.7 (3.9)	3.8 (4.0)	3.6 (3.8)	< 0.001
Training started before 24 months	2.7 (3.6)	2.7 (3.5)	2.9 (3.9)	< 0.001
Age at which diapers were no longer worn during the night (months)	27.4 (8.0)	27.9 (8.1)	26.9 (7.9)	< 0.001
Age at which the child stopped wearing diapers during the night and start of training during the day:				
Training started before 24 months	23.1 (6.8)	23.2 (6.8)	22.9 (6.7)	0.35
Training started at 24 months	32.2 (6.3)	32.5 (6.4)	31.8 (6.2)	0.03

SD = standard deviation.
* Student's *t* test for the difference between boys and girls.

Table 2 - Characteristics of sphincter control according to sex

Variable	Total (%)	Male (%)	Female (%)	p-value
Age at which training was introduced (months)				0.003*
< 18	20.9	19.9	22.2	
19 to 23	28.6	27.5	29.8	
24 to 29	34.1	34.9	33.3	
30 to 35	10.1	10.4	9.2	
36 or +	6.4	7.3	5.5	
Age at which the child stopped wearing diapers during the day (months)				0.006*
< 18	11.7	11.1	12.2	
19 to 23	18.4	17.2	19.7	
24 to 29	40.9	40.8	41.0	
30 to 35	15.4	16.3	14.3	
36 or +	13.7	14.6	12.8	
Age at which the child stopped wetting his/her pants (months)				< 0.001
< 18	8.5	8.3	8.8	
19 to 23	14.1	13.0	15.3	
24 to 29	36.4	37.0	35.6	
30 to 35	17.0	18.2	15.8	
36 or +	17.4	18.5	16.3	
Still wets his/her pants	6.6	5.1	8.4	
Age at which the child stopped soiling his/her diapers				< 0.001*
< 18	14.0	12.5	15.6	
19 to 23	21.1	19.8	22.5	
24 to 29	38.7	39.1	38.3	
30 to 35	13.8	14.4	13.2	
36 or +	11.7	13.2	10.0	
Still soils the diapers	0.7	1.0	0.4	
Duration of training (between diaper weaning and no wetting of pants) (months)				0.05
< 1	25.6	25.8	25.5	
1 to 3	23.4	23.0	23.8	
4 to 12	46.5	47.7	45.2	
> 12	4.5	3.6	5.5	
Duration of training (diaper weaning and no diaper use) (months)				0.50
< 1	36.8	37.6	36.1	
1 to 3	25.7	24.6	26.8	
4 to12	36.4	36.8	36.0	
> 12	1.1	1.1	1.2	

p-value = chi-square test.
* Chi-square test for linear trend for differences between sexes.

to do so (20.7%), spending on diapers (6.8%), children having to go to a day care center (1.8%) and being more practical (8.3%).

At the beginning of sphincter control training, 52.7% of the children used the chamber pot and 41.7% used the toilet. At 48 months, 90.2% used the toilet. Among these children, only 9.6% used the toddler-size seat, 2.7% used footrest and only 1.2% used both (toilet with toddler-size seat and footrest). Most mothers used disposable diapers (85.3%); 10.1% used cloth diapers; and a small percentage (4.5%) used both types.

Children whose screening test for development was normal for age showed higher prevalence of sphincter control, with a remarkable reduction as the test result

deviated from normality (-1 to -2 standard deviations), both in terms of daytime and nighttime control for both sexes (Figures 1 and 2).

Children with low birth weight had a lower prevalence of daytime sphincter control compared to normal-weight children. The same applies to nighttime control among boys. Premature birth did not influence the age at which sphincter control was achieved. Boys of mothers who work outside the home had higher prevalence of diaper-free time during the day. This prevalence was higher for the nighttime period among girls.

Discussion

The literature is controversial about the ideal age for diaper weaning. Regarding a child as toilet-trained depends on several factors, including the definition of sphincter control and of acquisition of sphincter control.[14] Despite

SD = standard deviation.

Figure 1 - Prevalence of children off diapers during the day according to Battelle's screening test

SD = standard deviation.

Figure 2 - Prevalence of children off diapers during the night according to Battelle's screening test

reports of sphincter control acquisition at a later age in many countries,[15] in Brazil this control continues to occur earlier. In 2004, in a cross-sectional, population-based study of children aged 3 to 9 years, the median sphincter control corresponded to 24 months, both for daytime and nighttime control.[16] In 2010, in the same town, the median for daytime control was equal to 24 months, whereas that for nighttime control was 26 months; around 50% were off diapers at 24 months, 75% at 30 months and 95% at 36 months. These findings differ from those described by Blum et al.[17] for U.S. children, for whom the mean daytime sphincter control was 36.8±6.1 months. In another U.S. region, the median was 32.5 months for girls and 35 months for boys.[4] A study of Swiss children[18] carried out 30 years ago shows that 89% had acquired daytime sphincter control by the age of 4 years.

Age at initial training was directly correlated with the age at diaper weaning. The duration of training was influenced by early initiation of training (before 24 months of life), showing an inverse relation, in line with the reports of Blum et al.[19] for the USA (even though, in their study, 27 months was considered to be an early age).

Several factors should be taken into account before initiating sphincter control training. According to different studies, girls acquire sphincter control earlier than boys. These findings have been reported in other countries as well.[6,20,21] Some abilities might already by present (such as walking, undressing, talking, understanding and following orders, knowing the difference between doing number 1 and number 2) and the child must be psychologically and physiologically prepared for the training process. Introducing toilet training at an early age is not related to an earlier sphincter control but rather to a longer duration of this training, with a similar final age. Studies differ as to the age considered to be early (before 18 months,[6] before 24 months or before 27 months[19]). Regardless of the age considered early, the outcome was the same: a longer duration of training among children who were introduced to training at an earlier age.

Unlike what was observed at the age of 2 years, at which the variables related to the children's environment were strongly associated with sphincter control,[6] at the age of 4 years, the maturation of urinary pathways is already complete and almost all children are able to achieve this control. Consequently, they will have acquired this hallmark of development regardless of external interventions,[22] as demonstrated in this study.

When the results are compared with those of the same cohort at 24 months, there was a tenfold decrease in the use of the chamber pot, as well as in the use of accessories for proper positioning on the toilet (toddler-size seat and footrest). Proper positioning on the toilet is important to adequate perineal relaxation, preventing voiding disorders.[20,23-27]
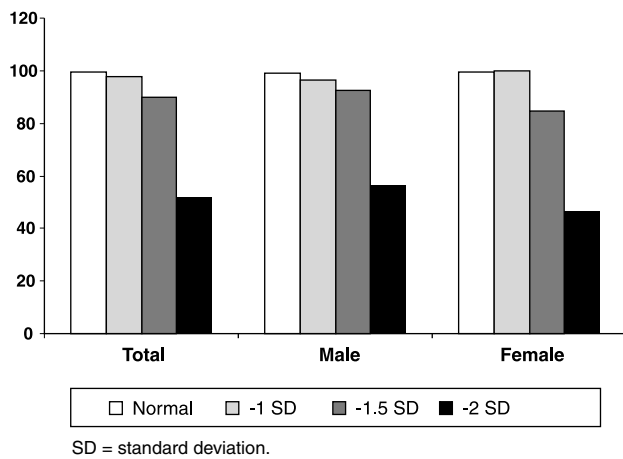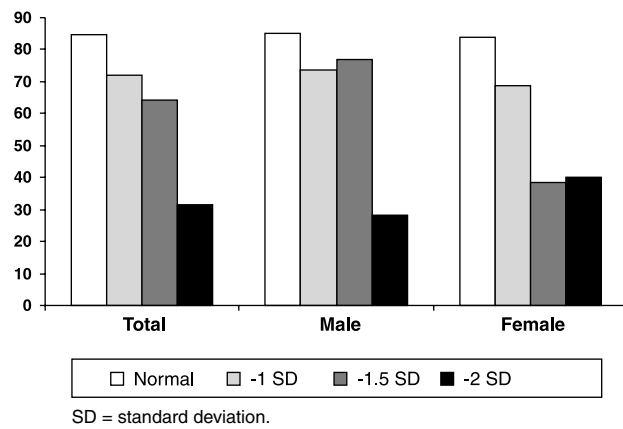
Finally, although there are reports of children who wear diapers for a longer time, in Brazil, diaper use is shorter than in other countries.[6,15-17,28] The driving factors for such differences could not be assessed in this study and there are not other Brazilian reports on these differences.

In fact, the child can be trained in terms of daytime sphincter control from the age of 2 years onwards and is able to acquire sphincter control by the age of 36 months.[2,3,29] Any attempt to anticipate the acquisition of sphincter control by initiating training at an earlier age will lead to a longer training period. As to nighttime control, it is not related to learning, but to natural acquisition around the age of 5 to 6 years.[30]

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Correspondence:
Denise Marques Mota
General Osório, 956
CEP 96020-000 – Pelotas, RS – Brazil
Tel.: +55 (53) 3222.4356
Fax: +55 (53) 3227.2257
E-mail: denisemmota@gmail.com