The Effect of Disposable Diapers usage on Voiding Signaling and bladder control in Infants

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Background

This study aimed to investigate the impact of prolonged (>18 months) disposable diaper (DD) usage on urinary elimination signal (ES) expression and bladder control development in Chinese 2-year-old infants,compared to those DD usage less than 12 months.

Methods

A retrospective questionnaire-based study was conducted from June to December 2024, recruiting 450 community-dwelling 2-year-old infants. Following screening, 374 eligible participants were enrolled and stratified into three cohorts: the DD group (continued DD use without structured toilet training), the DDT1 group (structured toilet training initiated at 1.5 years with progressive DD reduction), and the DDT2 group (training initiated at ≤1 year with progressive DD reduction). Primary caregivers completed structured questionnaires capturing demographic data, DD usage initiation, toilet training commencement, frequency of six pre-voiding signals (VS1: verbal expression; VS2: genital touching; VS3: toilet interest; VS4: activity cessation; VS5: avoidance behavior; VS6: nocturnal awakening), and achievement of diurnal/nocturnal bladder control. .

Results

Compared to the DDT1 and DDT2 the DD group had significantly lower expression frequencies of four key urination signals: VS1 (verbal expression), VS2 (genital touching), VS4 (activity cessation), and VS6 (waking from sleep) ($p<0.001$). In terms of bladder control, the daytime control rates of the DD, DDT1 and DDT2 groups were 42.3%, 55.7% and 69.6% respectively, while the nighttime control rates were 38.7%, 53.3% and 67.8% respectively. A clear trend exists: the earlier toilet training began, the higher the bladder control rate. Logistic regression analysis further confirmed that starting toilet training earlier could significantly enhance the expression of these key signals VS1, VS2, VS4 and VS6 ($p<0.05$).

Conclusions and Implications:

Persistent DD usage over 1 year since newborn significantly suppresses key pre-voiding signal expression and reduces bladder control rates, supporting the hypothesis of "DD comfort masking bladder sensation." This study supports reducing diaper use for infants from 1 year of age, combined with toilet training, to enhance infants' ability to recognize voiding signals and promote the bladder controls.

Table 1. Univariate analysis of Voiding Signals in DD group, DDT1 group, and DDT2 group at 2 years of age

signal	DD Group(n=137)	DDT1 Group (n=122)	DDT2 Group (n=115)	χ^2	P
VS 1				15.229	< 0.001
Exist	52 (38.0)	59 (48.4)	72 (62.6)		
Not exist	85 (62.0)	63 (51.6)	43 (37.4)		
VS 2				14.215	0.001
Exist	41 (29.9)	42 (34.4)	60 (52.2)		
Not exist	96 (70.1)	80 (65.6)	55 (47.8)		
VS 3				0.117	0.943
Exist	39 (28.5)	36 (29.5)	35 (30.4)		
Not exist	98 (71.5)	86 (70.5)	80 (69.6)		
VS 4				11.53	0.003
Exist	46 (33.6)	55 (45.1)	63 (54,8)		
Not exist	91 (66.4)	67 (54.9)	52 (45.2)		
VS 5				0.585	0.746
Exist	43 (31.4)	39 (32.0)	41 (35.7)		
Not exist	94 (68.6)	83 (68.0)	74 (64.3)		
VS 6				11.781	0.003
Exist	70 (51.1)	71 (58.2)	83 (72.2)		
Not exist	67 (48.9)	51 (41.8)	32 (27.8)		

Table 2. Logistic regression analysis of Voiding Signaling 1, 2, 4, and 6 in the DD group, DDT1 group, and DDT2 group at 2 years of age

signal	B	SE	Wald χ^2	Exp(B)	P
Group a (DD Group, DDT1 Group, and DDT2 Group)	-0.501	0.13	14.794	0.606	<0.001[a]
Group b (DD Group, DDT1 Group, and DDT2 Group)	-0.47	0.133	12.448	0.625	<0.001[b]
Group c (DD Group, DDT1 Group, and DDT2 Group)	-0.438	0.13	11.318	0.646	<0.001[c]
Group d (DD Group, DDT1 Group, and DDT2 Group)	-0.444	0.133	11.184	0.642	<0.001[d]

Note: a: Effects of DD, DDT1 & DDT2 groups on Signal 1; b: Effects of DD, DDT1 & DDT2 groups on Signal 2; c: Effects of DD, DDT1 & DDT2 groups on Signal 4; d: Effects of DD, DDT1 & DDT2 groups on Signal 6

Table 3. Status of daytime and nighttime voiding control acquisition in the DD group, DDT1 group, and DDT2 group at 2 years of age

Group	Cases	Daytime Voiding Control Acquisition Rate	Nighttime Voiding Control Acquisition Rate
DD Group	137	58（42.3）	53（38.7）
DDT1 Group	122	68（55.7）	65（53.3）
DDT2 Group	115	80（69.6）	78（67.8）
χ^2		18.767	21.34
p		<0.001	<0.001