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Diaper Use and Walking Milestone : A Corelational Analysis

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ABSTRACT

The use of diapers, which was first introduced in western nations to improve toileting habits, is now a significant aspect of parenting in India. The way a child is raised influences their motor development. According to a 2012 study by New York University. Aims: To evaluate the pattern and practice of using diapers, as well as the gait of toddlers wearing or not wearing diapers, with regard to the number of falls made while walking, the width and distance between steps, and the correlation between the pattern and practices of diaper use and abnormal gait. To test differential effect of diaper on novice walker and experienced toddler walker, a total of 210 sample population with two age group selected: 16-19 month old where infant have just began to walk and 20-24 month old where improvements in walking skill have begun. We used Observational Cross sectional analysis to test and assess the effect of diapers on toddlers. When walking with a diaper on, cloth diaper users experienced fewer falls and a mean step width of 12.49 cm, which is statistically significant with a p value of 0.021, compared to disposable diaper users. When wearing a cloth diaper, the step length of cloth users did not differ significantly from that of disposable diaper users. According to our research, an infant's gait pattern and ability to walk are negatively impacted right away by the kind of diaper they wear and the total amount of time they spend in them. Diaper side effects include dermatitis and urinary tract infections are brought on by prolonged diaper use and short intervals between changes. The precise measures that are employed to determine the increasing degree of ability that comes with walking are hampered by diapers. Diapers frequently impair a baby's walking abilities, both functionally (by increasing falls and stumbles) and proficiently (by causing less mature walking patterns).

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Key Words
Gait, diaper, development, child and walking

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INTRODUCTION

Due to the greater influence of western culture, diaper use-which was first adopted in western countries to improve toileting practices-has grown in importance in Indian parenting. Unintentionally, the advertising industry has contributed significantly to the way parents and caregivers think. Numerous disposable diaper brands have proliferated in recent years, drawing in customers with catchy taglines and effective marketing techniques. The way a child is raised influences their motor development. The manner in which infants are handled, clothed, and potty trained by their caregivers can have significant impacts on whether or not the infants acquire specific developmental skills, when the skills are acquired, and the developmental trajectory that follows due to cultural and historical differences[1]. Using diapers has both advantages and disadvantages. According to several studies, using diapers may affect an infant's motor development in addition to diaper dermatitis and urinary tract infections. According to earlier research, an infant's mobility and movements are restricted when wearing a disposable diaper, which lowers their level of physical activity and stunts their motor development[2]. Being able to move independently is crucial for carrying out a number of motor tasks in infancy that are linked to a premature stage of gait development. One indicator of typical motor development is gait[3]. There aren't many research studies on the use of diapers and how they affect a baby's walking milestone in the literature review; this study, which is conducted at our institute, is likely the first of its kind in India.

MATERIALS AND METHODS

Place of Study: Department of Pediatrics, Bhima Bhoi Medical College and Hospital, Bolangir, Gandhrel, Odisha 767002.

Period of Study: The study period will stretch from January 2023 to February 2024.

Study Design: It will be Observational Cross sectional Analytical study. Subject will be picked up from study population based on inclusion and exclusion criteria.

Sample Size Estimation: 210 populations

Exclusion Criteria:

- Preterm baby
- Sick child unable to walk
- Children with developmental delay
- Any lower limb or hip abnormality
- Syndromic baby
- Pain in thigh /gluteal region

RESULTS AND DISCUSSIONS

When walking with a diaper on, cloth diaper users experienced fewer falls and a mean step width of 12.49 cm, which is statistically significant with a p value of 0.021, compared to disposable diaper users. When wearing a cloth diaper, the step length of cloth users did not differ significantly from that of disposable diaper users. Disposable diaper users experienced more falls when walking without a diaper than cloth diaper users, with a statistically significant p value of 0.046. There is no discernible difference between cloth and disposable diaper users' step width mean and step length without diaper gait (Table 1).

In comparison to mothers with lower levels of education, those with higher education have graduated with more hours worked, more frequent diaper changes, and shorter intervals between diaper changes (Table 2). The study participants' average awake time in a diaper was 2.37 (1.49) hours, and their average sleeping time was 7.07 (1.36) hours. The participants used diapers on average for 9.40 (2.09) hours every day (Table 3).

About 3 (1.4%) of the children had a single diaper change in less than 2 hours. It took 71 (33.8%) children between 2 and 4 hours to change. It was 5 to 7 hours for 120 (57.1%) children and 8 or more hours for 16 (7.6%) children. The monthly average cost of diapers was Rs. 632.86 (229.66).198 children (94.3%) had no side effects from using diapers, 9 children (4.3%) had diaper rash, and 3 children (1.4%) had a UTI.In the 16-19 month age group, those who used disposable diapers experienced 0.8 times more falls, a mean step width of 12.71 cm, and a mean step length of 20.55 cm compared to those who used cloth diapers (Table 4). These differences are statistically significant.When using cloth diapers versus disposables, there was no discernible difference in abnormal gait abnormalities in the 20-24 month age group. According to this study,

Table 1: Correlation between diaper types and gait parameters

Parameter	Cloth (N = 31)	Disposable (N = 179)	p-value
No of falls with diaper			
Mean (SD)	0.13 (0.43)	0.42 (0.69)	0.021
Range	0.00-2.00	0.00-2.00	
Step width with diaper			
Mean (SD)	12.29 (0.77)	12.49 (0.91)	0.047
Range	10.50-14.00	11.00-15.00	
Step length with diaper			
Mean (SD)	21.13 (1.75)	20.76 (1.66)	0.26
Range	18.00-24.00	17.00-25.00	
No of falls without diaper			
Mean (SD)	0.03 (0.18)	0.21 (0.48)	0.046
Range	0.00-1.00	0.00-2.00	
Step width without diaper			
Mean (SD)	11.55 (0.72)	11.99 (0.82)	0.062
Range	10.00-14.00	11.00-14.60	
Step length without diaper			
Mean (SD)	20.94 (1.66)	20.42 (1.51)	0.083
Range	18.00-24.00	17.00-25.00	

Table 2: Correlation between Mother's Education and diaperpractice

Parameter	Primary (N = 21)	Upper Primary (N = 62)	Matric	Graduate (N = 40)	P-value
Diaper total hours					
Mean (SD)	8.95 (1.75)	9.17 (2.11)	9.73 (1.80)	9.88 (2.00)	0.11
Range	5-12	5.00 - 14.00	6.00 -15	6.00 - 16.00	
Diaper change frequency per day					
Mean (SD)	1.86 (0.65)	1.89 (0.80)	2.18 (0.64)	2.62 (0.67)	<0.001
Range	1.00 - 3.00	1.00 - 5.00	1.00 - 4.00	2.00 - 4.00	
Diaper change hours					
<2 hours	0 (0.0%)	3 (3.4%)	0 (0.0%)	0 (0.0%)	<0.001
2-4 hours	4 (19.0%)	17 (19.5%)	20 (32.3%)	30 (75.0%)	
5-7 hours	14 (66.7%)	57 (65.5%)	39 (62.9%)	10 (25.0%)	
8 or more hours	3 (14.3%)	10 (11.5%)	3 (4.8%)	0 (0.0%)	

Table 3: Diaper related characteristics

Parameter	Overall (N = 210)
Awake time	
Mean (SD)	2.37 (1.49)
Range	0.00-6.00
Sleeping time	
Mean (SD)	7.07 (1.36)
Range	5.00-1200
Daily Diaper hours	
Mean (SD)	9.45 (1.98)
Range	5.00-16.00
Diaper change frequency per day	
Mean (SD)	2.11 (0.77)
Range	1.00-5.00
Single diaper use hour	
<2 hour	3 (1.4%)
2-4 hour	71 (33.8%)
5-7 hour	120 (57.1%)
8 or more hour	16 (7.6%)
Diaper costs per month	
Mean (SD)	620.00 (235.75)
Range	300.0 -1500.00
Side effects	
None	198 (94.3%)
Diaper Rash	9 (4.3%)
UTI	3 (1.4%)
Diaper size fit	
Loose	24 (11.4%)
Optimal	173 (82.4%)
Tight	13 (6.2%)

Table 4: Correlation of Type of Diaper use with gait parameters for the age group of 16-19 months

Parameter	Cloth diaper users (N = 12)	Disposable diper users (N = 74)	p-value
No of falls with diaper			
Mean (SD)	0.33 (0.65)	0.82 (0.78)	0.043
Range	0.00-2.00	0.00-2.00	
Step width with diaper			
Mean (SD)	12.03 (0.72)	12.71 (1.02)	0.039
Range	10.00-14.00	11.00-15.00	
Step length with diaper			
Mean (SD)	21.61 (1.08)	20.55 (1.51)	0.023
Range	20.00 -24.00	17.00-24.00	

Table 5: Correlation of Type of Diaper use with gait parameters for the age group of 20-24 months

Parameter	Cloth diaper users (N = 19)	Disposable diaper users (N = 105)	p-value
No. of falls with diaper			
Mean (SD)	0.00-0.00	0.14 (0.43)	0.15
Range	0.00-0.00	0.00-2.00	
Step width with diaper			
Mean (SD)	12.32 (0.68)	12.33 (0.79)	0.93
Range	10.50-13.00	11.00-14.00	
Step length with diaper			
Mean (SD)	20.82 (2.04)	20.91 (1.74)	0.85
Range	18.00 -24.00	17.00-25.00	

wearing diapers for a longer period of time (16-19 months) is linked to gait disturbance, which is associated with a significant increase in falls and wider steps, but has no effect on step length. In this study,

Table 6: Correlation of diaper use (Total Hours) with gait disturbance for the age group of 16-19 months

Parameter	≥8 hours (N = 75)	<8 hours (N = 11)	p-value
No. of falls with diaper			
Mean (SD)	0.85 (0.78)	0.09 (0.30)	0.002
Range	0.00-2.00	0.00-1.00	
Step width with diaper			
Mean (SD)	12.85 (0.96)	12.07 (0.95)	0.013
Range	11.00-15.00	11.00-13.50	
Step length with diaper			
Mean (SD)	20.71 (1.57)	20.64 (0.96)	0.89
Range	17.00-24.00	19.00-22.00	

Table 7: Correlation of total diaper hours with gait parameters age group 20-24 month

Parameter	≥8 hours (N = 104)	<8 hours (N = 20)	p-value
No of falls with diaper			
Mean (SD)	0.13 (0.42)	0.05 (0.22)	0.38
Range	0.00-2.00	0.00-1.00	
Step width with diaper			
Mean (SD)	12.37 (0.77)	12.14 (0.74)	0.24
Range	10.50-14.00	11.00-13.60	
Step length with diaper			
Mean (SD)	20.86 (1.82)	21.05 (1.58)	0.67
Range	17.00-25.00	17.00-23.60	

wearing diapers for longer than an hour is not linked to abnormal gait in the 20-24 month age group (Table 5).

Using diapers has become a crucial aspect of contemporary parenting, and its effects on children's health are currently being studied. An infant's motor development may be impacted by outside factors during the early phases of gait development, such as diaper use and other childrearing techniques. Even contemporary disposables that are meant to be light, comfortable, and thin put bulk in between an infant's legs.

Strolling around in unclean diapers-something that happens frequently in daily life-would further enlarge the space between an infant's legs. They impede an infant's gait by pushing their legs apart. Additionally, because diapers are made of material that wraps around an infant's legs, they may restrict their forward movement and change the way they walk. Changes to the base of support may have a negative impact on balance and cause abnormalities in gait. Furthermore, the weight of the load would increase due to damp diapers.

Given the inclusion criteria, a suitable sample size of toddlers who have visited our tertiary care hospital has been included in this study. Documenting different

demographic profiles, developmental milestones met, diaper use patterns and practices and their effects on gait parameters were done. This was followed by a thorough statistical analysis and a detailed discussion of the results, including a comparison with current literature.

About 210 toddlers were examined in this study, and their gait patterns with and without diapers were evaluated. The study used a sample size of sixty people. There is a chance for improved results and comparisons in the current study as the sample size has increased. In our study, two age groups-16-19 months and 20-24 months-were chosen.20-24 months are regarded as experienced walkers, and 16-19 months as novice walkers.

The average age is 20 months. The studies' mean age and age distribution were 13 months for infants who had just started walking and 19 months for infants whose walking skill improvements had reached an asymptote. The selection of a different age group was influenced by two factors: the ability of both age groups to walk independently and the availability of healthy subjects willing to visit the immunization clinic for booster dose administration between the ages of 16 and 24 months.

In this study, 51.9% of the sample was male and 48% was female. It is comparable to research done by Adolph[4] had the same distribution of sexes. The study's participants' weights varied from 9 to 14 kg (mean -11.45 kg), their heights from 76 to 83 cm (mean 79.8 cm), and their mean BMI was 18.5.

There was no appreciable difference in the gait parameters according to height and weight. Overall obesity may affect strength and balance because it requires more force to move a heavier body. Adolph *et al*.[4]; Garciaguirre *et al*.[2], There was no relationship observed between gait parameters and height and weight after adjusting for the age of the infants.

Practice and Pattern of Diaper Use: About 31 individuals (14.8%) and 179 participants (85.2%) in this study used cloth diapers. The use of cloth diapers is more often associated with lower socioeconomic status. Adolph *et al*.[4] 90% of 13-month-olds and ninety-three percent of 19-month-olds used disposable diapers. Just two infants, ages 13 and 19, were cloth diaper users. This discrepancy in diaper use could be explained by the socioeconomic differences in diaper use between India and other countries.

In our study, the average amount of time spent wearing diapers is 2 hours while awake, 7 hours while sleeping, and 9 hours overall.

It was discovered that two diapers were worn on average each day. It was discovered that the average monthly cost of diapers was Rs. 600.

In a study conducted by "Diaper Facts". Real Diaper Association[6] Diapers for toddlers need to be changed five to six times a day, and the monthly cost of diapers typically ranges from $55 to $70. Diaper usage varies, most likely as a result of cultural and socioeconomic factors. About 9(4.3%) children in this study experienced diaper rash, 198 (94.3%) children had no side effects, and 3 (1.4%) children had a UTI.

In a study conducted by Jones *et al*.[6], of families reported cases of diaper dermatitis and Urinary tract infection. This is most likely the result of the diaper stretching and the dirty diaper's extended skin contact. This study revealed that diaper use practices are influenced by parents' educational attainment and employment status. Parents with higher socioeconomic status and education levels tend to use diapers more frequently, preferring disposables, and requiring less time for changing them.

Diaper Effect on Gait Parameters: In this study, the rates of falls for inexperienced walkers (16-19 months) wearing diapers were 0.68 times higher than those for experienced walkers (20-24 months), who fell 0.2 times more frequently than those who were walking naked. In a study conducted by Adolph *et al*.[4] and Hallemans *et al*.[7]. Ten out of thirty inexperienced walkers fell while they were nude, seventeen while wearing a disposable diaper, and twenty-one while wearing a cloth diaper; in contrast, eight out of thirty experienced walkers fell while wearing a cloth diaper.When we compared our study to the previous study, we discovered that while wearing disposable diapers, novice walkers fell more frequently and experienced walkers stumbled less frequently. However, when it came to wearing cloth diapers, we discovered that there were no falls, whereas in the previous study, cloth diaper wearers had more falls.

When it came to step width, the step width in both age groups was larger when wearing a diaper as opposed to being naked. With relatively narrow step widths, the 20-24 month age group walked better than the 16-19 month age group. The gait step width did not differ between those wearing cloth diapers and those wearing diapers; the diaper steps were relatively wider, while the naked steps were narrow and straight. In study Adolph *et al*.[4] Compared to when they were naked, infants in disposable diapers took wider (less mature) steps, and when they were in cloth diapers, they took even wider steps ($p<0.001$). When compared to previous studies, we found the opposite effect when using cloth diapers; this could be because different types of cloth diapers were used. In both studies, the step width was wider in the disposable diaper group, which is indicative of a less developed gait. Step length: In our research, experienced walkers (20-24 months)

had longer steps than novice walkers (16-19 months). When wearing a diaper, the step length was shorter than when not.

Adolph et al.[4] found that infants wearing cloth diapers took shorter (less mature) steps than those wearing naked or disposable diapers, with a p-value of $p<0.02$. The ANOVA on step length also showed a main effect for diaper condition, $F(2,110) = 9.23$, $p <0.001$, partial $\eta 2 =0.14$.

We discovered in this study that wearing diapers for extended periods of time increases the risk of gait abnormalities. This study found a significant correlation between extended diaper use (more than 8 hours) and an increased number of falls and step width in the 16-19 month age group. Extended diaper wear is not linked to any abnormalities in gait in the 20-24 month age group. It appears that no prior research on this has been done and published in any literature. It appears that researchers did not consider the possibility that something as non-biological and culturally prescribed as diapers could have an impact on locomotion in their quest for a clear, context-free explanation of how motor skills develop.

The field of anthropologists studies exotic clothing and toileting practices, while movement scientists study biomechanics. Naturally, the truth is more complicated than that. It is impossible to describe movement or development without considering their context. A growing child moves within a culture, and locomotion always takes place within an environment.

Limitation of the Study: There are not many limitations to this study. Future research and studies are warranted to determine whether or not these transient changes in gait caused by diaper use have longer-term developmental consequences. A longer study period and long-term follow-up could have improved the study's correlation analysis. Future research must employ a variety of diaper types to determine the relationship between the shape and bulk of diapers and how they affect the development of movement, as this study did not assess this relationship.

Due to the smaller sample size, sex differences in gait parameters were not fully observed in this study. Despite the fact that the study's subject sex balance was good, a larger sample size will be needed in a subsequent investigation to carry out an adequate statistical analysis.

CONCLUSION

According to our research, an infant's gait pattern and ability to walk are negatively impacted right away by the kind of diaper they wear and the total amount of time they spend in them. Diaper side effects include dermatitis and urinary tract infections are brought on by prolonged diaper use and short intervals between changes. The precise measures that are employed to determine the increasing degree of ability that comes with walking are hampered by diapers. Diapers frequently impair a baby's walking abilities, both functionally (by increasing falls and stumbles) and proficiently (by causing less mature walking patterns). In the end, every infant develops at their own rate, and intricate interactions between genetic, environmental, and developmental factors affect developmental milestones like walking. Instead of using diaper choice as the only factor in determining a baby's milestone achievement, parents should concentrate on creating a loving and supportive environment for their infant's general development, including chances for physical activity and exploration.

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