



Prevalence and Risk Factor of Diaper Dermatitis among Saudi Children

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Abstract

Background: Diaper dermatitis (DD), commonly known as diaper rash is an inflammatory disease of the skin of diaper wearing area. It is usually seen in children below 24 months and is not considered by doctors as a serious problem. However, it often causes discomfort and apprehension among parents. **Methods:** A cross-sectional study performed through patient questionnaires. A total of 1344 patients were included in the study. A pilot was done to test the validity and reliability of developed questionnaire and also to calculate the minimum sample size for our study. By considering the values derived from the pilot study done among 50 parents of children aged 1-24 months who used diapers. A standardized methodology was followed in the validation of this questionnaire that included focus group discussion, expert evaluation, pilot study, reliability and validity assessment etc. Three experts in the field of medicine (dermatologist, pediatrician, and internist) and one biostatistician were involved in the validation of our questionnaire. **Result:** In our study majority of the participants were females (87.3%), and 55.3% belonged to the 20-25 years age group. The fixed orthodontic related history showed 59.8% had undergone the treatment for 1 to 3 years and 31.6% of the participants reported that they had removed the fixed braces for more than five years. Among these participants, 89.5% (n=34) reported that the fascia (space) closed between the upper frontal teeth after Frenectomy, and 65.8% (n=25) agreed that spaced between the two upper front teeth still closed after removing the retainer. **Conclusion:** The reported prevalence of diaper dermatitis in our study was found to be more in the Kingdom of Saudi Arabia. There is huge anxiety created among parents, and this would result in increased pediatric consultations.

Keywords: Diaper Dermatitis, Allergic, Saudi Children.

Introduction

Diaper dermatitis (DD), commonly known as diaper rash is an inflammatory disease of the skin of diaper wearing area. It is usually seen in children below 24 months and is not considered by doctors as a serious problem. However, it often causes discomfort and apprehension among parents [1,2]. The exact prevalence of DD is difficult to determine as it varies across different countries and population studied [3]. Adalat et al. [3], Ward et al. [5], and Blume-Peytavi et al. [6] showed that the prevalence of DD ranged from 15% to 75% and most of the cases are not consulted to doctors [4-6]. In countries like Japan, USA, UK, and Italy reported DD prevalence of 87%, 75%, 25%, and 15% respectively among children [7]. Diaper dermatitis was the reason for 20% of all visits to the dermatologist of children, usually starts within the age of the 3rd and 12th weeks and the peak of its incidence is the age of 6-12

months up to the age of 5 years [4,8-10]. The highest incidence in infants is found between 9 and 12 months of age [4,8,9].

The main causes of DD include friction, prolonged and frequent exposure to urine, skin over hydration, increases in skin pH and change in the skin microbiota [11-13]. The exact cause of DD is allergic contact dermatitis that is caused due to the presence of some additives in the diapers such as some rubber components mercaptobenzothiazole-(MBT), cyclohexylthiophthalimide and p-tert-butylphenol formaldehyde (glue resin) [14-16]. Dyes present in the diaper cloth is also reported to produce skin irritation due to its leech from the cloth material [17]. Modern diaper design has been changed a lot when compared to the old times that used cloths to tie at the bottom of child. This advancement has made the manufacturers to use polymers and other chemical materials to perform their chosen role [18]. There are two main types of diaper rashes: diaper related rashes that is caused or worsened by the use of diapers and non-diaper rashes that are not related to diaper. The

former one includes rashes such as irritant dermatitis (urine and feces related), allergic reaction (polymers and dye related) and diaper candidiasis. The later type includes Psoriasis, seborrheic dermatitis, impetigo, atopic dermatitis (eczema), Scabies [19-21]. The exact data on diaper use among Saudi population is not available and also there is lack of data on prevalence of diaper dermatitis. Hence this study is aimed to investigate the prevalence of diaper dermatitis and associated risk factors among Saudi population for the past 6 months from the study period time.

Methods

A cross sectional study using a pretested questionnaire was conducted among Saudi parents of children aged 1-24 months in the Kingdom of Saudi Arabia. The approval for conducting the study was taken from Institutional Review Board and Ethical Committee, Taif University. A pilot was done to test the validity and reliability of developed questionnaire and also to calculate the minimum sample size for our study. By considering the values derived from the pilot study done among 50 parents of children aged 1-24 months who used diapers, a minimum sample size 714 was calculated at 95% confidence interval and power of study 80%.

The questionnaire was sent to the general population via email, social media (Whatsapp, Facebook, Instagram etc.) The responses were checked for its eligibility criteria for the further analysis. Responses from parents who have children aged ≤ 24 months who use diapers and who are citizens and/or residents of the Kingdom were only included for our study. The exclusion criteria for our study was that children having at least one of the following characteristics: (i) parents of children who didn't use diapers; (ii) parents of children aged >24 months (iii) parents who didn't give consent to participate. The responses of parents who has at least one of the exclusion criteria were not included for our assessment and sample collection was done until 15-20% more the required minimum sample size ($714 + 15-20\%$) is achieved who fulfills the inclusion criteria.

Validation of the questionnaire

A standardized methodology was followed in the validation of this questionnaire that included focus group discussion, expert evaluation, pilot study, reliability and validity assessment etc. Three experts in the field of medicine (dermatologist, pediatrician, and internist) and one biostatistician were involved in the validation of our questionnaire. A pilot study was done on 50 participants and the data obtained was used for reliability and validity analysis.

An exploratory factor analysis was performed to check the construct validity of the questionnaire. Items with correlation coefficient >0.7 were removed. In reliability check, internal consistency was done, but test/retest reliability could not be performed because of paucity of time. A Cronbach's α value >0.7 was considered for the questionnaire to be internally consistent. The version of the questionnaire that will be used online is attached as Annexure-I.

Statistical Analysis and Data management

All the data obtained through the questionnaire will be tabulated accordingly using MS Excel software. The data analysis was using SPSS Ver 23 (IBM Corp. USA). Frequencies and percentages were used to present data for descriptive data. Possible association

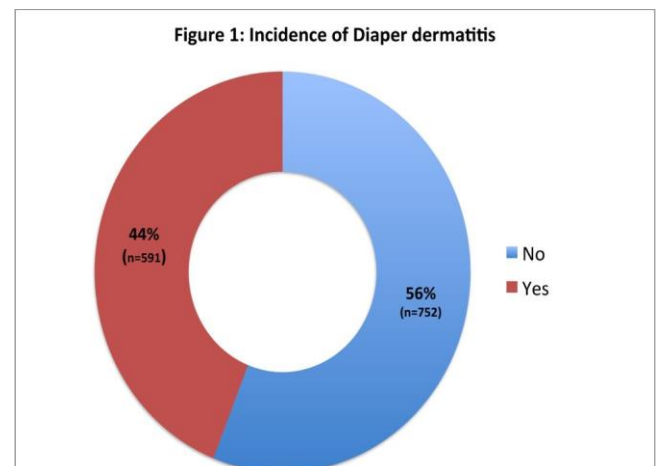
between categorical variables will be analyzed using Pearson's Chi-square test. A mixed model logistic regression analysis was used to test the relationship of Diaper dermatitis with possible risk factors. A significance value of <0.05 will be considered statistically significant.

Ethical considerations

All participants written consents from their parents and willing to be interviewed and examined if they agree or not to take part in the study. Only those who agreed to participate were included. Before conducting any study-related procedures, ethical approval was obtained from Research Ethics Committee at Taif University, Saudi Arabia.

Results

The study aimed to assess the incidence of diaper dermatitis (DD) and its associated factors in children living across Saudi Arabia. We included 1344 completed responses from participants based on the eligibility criteria for our the study. The prevalence of diaper dermatitis among the participants during the last six weeks was found to be 44% ($n=591$) [Figure 1].



The prevalence of DD was more in children aged less than 24 months (66.9%) compared to those >24 months (33.1%), $p<0.001$. There was no statistically significant association observed between the prevalence of DD with the child's birth weight ($p=0.868$) and gestational age ($p=0.919$). Parents who had University level education comparatively reported more DD prevalence (44.1%) for their children compared to others ($p=0.036$).

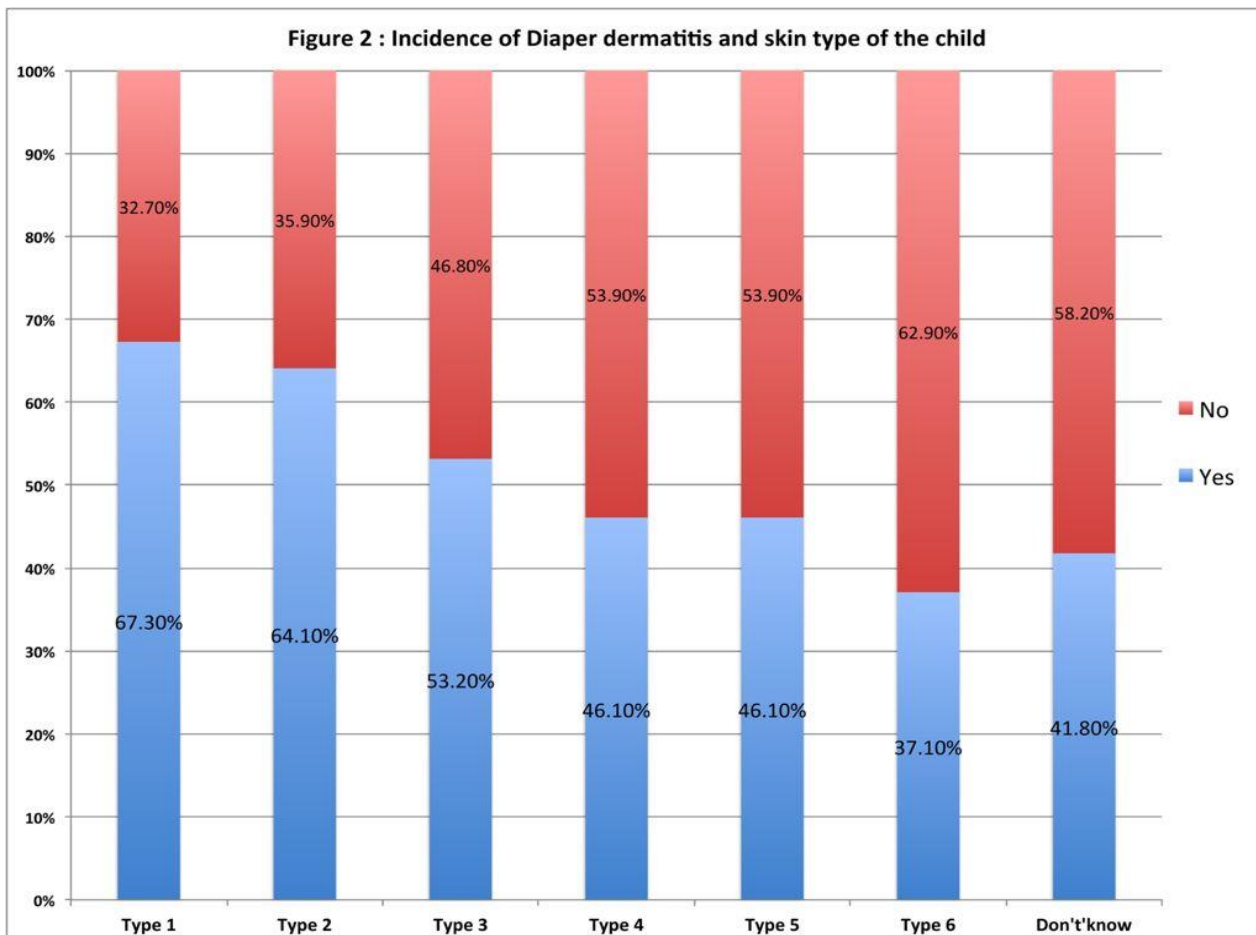
The prevalence of DD in children with a congenital malformation ($n=26$) was found to be 76.9% ($n=20$), which showed a statistically significant association ($p=0.001$). The prevalence of severe skin diseases in children as reported by parents was found to be 7.2% ($n=98$), and the incidence of DD during the last six weeks was found to be 61.2% ($n=60$) in these children and the association was statistically significant ($p<0.001$). It was observed that 2.0% ($n=27$) of children as reported by parents were on long-term medication for some illness, and the incidence of DD was found to be 74.1% ($n=20$) in these children, which showed a statistically significant association ($p=0.001$). It was found that 53.7% ($n=208$) of children who had Gastrointestinal tract (GIT) infections developed DD compared to those who didn't had GIT infections, which showed a statistically significant association ($p<0.001$). [Table 1]

Table 1: Prevalence of Diaper dermatitis based on children’s’ characteristics

		Prevalence of diaper rash		Total	P value
		Yes	No		
Child's birth weight	<2.5 kg	158 (44.4%)	198(55.6%)	356(100%)	0.868
	>2.5 kg	433 (43.9%)	554(56.1%)	987(100%)	
Child' Age	1-6 months	107(44.4%)	134(55.6%)	241 (100%)	<0.001
	7-12 months	134 (55.8%)	106(44.2%)	240 (100%)	
	13-18 months	105(53.8%)	90(46.2%)	195 (100%)	
	19-24 months	69(50.7%)	67(49.3%)	136 (100%)	
	>24 months	176 (33.1%)	355(66.9%)	531(100%)	
Gestational age of child	<37 weeks	115 (43.7%)	148(56.3%)	263(100%)	0.919
	>=37 weeks	476 (44.1%)	604(55.9%)	1080(100%)	
Educational level of Primary caregiver	University	435 (44.1%)	551(55.9%)	986 (100.0%)	0.036
	High school	104 (39.8%)	157 (60.2%)	261 (100.0%)	
	Middle school	31 (64.6%)	17 (35.4%)	48 (100.0%)	
	Primary	12 (41.4%)	17(58.6%)	29 (100.0%)	
	Uneducated	9 (47.4%)	10 (52.6%)	19 (100.0%)	
Congenital malformation	Yes	20 (76.9%)	6(23.1%)	26(100%)	0.001
	No	571 (43.4%)	746 (56.6%)	1317(100%)	
Severe skin diseases	Yes	60 (61.2%)	38(38.8%)	98(100%)	<0.001
	No	531 (42.7%)	714(57.3%)	1245(100%)	
Long term medications	Yes	20 (74.1%)	7 (25.9%)	27(100%)	0.001
	No	571 (43.4%)	745(56.6%)	1316 (100%)	
GIT infections	Yes	208 (53.7%)	179 (21.6%)	387 (100%)	<0.001
	No	383 (40.1%)	573 (59.9%)	956 (100%)	

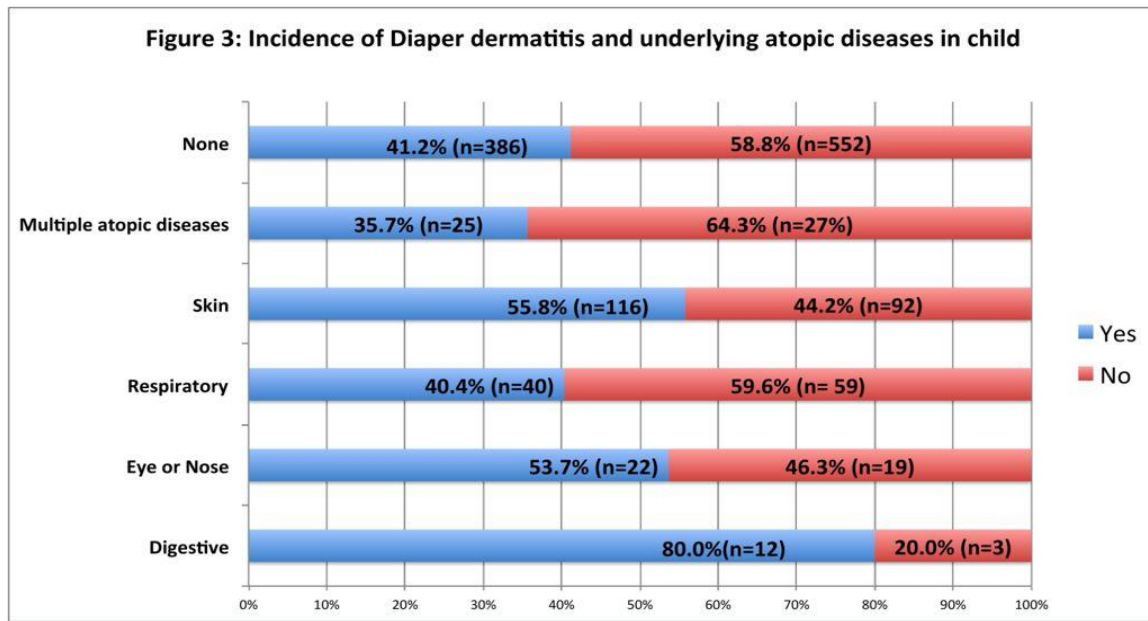
Regarding skin type of the children, the responded parents reported that 3.9% (n=52) had Type 1 skin (always burns, never tans, sensitive to ultraviolet exposure), and 2.9%, (n=39) had Type 2 (burns easily, tans minimally). Moreover, 7% of respondents had Type 3 (Burns moderately, tans gradually to light brown) (n=94), 6% had Type 4 (Burns minimally, always tans well to moderately

brown), 9.5% were of Type 5 (Rarely burns, tans profusely to dark) and 20.3% were of Type 6 (Never burns, deeply pigmented, least sensitive). The current study recorded that children with skin Type 1 and 2 showed more incidence of DD than other skin types, which showed a statistically significant association ($\chi^2 (1,6) = 28.022, p<0.001$) [Figure 2].



Among those children, it was found that 3.1% (n=42) of them were reported to have multiple atopic diseases. Digestive or GIT diseases were reported in 1.1% (n=15), and atopic skin diseases in 15.5% (n=208). Moreover, children with atopic diseases and

digestive diseases were found to have a comparatively higher incidence of DD than others, which showed a statistically significant relationship ($X^2(1,5) = 25.913, p=0.001$) [Figure 3].



It was reported that 5.6% of parents changed the diaper once daily, whereas 41.1% did it more than thrice. The frequency of diaper change during the night was reported to more than thrice in 7.7% and once in 34.6% of children. It was found that disposable type of diaper rash was 90.7%, and cloth type was used only in 4.1% (n=55), and incidence of DD among children who used cloth type diaper was 52.9% (n=37), but it showed no statistically significant differences ($p=0.170$). The most commonly used method for

cleansing the diaper area was soap (38.94%), followed by tap water (23.38%), tissue paper (23.38%), and only 6.63% used warm water. It was reported by 39.76% of parents that they used baby powder in the diaper area, whereas diaper cream was used by only 16.83%. When asked about the time to take the child to consult a doctor for diaper dermatitis, it was reported by 21.1% that they would take it as early as possible, and 25% reported that they would do it after no improvement within seven days [Table 2].

Table 2: Practices and attitude related to diaper use and diaper dermatitis

		Frequency	Percent
Frequency of diaper change during day	>3 times	552	41.1
	3 times	463	34.5
	Twice	253	18.8
	Once	75	5.6
Frequency of diaper change during night	>3 times	103	7.7
	3 times	229	17.1
	Twice	546	40.7
	Once	465	34.6
Type of diaper used	Disposable only	1218	90.7
	Cloth only	70	5.2
	Both	55	4.1
Method for cleansing the diaper area	Tap water	312	23.23%
	Warm water	89	6.63%
	Previously boiled water	45	3.35%
	Normal saline	37	2.76%
	Soap	523	38.94%
	Tissue paper	314	23.38%
	Disinfectant (alcohol)	23	1.71%
	Tap water	312	23.23%
Commonly used material diaper area	Diaper cream	226	16.83%
	Baby powder	534	39.76%
	Regular moisturizer	167	12.43%
	None	416	30.98%
Time to consult doctor for Diaper rash	As early as possible	284	21.1%
	After no improvement within 1-2 days	689	51.3%
	After no improvement within 7 days	336	25%
	After no improvement within 14 days	34	2.5%

We used a logistic regression model to assess the risk factors for DD in our study and found that female gender [OR= 1.52 (1.19, 1.93), p=0.001], child's age less than 12 months [OR= 1.47 (1.17, 1.84), p=0.001], previous histories of skin rashes [OR= 5.23 (4.09,

6.70), p<0.001], Skin Type 1 [OR= 2.16 (1.13, 4.12), p=0.019], watery and loose type stool [OR= 1.45 (1.14, 1.84), p=0.003] and GIT infections [OR= 1.30 (1.15, 1.46), p=0.016] were independent predictive factors for diaper dermatitis. [Table 3]

Table 3: Multivariate logistic regression

	Odds Ratio	95% C.I		P value
		Lower	Upper	
Gender of child (female)	1.52	1.19	1.93	0.001
Child's age < 12 months	1.47	1.17	1.84	0.001
Decreased Birth weight of child	1.01	0.76	1.33	0.974
Decreased Gestational age of child	0.88	0.64	1.19	0.404
Previous histories of skin rash	5.23	4.09	6.70	<0.001
Congenital malformation	1.93	0.65	5.75	0.239
Systemic disease	1.44	0.86	2.40	0.164
Skin Type 1	2.16	1.13	4.12	0.019
Long term medication	2.21	0.79	6.24	0.133
Atopic disease	1.02	0.95	1.10	0.610
Abnormal Stool type (watery and loose)	1.45	1.14	1.84	0.003
Gastrointestinal tract infection (GIT)	1.30	1.15	1.46	0.016
Type of diaper (cloth)	1.44	0.89	2.33	0.142
Constant	.004			.000

Discussion

The reported prevalence of diaper dermatitis (DD) among 0-24 months old children who are diaper dependent during the study period was 44%, and this number is higher when compared to prevalence seen in children above two years. Studies done by Adalat et al. IN United Kingdom and Suebsarakam et al. Thailand had reported a prevalence of 16% and 17.2% respectively [4,11]. The prevalence of DD varies significantly between different countries, and it is estimated to range from 16% to 65% [3]. The increased frequency in children less than two years old is largely attributed to the widespread usage of diapers, and this prevalence is found to decrease as they attain diaper independence gradually above two years. In KSA, there were no previous studies done to assess the prevalence of DD among Saudi infants, and to our knowledge, this is the first study done in this aspect.

The incidence of DD creates huge anxiety among parents, even though it clear up spontaneously with appropriate treatment in most children. The current study identified female gender, age of the child 12-24 months who are diaper dependent, history of skin allergies (atopic dermatitis/ skin rashes), Type I skin, and abnormal stool (watery and loose) as independent risk factors for DD. The increased prevalence of DD in female infants in our study is, in contrast, to a study done by Li et al. that reported no difference between male and female children and the overall prevalence was found to be 43.8% [21], and no evidence in the literature speculates a reason for the gender difference in its incidence [22].

In the current study, infants above 12 months of age experienced more DD than 0-12 months of age. After birth, in infants, the skin tone and structure change due to several behavioral and environmental factors, and periodic exposure to chemicals in diapers may become more noxious with urine and feces [23]. The diaper area has early colonization of microorganisms such as Clostridium species, Staphylococcus species, Lactobacillus species, and other gut-derived bacteria, which could decrease the oxygen availability, increase the pH of the skin when covered with a diaper [24,25]. Infants of age >12 months have been exposed to this type of irritant dermatitis reaction more than below 12 months, and

this could be the possible explanation for the increased prevalence in the former population [26].

When diagnosis DD lesions, a thorough review of medical history should include the duration of the rash, urination and defecation frequency, other symptoms such as pain and itchiness, history of other dermatologic allergic or infectious diseases, behavioral and hygiene practices, previous treatment is done, types of diaper used, frequency of changing diapers, recent drug use, etc. are very much crucial [19,27,28]. The lesion appears as an erythematous eruption in the genital areas and involves the buttocks' convex surface, and skin creases are usually spared [26].

In the current study, it was found that infants who had a history of skin allergies were found to have more incidence of DD than others who didn't have a history of skin diseases. Many skin disorders in infants and toddlers occur in the diaper region either isolated or along with other skin rashes such as atopic dermatitis, psoriasis, infections (bullous impetigo), Lichen sclerosis, metabolic diseases, neoplasms (Langerhans cell histiocytosis) [28,29]. The presence of dyes and other chemical agents used in diapers, such as preservatives, emulsifiers, fragrances, adhesives, and polymers compounds, cause allergic dermatitis, and modern single-use disposable diapers should avoid these materials [30]. The management of DD wouldn't be effective if there is a presence of other skin disorders, and it is very much essential to properly diagnose the type of skin rash. The study findings showed that children with Skin Type 1 had a high risk for DD compared to other types. In a study done by Carr et al. [3] that assessed the incidence of DD based on the child's race and skin type, it was reported that Caucasian infants with Fitzpatrick Skin Type 1 and 2 showed a higher incidence of DD compared to others. The findings also showed that infants who had watery and loose type stool had a higher risk of developing DD compared to others. Children with diarrhea may have increased potential to develop DD as there is a change in pH and increased wetness in the diaper area [31]. Previous Studies have also shown that a mixture of urine and stool is more irritating to the skin than urine or stool alone [32,33]. No significant difference was detected in incidence of DD between infants who were using a different type of diapers. Although, shreds of evidence showed that disposable diapers with AMG/cellulose core materials had a lower DD incidence due to better skin

compatibility (lower wetness, maintain normal skin pH) than conventional cloth diapers [33,34]. In the present study, more than half of the caregivers reported that they would consult a doctor for diaper rash when there is no improvement within 1-2 days. Management of DD should focus on two objectives: faster healing of the skin rash and prevention of a recurring rash [35]. In mild cases, the prime cause of the DD should be identified and eliminated, followed by the usage of barrier creams. A best therapeutic approach in the management of DD should involve a bacterial and fungal investigation followed by general skin hygiene measures (frequent diaper change, cleaning genital areas, air exposure, using modern diapers (AMG/cellulose), and use of topical barrier creams [36,37]. Parents should be advised to frequently change a diaper that would help to reduce the amount of time wetness and irritant contact with skin. An infant with DD should be allowed to rest without using diapers, thus giving air exposure, which would accelerate the repair of the damaged skin. Care also should be taken to avoid rubbing the rash area when changing a diaper, and gentle cleansing with warm water should be encouraged. This study has several potential limitations. The questionnaire was designed to respond from the parents or caregivers regarding diaper use and associated factors for diaper dermatitis, which could have resulted in recall bias and social desirability bias a future study should include these excluded factors for getting a clear picture of possible risk factors of diaper dermatitis.

Conclusion

The reported prevalence of diaper dermatitis in our study was found to more in the Kingdom of Saudi Arabia. There is huge anxiety created among parents, and this would result in increased pediatric consultations. Parents should be educated on modifiable risk factors of DD, approaches in management, proper diaper use, and good hygienic practices related to diaper care.

Ethics approval

Institutional research ethics board approval was acquired before conducting any study-related procedures. A statement was included at the beginning of the questionnaire clarifying that the participation in this study is voluntary and that collected data will be anonymous and will only be used for this study.

Conflicts of Interest

The authors have no conflicts of interest to declare.

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