



Diaper dermatitis and associated factors among 1–24 months children visiting public health facilities of Arba Minch town, Gamo zone, southern Ethiopia

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ABSTRACT

Background: Diaper dermatitis is one of infants and toddlers' most common skin diseases; it accounts for 10–20 % of all skin diseases and 25 % of pediatric dermatology visits. Diaper dermatitis also increases parents' mental health problems and compromises the quality of life. Despite its ill outcome, diaper dermatitis's burden and risk factors are poorly studied in Ethiopia. Therefore, this study aimed to assess the magnitude of diaper dermatitis and associated factors among 1–24 months children visiting public health facilities in Arba Minch town, southern Ethiopia.

Methods: A facility-based cross-sectional study was conducted among 671 mother-child pairs from May 15 to June 15, 2022. A structured and pretested interviewer-administered questionnaire and observational checklist were used to collect the information. The data was collected using an open data kit tools and analyzed using Stata version 17.0. Bivariable and multivariable analyses were carried out to identify factors associated with diaper dermatitis. P-value <0.05 was considered to declare statistical significance.

Results: In this study, 664 mother-child pairs, yielded a response rate of 98.96 %, were involved. Overall, 35.69 % [95 % CI: 32.04, 39.47] of children encountered diaper dermatitis. Being government-employed (AOR: 2.49, 95 % CI: 1.42, 4.35), primiparity (AOR: 1.52, 95 % CI: 1.03, 2.23), unplanned pregnancy (AOR: 1.93, 95 % CI: 1.22, 3.04), having poor knowledge about diaper dermatitis (AOR: 1.74, 95 % CI: 1.19, 2.56), using both disposable and non-disposable diapers alternatively (AOR: 3.35, 95 % CI: 1.55, 7.22), and applying ointments on diaper area (AOR: 1.93, 95 % CI: 1.26, 2.97) all increase the likelihood of diaper dermatitis.

Conclusion: Diaper dermatitis was high in the study hospitals; over one-third experienced it. Maternal occupation, parity, pregnancy status, maternal knowledge of diaper dermatitis, diaper type, and ointment application were significantly associated with diaper dermatitis. Improving maternal/guardian knowledge about diapering and diaper dermatitis is critical to reducing the burden and severity of the problem.

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1. Introduction

Diaper dermatitis (DD), also known as diaper rash or nappy rash, is an inflammation of the skin of the lower parts of the abdomen, lower backs, thighs, skin folds, and diaper areas [1,2]. DD can be classified as chaffing dermatitis, irritant contact dermatitis, and diaper candidiasis. DD can be primary (associated with irritants that spare the deep skin folds) or secondary (mainly caused by wild candida yeast) [3]. Atopic and seborrheic dermatitis correspondingly present as diaper rash. Fungal infections (*Candida albicans* and mycoses) and bacterial infections (*S.aureus* and *Streptococcus pyogenes*) are also etiologic agents for DD [4–7].

Prolonged contact with urine or feces, increased moisture, and irritants increase the likelihood of DD. Infants' anatomy, creases, moist environment, and high skin folds make them more susceptible to dermatitis. The lower abdomen and lumbar region, gluteal area, genitalia, and inner aspects of the thighs are primarily affected by diaper rash [4,5,8]. DD can occur as early as one week and peak between 9 and 12 months of age [4]. Friction, excessive hydration, and higher pH lead to irritating and painful visible erythematous lesions. DD also leads to rare but severe conditions such as granuloma gluteal infantum (GGI) [9], vesiculobullous [10], Jacquet's erosive DD [5], and DD complicated by secondary *Candida albicans* or *S. aureus* infections [6]. It also indicates systemic conditions [11]. Moreover, DD leads to behavioral changes such as increased crying, agitation, eating, and sleeping, indicating emotional distress [6]. Furthermore, DD causes anxiety for parents and compromises the overall quality of the family's life [6,12].

Diaper dermatitis is one of the most common skin diseases among infants and toddlers, accounting for 10–20 % of all skin diseases [13] and 25 % of pediatric dermatology visits [4]. The prevalence of DD is widely varied across countries; 8.7 % in the USA and 14.9 % in Germany [8], 36.1 % in Thailand [14], 67.3 % in Turkey [15], 1.3–43.8 % in China [8,16], and 25.0 % in Japan [17]. Studies conducted in Africa also reported that the prevalence of DD is reported as 18.4 % in Cameroon [18], 38.9 % in Nigeria [19], 27.3 % in Kenya [20], and 62.5 % in Ethiopia [21].

Studies reported that prolonged contact with irritants [4], infants age [14], rural residence [16], lower maternal education [20], less frequent diaper change during night time, previous episodes of diaper rash, topical application of baby powders [14], use of non-breathable disposable diaper [19], low utilization of cream [15], cloth diaper and poor diaper cleansing practice [20], oral antibiotics [22], diarrhea [19], oral thrush, complementary feeding [15] and food allergies increase the risk of DD [16]. Likewise, prematurity and Zinc deficiency are predisposing factors for DD; the skin of premature newborns takes months to develop the proper pH and function, which makes them more vulnerable to irritants [1,23].

Scholars revealed that prevention is the key to eradicating DD [7]; the ABCDE (air, barrier, cleansing, dry diaper, and education) is the first-line solution for treating and preventing DD. Air exposure for an extended period, barrier cream that contains Zinc oxide and Petroleum, cleaning with water/gentle cleansers, diaper change every 2–4 h, and education about proper diaper hygiene techniques are the primary preventive interventions [24,25]. Barrier creams, superabsorbent disposable diapers, and avoiding soap and alcohol-containing products are vital [6,23,26]. Furthermore, breastfeeding has ample benefits in reducing DD: preventing its occurrence [6], facilitating the healing process [27], and has a comparable outcome with hydrocortisone 1 % ointment alone to treat DD [28].

Despite diaper utilization increases over time, health education about the merits and demerits of different diapers and DD prevention strategies is hardly done. Moreover, studies addressing DD's burden and risk factors are limited in Ethiopia, where most parents use homemade diapers [29]. Therefore, this study aimed to assess the magnitude and risk factors of DD among under 24 months children in health facilities of Arba Minch town, southern Ethiopia.

2. Method and materials

2.1. Study area, design, and period

A facility-based cross-sectional study was conducted in public health facilities in Arba Minch town, Gamo zone, southern Ethiopia, from May 15 to June 15, 2022. Arba Minch town is between the Gamo highlands and two rift valley lakes, Abaya and Chamo. The city is about 505 km south of Addis Ababa (the national capital). The town is divided into four administrative sub-cities: Secha, Sikella, Abaya, and Nech Sar. Arba Minch had four governmental health facilities (one general hospital, one primary hospital, and two health centers) and eight non-governmental clinics. Arba Minch general hospital (AMGH) was one of the largest hospitals in the Gamo zone, offering comprehensive service for the catchment area population. Likewise, Dulfana primary hospital, upgraded from a health center in early 2021, provides maternal and child health services. Furthermore, Secha and Wezie health centers provide immunization and maternal and child health services.

2.2. Study population

Mothers who had under 24 months children and who visited Arba Minch public health facilities during the study period were considered as the study population and included in this study. Children brought to the facilities by someone other than family members/caretakers and those mothers who cannot communicate due to severe illness were excluded.

2.3. Sample size determination and sampling

EpiInfo 7 menu StatCalc was used to calculate the sample size after the considerations: 95 % level of confidence, 80 % power, 29.30 % (proportion of DD among infants with topical application of diaper cream (P1)), 40.42 % (proportion of DD among infants with

topical application of baby powder (P2)), unexposed to an exposed ratio of 1 [14], and 10 % non-response rate, the final sample size was 671. The sample was allocated proportionally to the facilities based on the previous six months' client flow. The data was then collected using systematic random sampling ($k = 2$) based on the client admission order.

2.4. Data collection methods

The data collection tool was adapted after reviewing previous studies [14–16,19] and had four parts: Part one includes the socio-demographic characteristics such as age, residence, occupation, educational status, marital status, husband occupation and educational status, family size, and average monthly income. Part two contains variables related to obstetric characteristics such as gravidity, parity, pregnancy status, place of delivery, antenatal care (ANC) follow-up, and postnatal care (PNC). Maternal knowledge about the risk factor, prevention, and management of DD was measured using 12 items, and those who scored the mean or above were labeled as knowledgeable [30]. Part three provides child characteristics such as age, sex, birth weight, gestational age, initiation of solid food, attending daycare center, childhood illnesses such as diarrhea, oral thrush, stool frequency per 24 h, allergy to food, and feeding habits.

Part four comprises variables related to diapering practice: knowledge about DD, diapering practice experience, type of diaper, frequency of diaper change, wipes, detergents/soap use, time of toilet training initiation, DD, and previous episodes of DD. Diaper dermatitis was recorded as a yes/no response after asking the mother/caretaker whether her child encountered any skin rash in the diaper areas and was observed using the new scoring system for the DD scale [14,31]. The severity score was computed using a Likert scale questions that range from (0) clear skin to (6) extensive DD. The scoring system is reliable ($\alpha = 0.702$) and had good inter-rater reliability (Intraclass correlation coefficients (ICCs): 0.850 to 0.949) generated from four domains: erythema and irritation, the area with any DD, papules or pustules, and open skin [31] (Table 1).

Six professional nurses and two master professionals were hired for data collection and supervision, respectively. The investigators provide theoretical and practical training about the study's objectives, data collection procedure, and open data kit (ODK) tools for the data collection team. The instrument was pretested on 33 infants in the Mirab Abaya health center. Then, the data collection was initiated after securing voluntary informed and written consent from the mother/caretaker of the child. Interviews of the mother/caretakers, observation of the infant's diaper areas, and review of medical records were used. Those children with DD were linked to the healthcare providers in the respective facilities for further evaluation and treatment. Besides, the mothers/caretakers were counseled about diapering and hygiene to prevent subsequent episodes of DD. The whole data collection process was supervised daily by the supervisors and investigators.

2.5. Data analysis

The data set was downloaded from Google Drive as an Excel file and imported to Stata 17.0 for analysis. The measure of central tendencies, dispersion, and simple frequencies were computed to describe participants' characteristics. Bivariate analysis was conducted using binary logistic regressions to see the strength and direction of association between the outcome variables and each predictor. The goodness of fit test and multicollinearity was checked using Hosmer and Lemshow and variance inflation factor (VIF) > ten, respectively. Variables with $P < 0.25$ in the bivariable analysis were included in the multivariable analysis to control for possible confounders. The adjusted odds ratio and 95 % CI were estimated to identify factors associated with DD in the multivariable model. P -value, <0.05 , was considered to declare a result as statistically significant.

2.6. Ethical considerations

Ethical approval for this study was obtained from Arba Minch University, College of Medicine and Health Sciences, Institutional

Table 1
Diaper dermatitis severity assessment Scale.

Parameters	Score
A. severity of erythema and irritation	
None: clear skin	0
Mild: skin not clear, some irritation detectable, but may not be obvious	1
Moderate: skin irritation is noticeable but not severe or intense	2
Severe: skin irritation intense, bright red, looks painful	3
B. extent of diaper dermatitis	
<50 % of the perianal–perineal–gluteal area or the diaper are affected	0
≥50 % of the perianal–perineal–gluteal area or the diaper are area affected	1
C. Papules and pustules	
Papules and pustules are present, but few would be practical to count them	0
Many clustered papules or pustules are present, would not be practical to count them	1
D. Open skin	
Superficial open skin involving only the epidermis; any erosion on the mucosa; any open skin judged to be caused by friction, injury, or etiology other than diaper dermatitis	0
Any deep dermal open skin with damage to the dermis (not caused by friction, injury, or etiology other than diaper dermatitis)	1

Review Board (IRB), with a protocol number of IRB/1154/2021. A permission letter was secured from each health facilities administrator. After explaining the purpose of the study, written consent was obtained from the child's parent before the commencement of the data collection. Code numbers were used throughout the study to maintain the confidentiality of information gathered from the study participant. Infants with DD were linked to the respective service unit for further evaluation and treatment. In addition, the mothers were counseled about appropriate diapering practices to prevent a similar problem.

3. Results

3.1. Maternal socio-demographic characteristics

In this study, 664 mother-infant pairs were involved, with a response rate of 98.96 %. The mean age of the mothers was 26.76 (SD \pm 4.95) years, with a minimum and maximum of 18 and 45 years, respectively. Of the participants, 251 (37.80 %) were between 25 and 29 years old, and 633 (95.33 %) were married. Regarding educational status, 214 (32.23 %) mothers and 205 (32.39 %) husbands attend secondary education. Over half, 360 (54.22 %), were housewives, 566 (85.24 %) were urban dwellers, and 582 (87.65 %) had a family size of less than or equal to five. More than half, 360 (54.22 %) participants, had a monthly income of between 3000 and 5000 Ethiopian birr (Table 2).

3.2. Obstetrics characteristics

Of the participants, 373 (56.17 %) were multipara, 321 (48.34 %) had four and above ANC follow-ups, and the pregnancy was planned for 527 (79.37 %) participants. Regarding PNC, 495 (74.55 %) did not have any PNC follow-up, and only 26 (3.92 %) had three and more PNC visits (Table 3).

Table 2
Socio-demographic characteristics of participants in public health facilities of Arba Minch Gamo Zone, Southern Ethiopia, 2022 (n = 664).

Variables	Category	Frequency	Percentage
Age in years	<25	213	32.08
	25–29	251	37.80
	30–34	151	22.74
	\geq 35	49	7.38
Marital status	Single	18	2.71
	Married	633	95.33
	Divorced	7	1.05
	Living apart	6	0.90
Maternal education	Unable to read & write	22	3.31
	Able to read and write	106	15.96
	Primary education	109	16.42
	Secondary education	214	32.23
Maternal occupation	College and above	213	32.08
	Housewives	360	54.22
	Government employee	120	18.07
	Merchant	79	11.90
Residence	Student	77	11.60
	^a Other	28	4.22
	Urban	566	85.24
	Rural	98	14.76
Husband occupation (633)	Farmer	68	10.74
	Government employee	208	32.86
	Daily laborer	95	15.01
	Merchant	155	24.49
Husband education (633)	Driver	84	13.27
	^b Other	23	3.63
	Unable to read & write	11	1.74
	Able to read and write	94	14.85
Family size	Primary education	75	11.85
	Secondary education	205	32.39
	College and above	248	39.18
	\leq 5	582	87.65
Monthly income	>5	82	12.35
	<3000	123	18.52
	3000–5000	360	54.22
	>5000	181	27.26

^a Daily laborer, farmer, chef, spiritual services.

^b Student, shimena, chief, private work.

Table 3

Obstetrics characteristics of participants in public health facilities of Arba Minch Gamo Zone, Southern Ethiopia, 2022 (n = 664).

Variables	Category	Frequency	Percentage
Gravidity	Primigravida	245	36.90
	Multigravida	419	63.10
Parity	Primiparity	291	43.83
	Multiparity	373	56.17
ANC ^a follow-up	No	32	4.82
	1–3	311	46.84
	≥4	321	48.34
Place of delivery	Home	10	1.51
	Health center	261	39.31
	Hospital	385	57.98
	Health post	8	1.20
Status of pregnancy	Planned	527	79.37
	Unplanned	137	20.63
PNC ^b follow-up	No	495	74.55
	1–3	143	21.54
	>3	26	3.92

^a Antenatal care.^b Postnatal care.

3.3. Children characteristics

The mean age of the children was 9.23 (SD ± 6.21) months. More than half, 363 (54.67 %) of the children were males, and 37 (5.57 %) were born with low birth weight (<2500 g). Regarding the feeding habit, 266 (40.06 %) feed breast milk alone, and 386 (58.13 %) provide mixed human milk and supplementary food. Most children, 545 (82.08 %), were cared for by their parents. Of the children, 376 (56.63 %), 36 (5.42 %), and 349 (52.56 %) encountered diarrhea, oral thrush, and medical illness, respectively (Table 4).

Table 4

Characteristics of children in public health facilities of Arba Minch Gamo Zone, Southern Ethiopia, 2022 (n = 664).

Variables	Category	Frequency	Percentage
Sex	Male	363	54.67
	Female	301	45.33
Age in months	<6	227	34.19
	6–12	251	37.80
	13–24	186	28.01
Birth weight	Low birth weight	37	5.57
	Normal	517	77.86
	Macrosomia	110	16.57
Feeding habit	Exclusive breastfeeding	266	40.06
	Mixed	386	58.13
	Supplementary food alone	12	1.81
*Type of solid food initiated	Don't start yet	280	42.72
	Cereals	347	52.34
	Fish	127	19.16
	Egg	270	40.72
	Other	38	5.73
Primary caregiver of the child	Parents	545	82.08
	Others	119	17.92
Attend daycare center	Yes	10	1.51
	No	654	98.49
Encountered diarrhea	Yes	376	56.63
	No	288	43.37
Experienced oral thrush	Yes	36	5.42
	No	628	94.58
Faced medical illness	Yes	349	52.56
	No	315	47.44
Allergic to food/drink	Yes	16	2.41
	No	648	97.59
Frequency of stool per 24 h	One	449	67.62
	Two	207	31.17
	Three	8	1.20
Previous episodes of DD ^a	Yes	181	27.26
	No	483	72.74

*a variable with multiple responses.

^a Diaper dermatitis.

3.4. Maternal knowledge about diaper dermatitis

The mean knowledge score of the mothers about DD was 4.56 (SD \pm 2.19); 301 (45.33 %) were knowledgeable about DD. Among the participants, 465 (70.03 %) correctly responded as DD is a common skin condition in babies and young children, and 482 (72.59 %) believed that infrequent diaper change is the most common cause of DD (Fig. 1).

3.5. Diapering practice

Of the participants, 181 (27.26 %) had previous episodes of DD. Regarding diaper use, 350 (52.71 %), 19 (2.86 %), and 255 (38.40 %) mothers used disposable, non-disposable, and homemade diapers, respectively. The diaper was changed at least two times per 24 h and during the night for 375 (56.48 %) and 396 (59.64 %) of the children, respectively. Among participants, 236 (35.54 %) bathed their child more than seven times a week, and 249 (37.50 %) initiated toilet training. Regarding the cleaning material for the diapering area, 286 (43.07 %), 555 (83.58 %), and 408 (61.45 %) used baby wipes, water alone, and soapy water, respectively (Table 5). Furthermore, 313 (47.14 %), 125 (18.83 %), and 66 (9.94 %) mothers applied vaseline, powder, and cream on diaper areas before putting on the diaper, respectively (Fig. 2).

3.6. Prevalence of diaper dermatitis

Overall, 237 [35.69 %, 95 % CI: 32.04, 39.47] of infants and young children encountered DD. Of them, 76 (32.07 %) infants presented with mild severity of erythema and irritation. Regarding the extent of DD, \geq 50 % of diaper areas were affected for 10 (4.22 %) infants. Furthermore, 6 (2.53 %) infants were presented with many or clustered papules or pustules, and 17 (7.17 %) faced deep

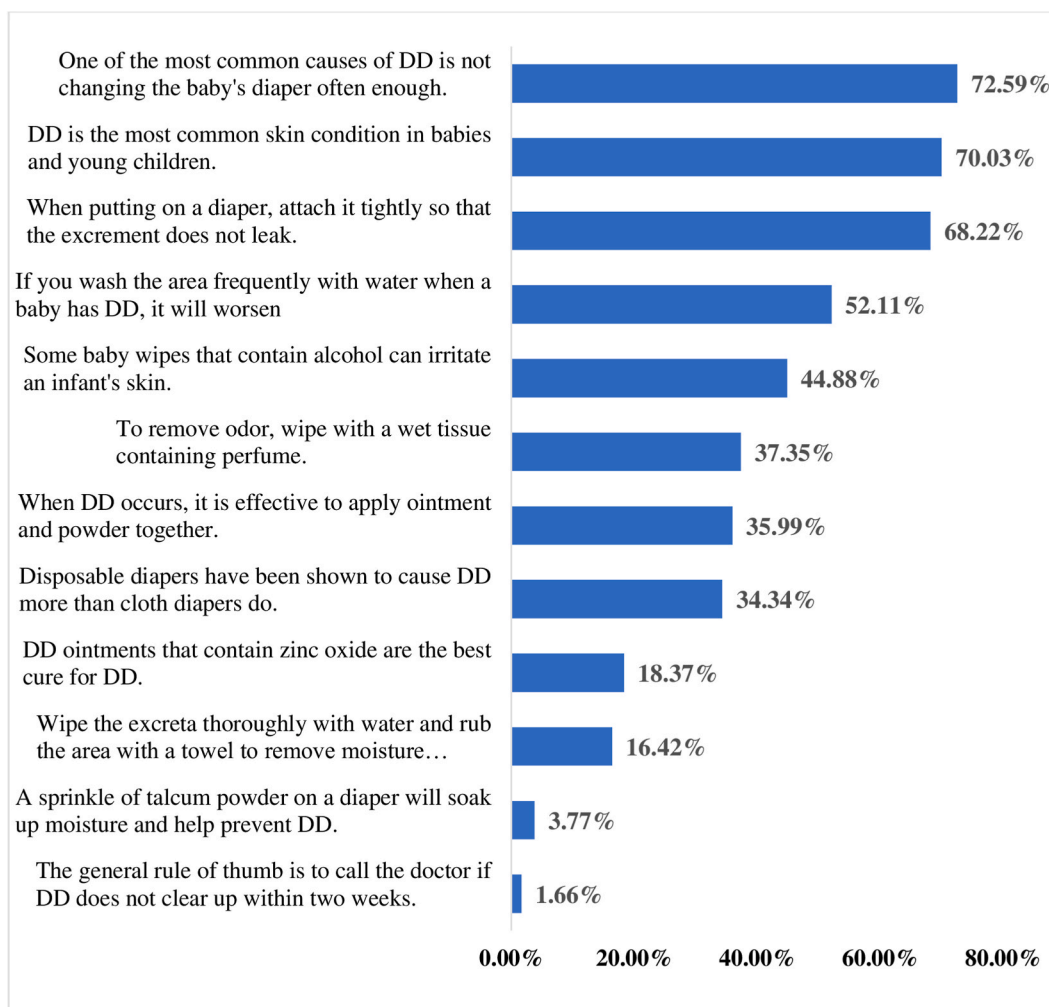


Fig. 1. Maternal knowledge about diaper dermatitis in public health facilities of Arba Minch Gamo Zone, Southern Ethiopia, 2022 (n = 664).

Table 5
Diapering practice of mothers in public health facilities of Arba Minch Gamo Zone, Southern Ethiopia, 2022 (n = 664).

Variables	Categories	Frequency	Percentage
Type of diaper use	Disposable only	350	52.71
	Non-disposable only	19	2.86
	Both disposable and non-disposable	40	6.02
	Homemade	255	38.40
Frequency of diaper change in 24 h	<3	375	56.48
	≥3	289	43.52
Frequency of diaper change during night	Yes	396	59.64
	No	268	40.36
Frequency of bathing per week	≤3	26	3.92
	4–7	402	60.54
	>7	236	35.54
Toilet training initiated	Yes	249	37.50
	No	415	62.50
*Cleaning material for diaper area	Baby wipes	286	43.07
	Normal water	555	83.58
	Warm water	50	7.53
	Soap	408	61.45
	Tissue paper	116	17.47
	^a Other	8	1.20
	Action taken when the child develops a diaper rash	Nothing	167
Apply diaper cream	Apply diaper cream	23	3.46
	Baby powder	195	29.37
	Regular moisturizer	105	15.81
	Vaseline	121	18.22
	^b Other	53	7.98
	Time to take to health facilities after the child develops a diaper rash	As early as possible	153
After no improvement within 1–2 days	After no improvement within 1–2 days	179	26.96
	After no improvement within seven days	242	36.45
	After no improvement within 14 days	90	13.55

*a variable with multiple responses.

^a Alcohol based fluid, normal saline.

^b Butter, wash regularly, take to health facility.

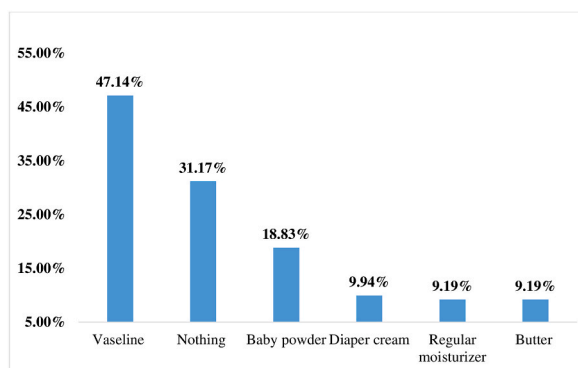


Fig. 2. Types of ointments applied among participants in public health facilities of Arba Minch Gamo Zone, Southern Ethiopia, 2022 (n = 664).

dermal open skin with damage to the dermis (Table 6).

3.7. Factors associated with diaper dermatitis

After adjustment for confounding variables, it was found that maternal occupation, parity, pregnancy status, maternal knowledge about DD, type of diaper used, and ointment applied to the diaper areas were significantly associated with DD. The odds of DD were 2.49 times (AOR: 2.49, 95 % CI: 1.42, 4.35) higher among mothers who were government employed than infants whose mothers were housewives. Primiparity increases the odds of DD by 1.52-fold (AOR: 1.52, 95 % CI: 1.03, 2.23) compared to multipara counterparts. Unplanned pregnancy increases the odds of DD by twofold (AOR: 1.93, 95 % CI: 1.22, 3.04). The odds of DD were 1.74 times (AOR: 1.74, 95 % CI: 1.19, 2.56) higher among infants whose mothers were poor knowledge about DD compared to infants whose mothers were knowledgeable about DD. Using disposable and non-disposable diapers alternatively increases the odds of DD by 3.35 times (AOR: 3.35, 95 % CI: 1.55, 7.22) compared to disposable diaper-alone users. The odds of DD were 1.93 times (AOR: 1.93, 95 % CI: 1.26,

Table 6
Severity assessment of diaper dermatitis using the new DD severity assessment scale (n = 237).

Parameters	Frequency (%)
Severity of erythema and irritation	
None: clear skin	127 (53.59)
Mild: skin not clear, some irritation detectable, but may not be obvious	76 (32.07)
Moderate: skin irritation is evident but not severe or intense	30 (12.66)
Severe: skin irritation intense, bright red, looks painful	4 (1.69)
Extent of diaper dermatitis	
<50 % of the perianal–perineal–gluteal area and of the diaper area affected	227 (95.78)
≥50 % of the perianal–perineal–gluteal area or the diaper area affected	10 (4.22)
Papules and pustules	
Papules and pustules are present, but few would be practical to count them	231 (97.47)
Many clustered papules or pustules are present; it would not be practical to count them	6 (2.53)
Open skin	
Superficial open skin involving only the epidermis; any erosion on the mucosa; any open skin judged to be caused by friction, injury, or etiology other than diaper dermatitis	220 (92.83)
Any deep dermal open skin with damage to the dermis (not caused by friction, injury, or etiology other than diaper dermatitis)	17 (7.17)

2.97) higher among infants whose mothers applied diaper ointments on the diaper area than mothers who did not use anything on the diaper area (Table 7).

4. Discussion

Despite advancements in diaper technology, DD remains the most common problem among infants and toddlers worldwide [4,13]. The current study revealed that over one-third of infants/toddlers experienced DD. Maternal occupation, parity, pregnancy status, maternal knowledge of DD, diaper type, and applying ointments to diaper areas increases the likelihood of DD.

In this study, 35.69 % of infants encounter DD. This finding is in line with the studies conducted in Thailand (36.1 %) [14], Nigeria (38.9 %) [19], and Saudi Arabia (39.33 %) [32]. However, this finding is higher than a large-scale study conducted in China (1.3 %), the USA (8.7 %), Germany (14.9 %) [8], Japan (25.0 %) [17], Dakar (22.8 %) [33], Cameron (18.4 %) [18], and Kenya (27.3 %) [20]. The possible explanations for such discrepancies include the participants' diapering knowledge and practice, educational status, and employment status. Another reason is that nearly half of the participants in this study use non-disposable and homemade diapers. The environmental condition of Arba Minch town and surrounding districts could also be a factor, as hot temperatures increase the likelihood of diaper dermatitis. On the other hand, this finding is lower than the studies conducted in Turkey (67.3 %) [15], China (43.8 %) [16], and Ethiopia (62.5 %) [21]. This variation could be attributed to differences in study time and advancements in the quality of disposable diapers. Furthermore, the utilization of these products has significantly improved over time.

In our study, the odds of DD are 2.5 times higher among government-employee compared to housewives. Though we did not find studies that directly support or contradict this finding, studies on maternal knowledge of DD management reported that homemakers better understand diaper rash management than those engaged in economic activities [30]. The possible justification is that homemakers have enough time to provide comprehensive infant care, such as bathing and cleaning after urine and defecation, changing diapers frequently, and providing all other infant care. In contrast, mothers engaged in income-generating activities and education have limited time to care for their infants adequately. Furthermore, those mothers who are employed or engaged in economic activities leave their infants at home maid or put them in daycare centers. Even though the multivariable analysis is not statistically significant, the current study also revealed that the proportion of DD is higher among infants cared for by others other than parents.

According to this study, primiparity increases the odds of DD by 1.52-fold compared to multipara counterparts. This finding could be due to a lack of experience; primi mothers are unfamiliar with infant care, including diapering. Scholars also demonstrated that maternal expertise plays a significant role in lowering DD [34]. This study also revealed that unplanned pregnancy doubles the risk of DD. This finding is possible because unintended pregnancy is associated with various maternal physical and mental health issues, low birth weight, and prematurity. Furthermore, it jeopardizes the overall quality of care for neonates, infants, and young children. In Ethiopia, 28 % of pregnancies are unplanned (one of the highest in the world) [35] and are associated with adverse birth outcomes and poor quality of infant care.

In our study, the odds of DD are 1.74 times higher among infants whose mothers had poor knowledge about DD than infants with good knowledge. Although there are studies that address maternal knowledge of DD [30,36], they do not assess its relationship with the prevalence of diaper rash. The incidence of DD is significantly reduced when mothers have adequate knowledge of the condition, aggravating factors, and prevention mechanisms. Maya and colleagues demonstrated that increasing maternal knowledge of diapering practices through awareness creation programs is critical for DD prevention and management [34].

This study revealed that using disposable and non-disposable diapers alternatively increases the odds of DD by 3.35-fold compared to those who use disposable diapers alone. This finding is supported by previous studies [19,37] where disposable diapers decrease the risk of DD. This finding is also consistent with a survey conducted in Kenya, which discovered that using cloth diapers increases the likelihood of DD by a factor of six [20]. The possible justification is that disposable diapers are absorbent and breathable, minimizing moisture from urine and fecal matter.

Table 7

Factors associated with diaper dermatitis in public health facilities of Arba Minch Gamo Zone, Southern Ethiopia, 2022 (n = 664).

Variables	Diaper dermatitis		COR [95 % CI]	P-value	AOR [95 % CI]	P-value
	Yes, N (%)	No, N (%)				
Marital status						
Married	220 (34.76)	413 (65.24)	1		1	
^a Other	17 (54.84)	14 (45.16)	2.28 (1.10, 4.71)	0.026	0.98 (0.41, 2.33)	0.955
Maternal occupation						
Housewives	96 (26.67)	264 (73.33)	1		1	
Gov't employee	64 (53.33)	56 (46.67)	3.14 (2.05, 4.82)	<0.001	2.49 (1.42, 4.35)*	0.001
Merchant	34 (43.04)	45 (56.96)	2.08 (1.26, 3.44)	0.004	1.73 (0.95, 3.13)	0.071
Student	35 (45.45)	42 (54.55)	2.29 (1.38, 3.80)	0.001	1.56 (0.84, 2.88)	0.156
^b Other	8 (28.57)	20 (71.43)	1.10 (0.47, 2.58)	0.827	0.73 (0.29, 1.82)	0.497
Residence						
Urban	209 (36.93)	357 (63.07)	1		1	
Rural	28 (28.57)	70 (71.43)	0.68 (0.43, 1.09)	0.112	0.85 (0.49, 1.48)	0.563
Parity						
Primiparity	120 (41.24)	171 (58.56)	1.54 (1.12, 2.11)	0.009	1.52 (1.03, 2.23)*	0.035
Multiparity	117 (31.37)	256 (68.31)	1		1	
Status of pregnancy						
Planned	172 (32.64)	355 (67.36)	1		1	
Unplanned	65 (47.45)	72 (52.55)	1.86 (1.27, 2.73)	0.001	1.93 (1.22, 3.04)*	0.005
Primary care provider of the child						
Parents	170 (31.19)	375 (68.81)	1		1	
Others	67 (56.30)	52 (43.70)	2.84 (1.90, 4.26)	<0.001	1.23 (0.70, 2.17)	0.478
Maternal knowledge about diaper dermatitis						
Poor	147 (40.50)	216 (59.50)	1.60 (1.15, 2.21)	0.005	1.74 (1.19, 2.56)*	0.005
Good	90 (29.90)	211 (70.10)	1		1	
Child age in months						
<6	67 (29.52)	160 (70.48)	1		1	
6–12	85 (33.86)	166 (66.14)	1.22 (0.83, 1.80)	0.308	1.02 (0.63, 1.65)	0.945
13–24	85 (45.70)	101 (54.30)	2.01 (1.34, 3.02)	0.001	1.49 (0.86, 2.60)	0.155
Encounter diarrhea						
Yes	149 (39.63)	227 (60.37)	1.49 (1.08, 2.06)	0.016	1.27 (0.82, 1.98)	0.284
No	88 (30.56)	200 (69.44)	1		1	
Type of diaper used						
Disposable only	126 (36.00)	224 (64.00)	1		1	
Non-disposable only	9 (47.37)	10 (52.63)	1.60 (0.63, 4.04)	0.320	1.99 (0.73, 5.43)	0.181
Both disposable and non-disposable	26 (65.00)	14 (35.00)	3.30 (1.66, 6.55)	0.001	3.35 (1.55, 7.22)*	0.002
Homemade	76 (29.80)	179 (70.20)	0.75 (0.53, 1.07)	0.111	0.94 (0.60, 1.49)	0.806
Apply ointment to the diaper area						
No	46 (22.22)	161 (77.78)	1		1	
Yes	191 (41.79)	266 (58.21)	2.51 (1.72, 3.66)	<0.001	1.93 (1.26, 2.97)*	0.003
Using soap for cleaning the diaper area						
No	81 (31.64)	175 (68.36)	1		1	
Yes	156 (38.24)	252 (61.76)	1.34 (0.96, 1.86)	0.085	1.27 (0.86, 1.88)	0.229
Frequency of diaper change per 24 h						
<3	138 (36.80)	237 (63.20)	1		1	
≥3	99 (34.26)	190 (65.74)	0.89 (0.65, 1.23)	0.498	0.74 (0.50, 1.09)	0.131

^asingle, divorced, separated; ^bdaily laborer, farmer, chief, spiritual services; Hosmer-Lemeshow: 0.407; *significant at P < 0.05.

This study demonstrated that the odds of DD are two times higher among infants whose mothers applied ointments on the diaper area than mothers who did not use anything on the diaper area. This finding agrees with the study conducted in Thai, where the topical application of baby powders increases the incidence of DD [14]. On the other hand, this finding contradicts the study that demonstrates that cream usage decreases the prevalence of DD [15]. Such inconsistencies might be attributed to the type of cream, powder, or any other ointment applied to the diaper area. Ointments containing petroleum and zinc oxide ingredients are scientifically proven substances in reducing diaper rash. On the other hand, creams with unknown ingredients and alcohol-based lotions irritate the infants' skin.

Previous studies consistently found that diarrheal disease increases the risk of developing DD [16,38]. In the current study, however, diarrheal disease is not significantly associated with DD after adjustment. The possible explanation is that infant care during such sickness might be improved, and the mothers frequently clean the diaper areas to prevent skin irritation from frequent bowel movements and digestive enzymes.

This study is the first that examine DD's prevalence and risk factors in southern Ethiopia. The findings are critical for clinicians to understand the current burden of DD and prepare diapering practice counseling manuals for parents. The results of this study are also essential for launching community-based diaper awareness creation programs. Furthermore, it benefits the scientific community to initiate projects or interventional studies to raise parental awareness of diaper dermatitis.

This study has many strengths, such as using a validated and reliable data collection tool and electronic data collection using ODK

tools. Despite its strengths, this study has the following limitations: the study design prevents us from assessing the cause-effect relationship between variables. Scholars with similar interests are encouraged to conduct longitudinal and qualitative studies to appropriately evaluate variables and identify traditional practices that increase the incidence of DD. Furthermore, this study only reports the crude extent of dermatitis, so laboratory-based studies are imperative to address the specific types of dermatitis in the diaper area.

5. Conclusion

The prevalence of DD in the study hospitals was high; over one-third of the children suffered from DD. Being government-employed, being primiparity, having an unplanned pregnancy, having poor knowledge about DD, using disposable and non-disposable diapers alternatively, and applying ointments on the diaper area all increase the likelihood of DD. Awareness creation programs about DD prevention for parents are critical to minimize short and long-term complications. The caretakers should be counseled on ABCDE; they must be advised to wipe the diaper area in a front-to-back direction, avoid scrubbing, and clean their hands before and after changing diapers. The healthcare providers must prepare a comprehensive protocol for diapering practice and counsel mothers during the postpartum period, postnatal visits, and immunization clinics. Furthermore, DD is one of the most overlooked problems in Ethiopia. Thus, scholars are suggested to conduct longitudinal studies spanning large geographical areas, involving diverse population groups, and addressing cultural practice-related predictors of DD.

Ethical statement

The Institutional Review Board (IRB) of Arba Minch University, College of Medicine and Health Sciences, approved the study with a protocol number of IRB/1154/2021.

Author's contribution

Agegnehu Bante (AB): Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools, or data; Wrote the paper. Meseret Girma (MG), Dr. Muluken Ahmed (MA), and Zeleke Aschalew (ZA): Performed the experiments; Contributed reagents, materials, analysis tools, or data.

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Data availability

Data will be made available on request.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Abbreviations

ABCDE	Air, Barrier, Cleansing, Dry Diaper and Education
ANC	Antenatal care
DD	Diaper dermatitis
PNC	Postnatal care
NICU	Neonatal Intensive Care Unit
ODK	Open Data Kit

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.heliyon.2023.e20785>.

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