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An Integrative Review of Clinical Characteristics of Infants With Diaper Dermatitis

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ABSTRACT

Background: Diaper dermatitis (DD) severity is demonstrated by the degree of erythema and skin breakdown. Many studies describe diaper dermatitis, but lack a full description of clinical characteristic (CC) involvement.

Purpose: The purpose of this literature review is to explore the descriptions of CC of infants with DD provided within infant DD literature.

Search Strategy: PubMed and Web of Science were searched using the keywords: diaper dermatitis, diaper rash, infant, and neonate. The inclusion criteria for this project are as follows: published after 1990, English language, include skin assessment or evaluation, and infant/children < two years of age. Review and opinion articles were excluded.

Results: A total of 454 studies were retrieved, 27 remained after review for duplicates and relevance. The CC described most often were: type of feeds, stool frequency, history of DD, use of antibiotics, and delivery mode.

Synthesis of Evidence: The studies reported inconsistent CC and a lack of correlation between these characteristics and the condition of diapered skin. Many studies focused solely on the efficacy of interventions lacking description of possible relationships between DD and CC.

Implications for Practice: Skin condition outcome variables can be improved with the acknowledgment of the impact CC have on the development of DD. The combination of assessment measures and CC may ultimately demonstrate more merit or rigor for describing DD severity and skin condition.

Implications for Research: Future research should expand this exploration to include environmental or contributing factors to continue to identify additional risk factors for DD.

Key Words: clinical characteristics, diaper dermatitis, infant, literature review, NICU

Diaper dermatitis (DD) is a common condition in infants younger than 12 months.^{1,2} DD is an inflammatory process that is a result of incontinence and irritation within the diaper area. The concept of DD in the infant population was first identified in the 1940s, and continues as a common condition today.³

DD is a prominent skin injury among hospitalized infants.⁴⁻⁸ Although the exact prevalence of DD in neonatal intensive care unit (NICU) settings is unknown, Migoto et al⁷ described a 29.7% incidence of DD among a small sample in Brazil, while researchers from Hungary reported an incidence of 25% among a larger sample in a NICU that provided a higher level of care.⁶

Several researchers describe efforts to reduce the incidence of DD using evidence-based practice and

skin care guidelines.⁹⁻¹¹ An evidence-based national skin care guideline was created by researchers and clinical experts to provide a standard of care and promote consistency among skin care practices.¹² Nurses in different countries who led quality improvement initiatives have adapted the guideline to test methods that further investigate skin conditions such as DD in clinical settings.^{7,13,14}

Despite the numerous published reviews, guidelines, and studies that examined DD, there is a lack of adequately studied clinical characteristics associated with the development, management, or treatment of DD. Clinical characteristics are often overlooked as potential risk factors when the primary focus for the study is on management or treatment of DD. The purpose of this literature review is to explore the descriptions of clinical characteristics of infants with DD provided within infant DD literature.

METHODS

Search Strategy

The following databases were searched: PubMed, CINAHL, and Web of Science, with the following keywords: diaper dermatitis, diaper rash, infant, and

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neonate. The inclusion criteria for this project are as follows: articles published since 1990s; published in English, studies that mention skin assessment or evaluation, and articles that studied (1) infant/children younger than 2 years and (2) any gestational age. The exclusion criteria were as follows: review articles, opinion articles, dissertations, book chapters and books, newspaper articles, and retrospective studies.

Data Characteristics

Participant characteristics (demographic, maternal or delivery information, presence or absence of DD, and health status), purpose of the study, type of design, additional characteristics of the subjects, type of assessment tool including physiologic and visual tools, intervention type, and results were extracted from each study. How are these different from clinical characteristics?

Levels of Evidence

To provide level of rigor, each study was assigned an evidence level using the Melynck and Fineout-Overholt¹⁵ guidelines. The assignment of evidence level was as follows: level I (systematic review of randomized control trials), level II (evidence of a well-done randomized control trial), level III (quasiexperimental, well-designed control trial), level IV (evidence of case control or cohort study), level V (evidence from systematic review of descriptive studies), and level VI (evidence of a descriptive study).¹⁵

RESULTS

The search of the databases resulted in 454 studies, 282 from PubMed and 172 from Web of Science using Prisma methods. Inclusion and exclusion criteria were applied, and 27 articles remained after further review for duplicates and relevance to the purpose (see Figure 1). The remaining articles are presented in 2 tables based on the type of study performed and include (1) assessment and prevention-focused studies and (2) treatment focused studies, and are displayed chronologically in Tables 1 and 2, respectively. Twenty of the studies presented a randomized control trial (RCT) design and demonstrated methodological and design rigor. In Table 3, the common clinical characteristics identified among the studies in Tables 1 and 2 are presented.

Assessment and Prevention Studies

Fourteen studies demonstrated assessment or preventive-themed designs and are presented in Table 1.^{5,16-28} Several factors identified within the 14 studies are associated with the development of DD to include stool frequency, antibiotic usage, diarrhea, and oral thrush.^{5,8,16,21,23} Researchers identified vaginal or cesarean section delivery as a clinical characteristic in 2 studies.^{22,24,28} Researchers also identified protective elements against DD that include human milk feeds and phototherapy.^{5,21,26} Among all the studies, DD was not found in any infant during the day of birth or

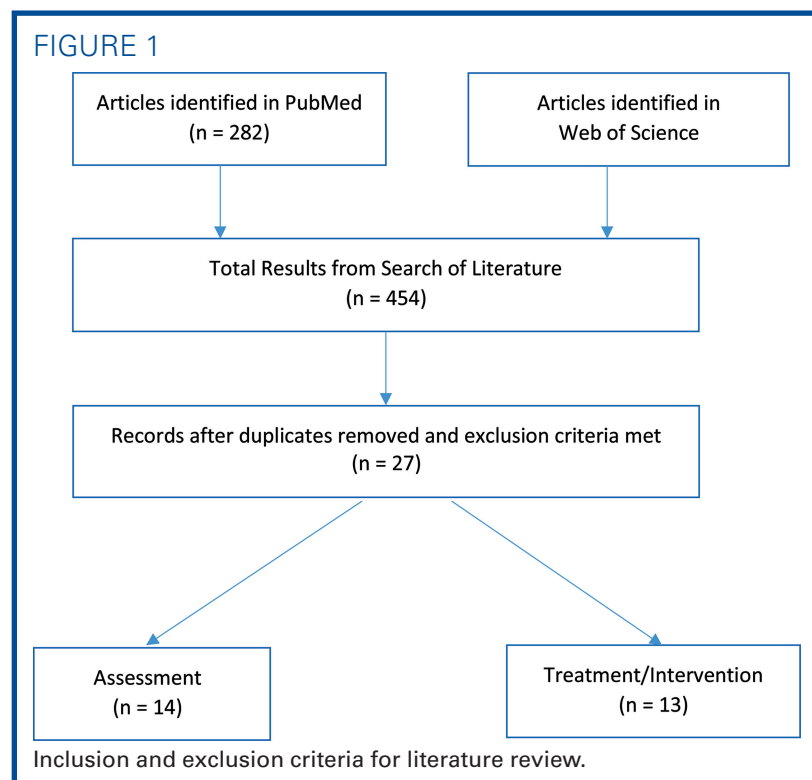


TABLE 1. DD Assessment and/or Prevention Studies

Author	Purpose	Study Design	Sample Size	Sample Age	Setting	Clinical Characteristics
Visser et al ¹⁶	To examine the stages of DD within the initial 28 d of life	Descriptive, observational study	n = 31	37-42 wk	Hospital/home	Gender DOL BW Race Frequency of feeds Frequency of diaper changes Frequency of stools/urine
Odio et al ¹⁷	To determine the effects of 2 different diaper technologies on DD development and skin erythema	Two study groups (A&B): double-blinded, randomized parallel group	n = 391	8-24 mo	Outpatient	Gender Age DOL Days of diaper use
Ferrazzini et al ¹⁸	To determine severity of DD when correlated with bacterial colonization	Multicenter, correlational study	n = 76	2-24 mo	Outpatient	Gender Age Weight Height Race Hx of DD Type of DD Concurrent illness
Visser et al ¹⁹	To examine the effect of diaper wipes vs water wipes on the diaper area skin condition	Randomized, single-blind study	n = 130	23 to \geq 38 wk	Hospital	Gender GA at birth BW Frequency of diaper changes Frequency of stools/urine
Stamatas et al ²⁰	To examine DD pathophysiology and its relationship to skin barrier function	Observational, descriptive study	n = 35	3-24 mo	Outpatient	None reported
Liu et al ²¹	To determine severity and presence of DD with the use of cloth diapers	Observational study	n = 694	3-9 mo	Outpatient/home	Gender Age Location Type of feeds Frequency of diaper changes Use of skin care products Frequency of DD Presence of diarrhea and teething
Lavender et al ²²	To evaluate the use of a specially formulated wipe vs cloth and water on skin hydration	Prospective, assessor-blinded, randomized controlled equivalence study	n = 280	>37 wk at birth	Hospital/home	Gender BW Type of feeds # of diaper changes Frequency of bathing Maternal factors
Li et al ²³	To examine rate of DD in children 1-24 mo of age and associated risk factors	Cross-sectional, observational study	n = 1036	1-24 mo	Outpatient	Gender Age Type of feeds Presence of diarrhea Frequency of diaper changes and stools Type of skin cleansers Type of diaper Barrier cream use Frequency of bathing Maternal factors

(continues)

TABLE 1. DD Assessment and/or Prevention Studies (Continued)

Author	Purpose	Study Design	Sample Size	Sample Age	Setting	Clinical Characteristics
Alonso et al ¹⁵	To examine petrolatum jelly as a preventive treatment for DD and assess the relationship with nutrition and other treatments	Randomized, controlled, single-blinded study with 2 parallel groups	n = 213	Up to 38-wk GA	Hospital (medium care unit)	Temperature Type of bed and Humidity if in incubator # days on IVF # of stools DD Treatments
Yonezawa et al ²⁴	To examine the relationship between DD in the first month of life and skin barrier function	Prospective cohort study	n = 88	>35-wk GA	Home	# of stool/urine Type of diaper, soaps, and wipes Maternal factors
Garcia Bartels et al ²⁵	To examine the effect of diaper care treatments on skin barrier function comparing diapered and nondiapered skin	Single-center, randomized control trial	n = 83	39-wk GA at birth	Outpatient	Type of feeds Fitzpatrick skin type Maternal factors
Ersoy-Evans et al ²⁶	In a review of DD cases, demographic and clinical descriptions were examined	Descriptive study	n = 63	Birth to 12 mo	Outpatient	Presence of DD candida Type of DD treatment Maternal factors Primary caregiver
Owa et al ²⁷	To examine the relationship between TEWL, pH, and DD	Cross-sectional, descriptive study	n = 424	2 d to 23 mo	Outpatient	Type of bath soap Secondary caregiver
Yonezawa et al ²⁸	To examine skin barrier function in relation to moisturizing skin care regimens	Randomized parallel comparison control trial	n = 202	1 wk to 3 mo and >35-wk GA	Outpatient	Amount of vernix on whole body Maternal factors

Abbreviations: #, number or number of; BF, breastfeed or breastfed; BW, birth weight; DD, diaper dermatitis; DOL, day of life; GA, gestational age; Hx, history; IVF, intravenous fluid; OFC, occipitofrontal circumference; TEWL, transepidermal water loss.

TABLE 2. DD Treatment/Intervention Studies

Author	Purpose	Study Design	Sample Size	Sample Age	Setting	Clinical Characteristics
Concannon et al ²⁹	To examine and compare effectiveness of miconazole nitrate 0.25% vs zinc oxide on DD	Double-blind, randomized, placebo controlled, parallel group study	n = 202	2-13 mo	Outpatient	Gender Age Adverse events
Al-Waili ³⁰	To examine the effects of a honey mixture on DD	Comparative study	n = 12	3-18 mo	Outpatient	Gender Age
Sabzghabaei et al ³¹	To evaluate the use of menthol for DD	Randomized comparative study	n = 70	<28 d	Hospital	Gender GA Weight
Gunes et al ³²	To examine the effectiveness of guaiazulene on DD	Controlled prospective study	n = 30	22-67 d	Hospital (NICU)	Gender GA at birth BW
Bonifaz et al ³³	To examine the effects of sertaconazole cream (2%) on DD	Descriptive, prospective noncomparative study	n = 27	2-22 mo	Dermatology unit ^a	Gender Age
Farahani et al ³⁴	To examine the effectiveness of human milk vs hydrocortisone 1% on DD	Randomized study	n = 141	0-24 mo	Pediatric unit ^a	Age Maternal and infant health hx
Gozen et al ³⁵	To examine the effectiveness of barrier cream vs human milk on DD	Randomized, controlled, prospective study	n = 63	Preterm and term	Hospital (NICU)	Gender GA Feeding type Antibiotics Type of cleansing Ventilation
Adib-Hajbaghery et al ³⁶	To examine and compare the effectiveness of Bentonite and Calendula on DD	Randomized, double-blind control study	n = 60	1-24 mo	Outpatient	Gender Age Hx of DD # of diaper changes Maternal factors
Mahmoudi et al ³⁷	To examine and compare the effects of Bentonite and Calendula on DD	Prospective, double-blind, randomized control trial	n = 100	1-24 mo	Outpatient	Gender Age Weight Type of feeds
Goodarzi et al ³⁸	To examine and compare the effects of nystatin, clotrimazole, and mupirocin on DD	Randomized control trial	n = 112	4 mo to 2 y	Outpatient	Gender Age Infectious disease hx # of diaper changes Frequency of cleansing Type of diaper

(continues)

TABLE 2. DD Treatment/Intervention Studies (Continued)

Author	Purpose	Study Design	Sample Size	Sample Age	Setting	Clinical Characteristics
Keshavarz et al ³⁹	To examine and compare the effects of henna and hydrocortisone on DD	Triple-blinded, randomized control trial	n = 82	<2 y	Hospital	Type of diaper Frequency of cleansing Cleansing products Medical hx
Seifi et al ⁴⁰	To examine effect of human milk vs no treatment on DD	Randomized, case control study	n = 30	0-12 mo	Home	Type of diaper # of diaper changes # of rashes
Dastgheib et al ⁴¹	To examine cure rate of <i>Coriandrum sativum</i> extract cream vs hydrocortisone 1% on DD	Nonrandomized case control study	n = 58	<2 y	Home	Gender Age Parent employment Family income

Abbreviations: #: number or number of; BF, breastfeed or breastfed; BW, birth weight; DD, diaper dermatitis; GA, gestational age; Hx, history; NICU, neonatal intensive care unit.
^aUnclear if unit is an inpatient unit of a hospital.

TABLE 3. Significant Clinical Characteristics

Clinical Characteristics	Assessment/Prevention Studies	Treatment/Intervention Studies
Type of Feeds	Liu et al ²¹ Lavender et al ²² Li et al ²³ Alonso et al ⁵ Yonezawa et al ²⁴ Garcia Bartels et al ²⁵ Ersoy-Evans et al ²⁶	Gozen et al ³⁵ Mahmoudi et al ³⁷
Stool frequency	Visscher et al ¹⁶ Visscher et al ¹⁹ Li et al ²³ Alonso et al ⁵ Yonezawa et al ²⁴	
History of DD	Ferrazzini et al ¹⁸ Liu et al ²¹ Owa et al ²⁷	Mahmoudi et al ³⁷ Keshavarz et al ³⁹ Seifi et al ⁴⁰
Use of antibiotics	Alonso et al ⁵	Gozen et al ³⁵
Delivery mode	Lavender et al ²² Yonezawa et al ²⁴ Garcia Bartels et al ²⁵ Yonezawa et al ²⁸	

first day of life. In the studies that included preterm infants, DD developed in infants with higher gestational ages.^{5,23} Colonization of mycological and bacterial organisms was common and did not appear to be a factor in the development of DD unless there was an increase in colonization.^{18,25} These studies provide several consistent clinical characteristics among subjects with DD: age, gender, weight, type of feeding, stool frequency, history of DD, antibiotic use, and delivery type (Tables 1 and Table 3).

The studies in Table 1 lack further correlation between clinical characteristics and DD demonstrated by the exclusion of clinical characteristics in the analysis. This omission is also seen with a lack of description of potential exacerbating elements that may originate from examination of clinical characteristic relationships to DD.

Treatment Focused Studies

Thirteen studies describe treatment or intervention-based research studies and are displayed in Table 2.²⁹⁻⁴¹ Two of these studies were performed in

a NICU hospital setting that included preterm infants greater than 32 weeks' gestational age at birth.^{32,35} Two of the studies in Table 2 acknowledge the type of feeding as informative to the study.^{35,37} Previous episodes of DD were mentioned in 3 of the studies that highlight the significance and reoccurrence of DD.^{37,39,40} Antibiotics are often used in hospital settings and may contribute to the development of DD but were not correlated consistently to DD in this review. Gozen et al³⁵ were the only researchers to acknowledge and present the frequent use of antibiotics among infants in the NICU and include the concept as a clinical characteristic.

The treatment designs reported in the studies contained in Table 2 did not allow for the examination of relationships between clinical characteristics and DD in all cases. Despite the lack of association between clinical characteristics and DD, these studies provide several consistent demographic and clinical characteristics for subjects with DD such as age, gender, weight, type of feeding, history of DD, and antibiotic use (Tables 2 and 3).

DISCUSSION

This literature review demonstrates a prominence of the following clinical characteristics across the total of studies reviewed: age, stooling frequency, type of feeding, antibiotic exposure, previous episodes of DD, mode of delivery for birth, and phototherapy. The review provides a better understanding of the clinical characteristics commonly observed within studies that examine DD as an outcome. The identification of commonality between types of studies such as assessment, prevention, or intervention provides a strong pool of clinical characteristics to promote further inquiry.

An important barrier to researchers' and clinicians' ability to prevent and treat DD is that clinical characteristics are inconsistently reported within DD studies and are not used as covariates. Clinical characteristics are often provided when descriptive statistics are performed, but researchers have not explored their relationships to DD within the objectives of the study. There is a need to examine the interaction of clinical characteristics of infants in the NICU with DD and associated skin integrity factors. This review provides the basis for further examination of specific clinical characteristics that may be useful to describe an at-risk population in the NICU for DD.

The studies presented in this review also demonstrate the variance in skin assessment. Physiologic measures (eg, evaporimeter, pH, and skin hydration) for skin condition were used in 9 of the studies in Table 1 to assist in the assessment of skin condition, DD development, and quantify changes in DD skin condition.^{8,16,20-22,24,25,27,28} Changes in

skin condition were determined by the use of a visual assessment tool often paired with physiologic tools. Strength in the full description of skin condition may lie in the interpretation of physiologic measurements, but may be elevated when combined with visual assessment.

Comparatively, visual assessment tools were used abundantly within the intervention studies in Table 2 to provide subjective descriptions and quantify the effectiveness of the intervention on the severity of DD. Visual assessment may be the tool of choice in the determination of DD severity, but the physiologic components used in assessment studies can add strength to the results. The difference in tool usage between types of studies demonstrates an additional gap in the literature related to skin assessment in the diaper area. Skin assessment tools in the NICU are vague and lack specification of area of involvement defined, such as the diaper area. Further research can best be conducted using the clinical characteristics identified in this review to develop specific guidelines for a DD-specific assessment tool. The development of a DD-specific skin assessment tool can increase the prevention of DD if clinical characteristics can be correlated with DD development.

CLINICAL CHARACTERISTICS AND THE SKIN SAFETY MODEL

The skin safety model (SSM) was identified as an ideal model and framework to guide the identification and interpretation of clinical characteristics in the context of skin vulnerability.⁴² The SSM was originally designed for use among adult patients in the intensive care unit. The characteristics that define the NICU patient for which DD outcomes are extracted should include factors that relate to skin health. These characteristics can be translated into descriptors of the infant in the NICU, which provides a guide to consider factors that contribute to subsequent skin injury outcomes.⁴² Contributing factors within the SSM include patient factors, situational stressors, and system factors.⁴² Additional exacerbating elements are also considered within the patient's environment and can be combined with the contributing factors to potentiate skin vulnerability and ultimately injury. The elements that have the greatest potential to exacerbate skin injury and vulnerability include friction, shear, and irritants to the skin.⁴²

The results of this review can be instrumental in the adaptation of the SSM. The significant clinical characteristics identified include age, nutrition, previous episodes of DD, stooling frequency, antibiotic exposure, and delivery mode of birth. The clinical characteristics identified can be included in as concepts under the construct of "contributing factors" along with inclusion among the construct of

“exacerbating elements.” A gap in the literature is present in the documentation of a clear connection between contributing factors during hospitalization, development of DD, and effective assessment to perform adequate treatment or eradication of DD.

GLOBAL REPRESENTATION

Despite the vast geographical representation and cultural differences of child care, DD is recognized as a common condition of infants. The studies in Table 1 and 2 demonstrate that the issue of DD has been studied worldwide to include studies originating from several countries (see Table 4). The identification of DD as a globally studied condition demonstrates the importance of its continued investigation and need for prevention. The global demonstration of investigation into this condition prompts further discussion about how clinical characteristics of the infant impact the development of DD.

IMPLICATIONS FOR RESEARCH

As noted in this review, clinicians and researchers have identified many interventions utilized to decrease DD, but few accurately describe contributing factors. Future research should include the collection of clinical characteristics, environmental or contributing factors, to use to identify additional risk factors for DD. Another area of interest is the evaluation of the microbiome and the differentiation that occurs in the hospital versus home environment and the impact on DD development.

Additionally, the inconsistent use of physiologic measurement among intervention studies is a gap that needs to be addressed. Skin pigment and erythema are major components of the skin, and its compromise, without physiologic measures the

TABLE 4. Countries of Origin Within the Literature Review

Country	Assessment/Prevention-Type Studies	Treatment/Intervention Studies	Total
Africa	1		1
Australia		1	1
China	2		2
Germany	1		1
Iran		8	8
Istanbul		1	1
Japan	2		2
Mexico		1	1
Spain	1		1
Switzerland	1		1
Turkey	1	1	2
United Arab of Emirates		1	1
United Kingdom	1		1
United States	4		4

objectivity and rigor, will continue to be lower among these types of studies. Objective measures of skin condition that have been studied for reliability and validity, especially as the skin becomes irritated as seen with DD, would be beneficial to report to enhance treatments and management.

IMPLICATIONS FOR PRACTICE

There is a gap in the research that identifies DD as a significant issue among the NICU population and thus the nursing profession has a unique

Summary of Recommendations for Practice and Research	
What we know:	<ul style="list-style-type: none"> • Diaper dermatitis is a common issue among infants. • Diaper dermatitis pathophysiology and treatments are more prominent in the literature than preventive methods. • Clinical characteristics of infants with diaper dermatitis are not consistently described in research.
What needs to be studied:	<ul style="list-style-type: none"> • Hospitalized infants in the NICU differentiated by clinical characteristics such as gestational age, type of feeds, stooling frequency, and diagnosis. • Comparison of timing of diaper dermatitis among infants of the NICU compared to infants not hospitalized within the first year of life. • The impact of persistent diaper dermatitis practices on infants in the NICU.
What we can do today:	<ul style="list-style-type: none"> • Recognize that diaper dermatitis is a common issue in the NICU. • Take clinical characteristics into consideration when developing diaper dermatitis guidelines. • Incorporate skin assessment tools into diaper dermatitis management to objectively describe severity of injury to ensure adequate methods of treatment.

opportunity to fill this gap. Showcasing the importance of clinical characteristics and the incorporation of a skin assessment tool may be helpful to (1) identify the incidence and prevalence of DD, (2) uncover commonalities among degrees of severity, and (3) attribute the assessment of correlations with clinical outcomes specific to the NICU patient. The use of a reliable and valid skin assessment tool in daily care would provide nurses with the ability to identify, treat, and accurately document an infant's DD progression and healing.

CONCLUSION

The literature provided in this review demonstrates the variance among studies that evaluate DD in the infant population. This review demonstrated the lack of consistency to control for demographic and clinical characteristics among infants in a variety of settings. Researchers can use clinical characteristics of a sample to further analyze contributing factors or exacerbating elements that may increase an infant's risk for developing DD. Therefore, studies that include consistent clinical characteristics combined with rigorous research designs are critical for adequate assessment of an infant's risk of developing DD and may enhance the documentation of treatment outcomes for DD.

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