

# Efficacy of bleach baths in reducing severity of atopic dermatitis: A systematic review and meta-analysis

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## ABSTRACT

**Background:** Bleach baths have been proposed as a treatment for decreasing the severity of atopic dermatitis (AD). However, conflicting results have been found regarding their efficacy.

**Objective:** To determine the efficacy of bleach vs water baths at decreasing AD severity.

**Methods:** We performed a systematic review of all studies evaluating the efficacy of bleach baths for AD. Cochrane, EMBASE, GREAT, LILACS, MEDLINE, and Scopus were searched. Two authors independently performed study selection and data extraction.

**Results:** Five studies were included in the review. Four studies reported significantly decreased AD severity in patients treated with bleach on at least 1 time point. However, of 4 studies comparing bleach with water baths, only 2 found significantly greater decreases in AD severity with bleach baths, 1 found greater decreases with water baths, and 1 found no significant differences. In pooled analyses, there were no significant differences observed between bleach vs water baths at 4 weeks vs baseline for the Eczema Area and Severity Index ( $I^2 = 98\%$ ; random effect regression model,  $P = .16$ ) or body surface area ( $I^2 = 96\%$ ;  $P = .36$ ).

**Conclusion:** Although bleach baths are effective in decreasing AD severity, they do not appear to be more effective than water baths alone. Future larger-scale, well-designed randomized controlled trials are needed.

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## Introduction

Atopic dermatitis (AD) is a chronic, relapsing inflammatory skin disorder affecting 15% to 20% of children and 1% to 10% of adults in the United States and worldwide.<sup>1–4</sup> Deficiencies in the epidermal barrier and dysfunction of the immune system contribute to AD pathogenesis, resulting in the characteristic signs and symptoms of AD (eg, xerosis and pruritus) and predisposing patients to cutaneous infections. AD is associated with a higher prevalence of epidermal *Staphylococcus aureus* colonization compared with healthy controls (>70% vs 10–20%).<sup>5,6</sup> In particular, AD severity is correlated with epidermal *S aureus* density; AD flares are associated with cutaneous *S aureus* infection and AD exacerbations can be induced by *S aureus* overgrowth even without frank infection.<sup>5,7,8</sup> Given the importance of *S aureus* colonization and microbiome in AD, antibacterial treatments have been considered for managing AD.<sup>9</sup> However, the prolonged use of traditional topical and/or systemic antibiotics to suppress recolonization might be impractical given potential concerns about increased antibiotic resistance from long-term antibiotic use.<sup>10,11</sup>

Bleach (sodium hypochlorite, NaOCl) baths are an inexpensive, widely accessible, alternative antibiotic treatment.<sup>12</sup> Bleach baths demonstrate *in vitro* and *in vivo* antibacterial and anti-biofilm properties,<sup>13,14</sup> are associated with few adverse events (AEs), demonstrate no harmful effects on stratum corneum hydration, transepidermal water loss, and epidermal pH,<sup>15</sup> and do not appear to cause antibiotic resistance.<sup>12</sup> As such, dilute bleach baths have been proposed to suppress epidermal *S aureus* load and ultimately decrease AD severity. Huang et al<sup>9</sup> first conducted a randomized controlled trial (RCT) of bleach baths as treatment for moderate-to-severe AD with promising results. However, subsequent RCTs yielded conflicting results. Nevertheless, bleach baths are recommended in multiple clinical practice guidelines.<sup>16–19</sup> We performed a systematic review to determine whether bleach baths are consistently effective in decreasing the severity of AD.

## Methods

### Literature Search

This study was exempt from institutional review board approval at the Northwestern University Feinberg School of Medicine (Chicago, Illinois) because data were gathered from published literature. The following databases were searched for articles before June

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5, 2017: Cochrane Library, MEDLINE, EMBASE, Global Resource of Eczema Trials (GREAT), Latin American and Caribbean Health Sciences (LILACS), and Scopus.

Inclusion criteria were any retrospective or prospective study, use of bleach bath or topical bleach agent interventions, evaluation of AD severity, patients with AD of any age, published online, in print, or in press, and in any language before June 5, 2017. Title and abstract reviews were performed independently by 3 reviewers (R.C., P.V., and R.S.) with conflicts resolved by discussion. Studies were excluded based on the title and/or abstract if there was no clear indication they evaluated the efficacy of bleach therapy in patients with AD. The remaining articles underwent full-text review for inclusion.

#### Data Extraction

The following data were collected: first author; year of publication; study design; comparison or control arm; geographic region; type of intervention; number of patients enrolled in study; number of patients who completed the study; age; sex; level of blinding; baseline severity instruments and means; target population; severity scale used for inclusion and whether thresholds were provided; inclusion and exclusion criteria; AD diagnostic criteria; permitted and prohibited medications; bathing protocol; bleach concentration; duration and frequency of baths; bath aftercare; nonadherence criteria; length of study; follow-up intervals; severity scores; *S aureus* colonization; epidermal *S aureus* density; and frequency of AEs. Study authors were contacted to obtain any values unspecified or incorrectly documented in the articles.

#### Statistical Analysis

Statistical analyses were performed in SAS 9.4 (SAS Institute, Cary, North Carolina). Comparable outcomes across at least 3 studies were combined and pooled means were estimated. Pooled mean and SDs were estimated and plotted. Cohen *d* and 95% confidence intervals were used to measure effect size. Significant heterogeneity of results was detected across studies as judged by an  $I^2$  statistic higher than 50%. Therefore, random-effect models were performed to generate more accurate estimates of SE between studies. A 2-sided *P* value of .05 was taken as significant.

## Results

#### Study Selection

We identified 124 non-duplicate citations with our initial search strategy. Title and abstract review excluded 116 citations, and the full-text review excluded an additional 3 citations. We included 5 studies<sup>9,20–23</sup> in this systematic review as outlined in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)<sup>24</sup> flow diagram (Fig 1).

#### Study Characteristics

Study characteristics are presented in Table 1. Of the 5 studies, 3 were RCTs, 1 was a randomized crossover trial, and 1 was a single-arm pilot study. Two studies were double blinded, 2 were single blinded, and 1 was unblinded. Four studies were prospective and 1 was partly prospective and partly retrospective. Date of publication ranged from 2009 to 2016. Three studies were conducted in North America and 2 were conducted in Asia.

Four trials included children and 1 included children and adults (mean age, 13.7–145.2 months; range, 3–360 months). Study populations ranged from 18 to 40 patients. AD was diagnosed by the Hanifin-Rajka criteria in 2 studies and the Eichenfield modification of the Hanifin-Rajka criteria in 1 study; diagnostic criteria were not documented in 2 studies. All 5 studies

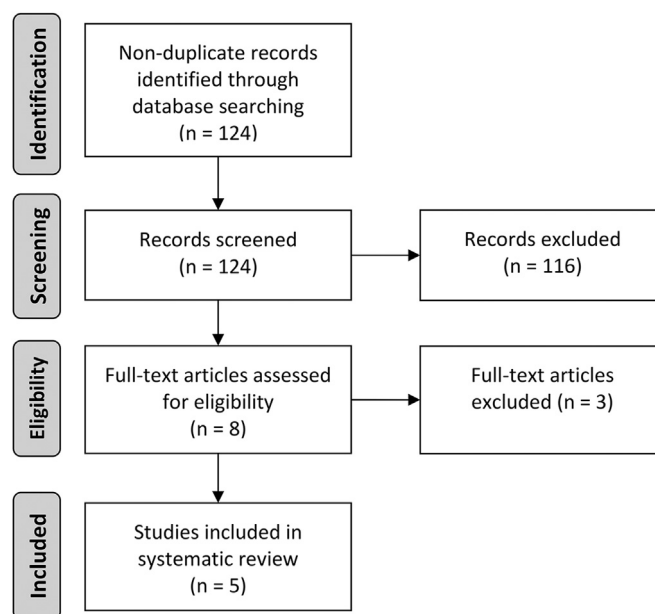


**Figure 1.** Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) diagram.

recruited patients with moderate-to-severe AD, as judged by Investigator Global Assessments (IGA; *n* = 3), objective Scoring Atopic Dermatitis Index (oSCORAD; *n* = 1), or Rajka-Langeland criteria (*n* = 1). Washout and concomitant treatment regimens are presented in Table 1.

Four studies evaluated the efficacy of 0.005% bleach baths, and 1 study evaluated a 0.0061% cleanser containing bleach. Lengths of baths ranged from 5 to 10 minutes, with 1 study not documenting whether bathing times were standardized. Patients were instructed to bathe in bleach baths or use the bleach cleanser biweekly (*n* = 3), biweekly or triweekly (*n* = 1), and at least triweekly (*n* = 1). Allowance for additional regular water baths were not restricted (*n* = 1) or not documented (*n* = 4).

Study follow-up assessments were 2 (*n* = 1), 4 (*n* = 5), 8 (*n* = 2), and 12 (*n* = 2) weeks. Outcome measures included body surface area (BSA; *n* = 4), Eczema Area and Severity Index (EASI; *n* = 3), IGA (*n* = 3), local EASI (*n* = 1), SCORAD or oSCORAD (*n* = 1), Children's Dermatology Life Quality Index (*n* = 1), visual analog scale for itch (*n* = 1), transepidermal water loss (*n* = 1), and skin hydration using an unspecified methodology (*n* = 1). Four studies assessed different bacteriologic parameters.

#### Efficacy

Four studies documented whether bleach baths or cleansers caused significant decreases in AD severity. All 4 demonstrated significant decreases in the bleach group in at least 1 time point. However, of the 4 studies comparing bleach with water baths, only 2 found significantly greater decreases in AD severity with bleach baths, 1 found greater decreases with water baths, and 1 found no significant differences.

At 4 weeks, 1 study found a significant decrease in AD severity compared with controls (EASI, BSA, and IGA), 2 found no significant differences (EASI [*n* = 2], IGA [*n* = 1], local-EASI [*n* = 1], BSA [*n* = 1], visual analog scale for itch [*n* = 1], and patient self-assessment [*n* = 1]), and 1 showed mixed results. In other words, of the aggregated 15 severity assessment evaluations at 4 weeks, only 3 assessments demonstrated that bleach baths were more effective than water baths, 11 reported no difference, and 1 reported regular water baths to be more effective.

**Table 1**  
Characteristics of Bleach Bath Randomized Controlled Trials

| Variables                                              | Huang et al, 2009                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Wong et al, 2013                                                                                                                                                                                                                                                                                              | Gonzalez et al, 2015                                                                                                                                                                                                                                         | Hon et al, 2016                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|--------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Study design                                           | RCT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | RCT                                                                                                                                                                                                                                                                                                           | RCT                                                                                                                                                                                                                                                          | RCT (crossover design)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Subjects who completed the study, N                    | 22                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 36                                                                                                                                                                                                                                                                                                            | 18                                                                                                                                                                                                                                                           | 40                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Completion rate, treatment/<br>placebo                 | 60.0/81.3                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 85.7/85.7                                                                                                                                                                                                                                                                                                     | 90.0/81.8                                                                                                                                                                                                                                                    | 100.0/100.0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Age (mo), min–max                                      | 8.4–207.6                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 36–360                                                                                                                                                                                                                                                                                                        | 3–60                                                                                                                                                                                                                                                         | 145.2 <sup>a</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Diagnostic criteria                                    | not documented                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | H&R                                                                                                                                                                                                                                                                                                           | Eichenfield modification                                                                                                                                                                                                                                     | H&R                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Inclusion criteria; definitions<br>provided            | moderate to severe (IGA); yes                                                                                                                                                                                                                                                                                                                                                                                                                                                         | moderate to severe (R&L); no                                                                                                                                                                                                                                                                                  | moderate to severe (IGA); yes                                                                                                                                                                                                                                | moderate to severe (oSCORAD);<br>yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Signs of cutaneous infection<br>required for inclusion | yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | no                                                                                                                                                                                                                                                                                                            | no                                                                                                                                                                                                                                                           | yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Interventions                                          | cephalexin (2 wk) + intranasal<br>mupirocin + bleach baths vs<br>cephalexin + intranasal<br>petrolatum + water bath                                                                                                                                                                                                                                                                                                                                                                   | bleach vs water baths                                                                                                                                                                                                                                                                                         | bleach baths + TCS BID vs water<br>baths + TCS BID                                                                                                                                                                                                           | bleach vs water baths                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Blinding                                               | single                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | double                                                                                                                                                                                                                                                                                                        | single                                                                                                                                                                                                                                                       | double                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Blinding protocol                                      | Mupirocin and petrolatum<br>ointment were dispensed in<br>identical white jars. Bleach<br>and water were dispensed in<br>identical bleach bottles with<br>identical brand-name labels.<br>Patients and/or family<br>members could distinguish<br>bleach from water based on<br>odor but were directed not to<br>reveal their treatment to<br>investigators. Bathing in<br>bleach did not result in<br>lasting odor so investigators<br>could not differentiate<br>between study arms. | Bleach and distilled water were<br>dispensed in identical bottles.                                                                                                                                                                                                                                            | Plain white bottles were filled<br>with bleach or water.                                                                                                                                                                                                     | Bleach and water were<br>dispensed in identical<br>opaque, brown bottles with<br>identical brand-name labels.<br>Investigators were blinded to<br>the contents of the bottles.<br>Patients and investigators<br>were blinded to study arm.<br>The bleach and water dilution<br>was pretested so that the<br>color and odor were similar.<br>Patients and/or family<br>members could distinguish<br>bleach from water based on<br>odor but were directed not to<br>reveal their treatment to<br>investigators. Bathing in<br>bleach did not result in<br>lasting odor so investigators<br>could no differentiate<br>between study arms. |
| Bathing instructions provided<br>to patient            | A ½ cup of 6% bleach or water<br>was added to a full bathtub of<br>water (40 gallons). Amount of<br>bleach or water was adjusted<br>by the family based on<br>bathtub size and height of<br>bathtub water.                                                                                                                                                                                                                                                                            | Clear oral and written<br>instructions were provided.<br>Sodium hypochlorite 5% 100<br>mL or distilled water 100 mL<br>was added to water 100 L (eg,<br>half a bathtub). For children<br><12 y old, 50 mL was added<br>to a ¼ tub of water (50 L).<br>Patients were instructed to<br>soak from the neck down. | Instruction handout was<br>provided. A ¼ cup of<br>household bleach (6.15%<br>sodium hypochlorite) was<br>added to half-full bathtub or a<br>½ cup to a full bathtub (40<br>gallons), or ½ teaspoon per<br>gallon of water if they were<br>using a baby tub. | 6% bleach 83 mL from a<br>prepared bottle or water to<br>water 100 L; amount was<br>adjusted by the family based<br>on the bathtub size and<br>estimated height of bathtub<br>water.                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Bath frequency; duration                               | BIW; 5–10 min                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | BIW; 10 min                                                                                                                                                                                                                                                                                                   | BIW; not documented                                                                                                                                                                                                                                          | BIW-TIW; 10 min                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Bath aftercare                                         | not documented                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | patients should rinse off with<br>normal tap water                                                                                                                                                                                                                                                            | not documented                                                                                                                                                                                                                                               | not documented                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Standardization of TCS                                 | not documented                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | not documented                                                                                                                                                                                                                                                                                                | BID but unrelated to bath<br>schedule                                                                                                                                                                                                                        | not permitted                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Other interventions prohibited                         | topical or systemic antibiotics                                                                                                                                                                                                                                                                                                                                                                                                                                                       | systemic antibiotics or oral<br>steroids                                                                                                                                                                                                                                                                      | topical or systemic antibiotics                                                                                                                                                                                                                              | systemic antibiotics, topical<br>steroids, or antihistamines                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Other interventions permitted                          | stable regimen of topical anti-<br>inflammatories and<br>emollients                                                                                                                                                                                                                                                                                                                                                                                                                   | stable regimen of topical anti-<br>inflammatories and<br>emollients                                                                                                                                                                                                                                           | previously used emollients                                                                                                                                                                                                                                   | stable regimen of emollients                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Adherence defined                                      | yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | no                                                                                                                                                                                                                                                                                                            | yes                                                                                                                                                                                                                                                          | yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Study duration (d)                                     | 84                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 56                                                                                                                                                                                                                                                                                                            | 28                                                                                                                                                                                                                                                           | 28                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Outcomes assessed                                      | total EASI, IGA, BSA                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | total EASI, BSA, VAS itch, PRO                                                                                                                                                                                                                                                                                | IGA, total EASI, local EASI                                                                                                                                                                                                                                  | SCORAD, oSCORAD, BSA, CDLQI,<br>TEWL, SH                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Follow-up assessment schedule<br>(d)                   | 28, 84                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 14, 28, 56                                                                                                                                                                                                                                                                                                    | 28                                                                                                                                                                                                                                                           | 28                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Bleach baths cause significant<br>decrease in severity | yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | yes                                                                                                                                                                                                                                                                                                           | yes                                                                                                                                                                                                                                                          | not documented                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Water baths cause significant<br>decrease in severity  | yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | not documented                                                                                                                                                                                                                                                                                                | yes                                                                                                                                                                                                                                                          | not documented                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Bleach or water baths more<br>effective                | 1 mo = bleach (EASI, BSA, IGA);<br>3 mo = bleach (EASI, BSA); no<br>difference (IGA)                                                                                                                                                                                                                                                                                                                                                                                                  | 1 mo = no difference (total<br>EASI, BSA, VAS itch, PRO); 2<br>mo = bleach (EASI, BSA); no<br>difference (VAS itch, PRO)                                                                                                                                                                                      | 1 mo = no difference (IGA, total<br>EASI, local EASI)                                                                                                                                                                                                        | 1 mo (ITT) = no difference<br>(oSCORAD, pruritus, sleep<br>loss, SCORAD intensity,<br>CDLQI), water (BSA and<br>oSCORAD per protocol<br>approach)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

(continued on next page)

Table 1 (continued)

| Variables                                            | Huang et al, 2009         | Wong et al, 2013          | Gonzalez et al, 2015      | Hon et al, 2016           |
|------------------------------------------------------|---------------------------|---------------------------|---------------------------|---------------------------|
| Changes in <i>Staphylococcus aureus</i> colonization |                           |                           |                           |                           |
| Absence vs presence of CFU                           | no significant difference | not documented            | not documented            | not documented            |
| Absence vs presence of quantitative PCR              | not documented            | no significant difference | no significant difference | no significant difference |
| Adverse events                                       | not documented            | no significant difference | no significant difference | no significant difference |

Abbreviations: BID, twice daily; BIW, twice weekly; BSA, body surface area; CDLQI, Children's Dermatology Life Quality Index; CFU, colony-forming units; DC, diagnostic criteria; EASI, Eczema Area and Severity Index; H&R, Hanifin-Rajka criteria; IGA, Investigator Global Assessment; ITT, intention to treat; max, maximum; min, minimum; oSCORAD, objective Scoring Atopic Dermatitis; PCR, polymerase chain reaction; PRO, undefined patient-reported outcome (patient overall assessment of treatment response); RCT, randomized controlled trial; R&L, Rajka-Langeland criteria; SH, skin hydration (unspecified methodology); TCS, topical corticosteroid; TEWL, transepidermal water loss; TIW, thrice weekly; VAS, visual analog scale.

<sup>a</sup>Mean age not documented.

In 1 study at 8 weeks, bleach baths caused significant decreases in EASI and BSA assessments but not in visual analog scale for itch or patient's self-assessment. In 1 study at 12 weeks, bleach baths caused significant decreases in EASI and BSA but not in IGA. Across all 5 studies at all follow-up periods, there were no significant differences in patient-reported outcomes between treatment arms.

### Pooled Analysis of Efficacy

The EASI and BSA assessments at 4 weeks were the only end points and time points in common across at least 3 studies (Fig 2A, B). In pooled analyses, the mean  $\pm$  SD for EASI and BSA assessments

decreased at 4 weeks vs baseline for bleach baths (EASI,  $11.0 \pm 7.8$  vs  $24.9 \pm 25.3$ ; BSA,  $42.8 \pm 12.7\%$  vs  $49.8 \pm 18.1\%$ ) and water baths (EASI,  $14.2 \pm 7.7$  vs  $25.2 \pm 12.3$ ; BSA:  $41.1 \pm 18.1\%$  vs  $45.6 \pm 17.9\%$ ), respectively (Fig 2C, D). There were no significant differences observed between bleach and water baths at 4 weeks vs baseline for the EASI ( $I^2 = 98\%$ ; random effect regression model,  $P = .16$ ) or BSA ( $I^2 = 96\%$ ;  $P = .36$ ).

### Bacteriologic Assessments

All 5 studies evaluated the effect of bleach baths or cleansers on *S aureus* status, but only 4 could reliably assess bacteriologic parameters. One study found no decrease in the proportion of patients colonized in the 2 groups. Three of 3 studies found decreases in *S aureus* density after bleach and normal baths, but with no significant differences between groups. Two studies found no significant differences of antibiotic resistance between groups.

### Safety, Tolerability, and Adherence

Adverse events of bleach baths and cleansers were documented in 4 of 5 studies. AEs included stinging and burning (6 of 56; 11%), itch (6 of 57; 0.5%), xerosis (4 of 38; 10.5%), erythema (2 of 29; 6.9%), urticaria (1 of 20; 5%), and oozing (1 of 20; 5%). There were no differences of AE between bleach and water baths.

Adherence was assessed in 3 studies but was measured differently across all studies (completion of cephalixin therapy, frequency and concentration of bleach baths, frequency and duration of intranasal mupirocin application, whether patients bathed  $<2$  times per week, delayed follow-up, or using oral antibiotics during the study). There were no significant differences in adherence between patients in the 2 treatment arms.

### Discussion

This systematic review found that bleach baths or cleansers and water baths alone significantly decreased AD severity. However, water baths were as effective as bleach baths at 4 weeks in pooled analyses, with only 1 study of efficacy at later time points. There were no differences of *S aureus* density in patients treated with bleach vs water baths. Together, the results suggest that much of the efficacy of bleach baths at decreasing AD severity is attributable to water baths and less to bleach per se.

Bleach baths are compound interventions with multiple steps: water bath, exposure to bleach during the bath, and application of emollients and/or topical anti-inflammatory agents after the bath. Each of these 3 steps can be effective at decreasing AD severity. Water baths alone can hydrate and soothe the skin and wash away scale and serum crust. The bleach can have anti-staphylococcal and other disinfecting properties. However, the results of the present study indicate that water baths were similarly effective as bleach baths at disinfecting the skin. Application of emollients and/or topical anti-inflammatories after the bath (referred to as

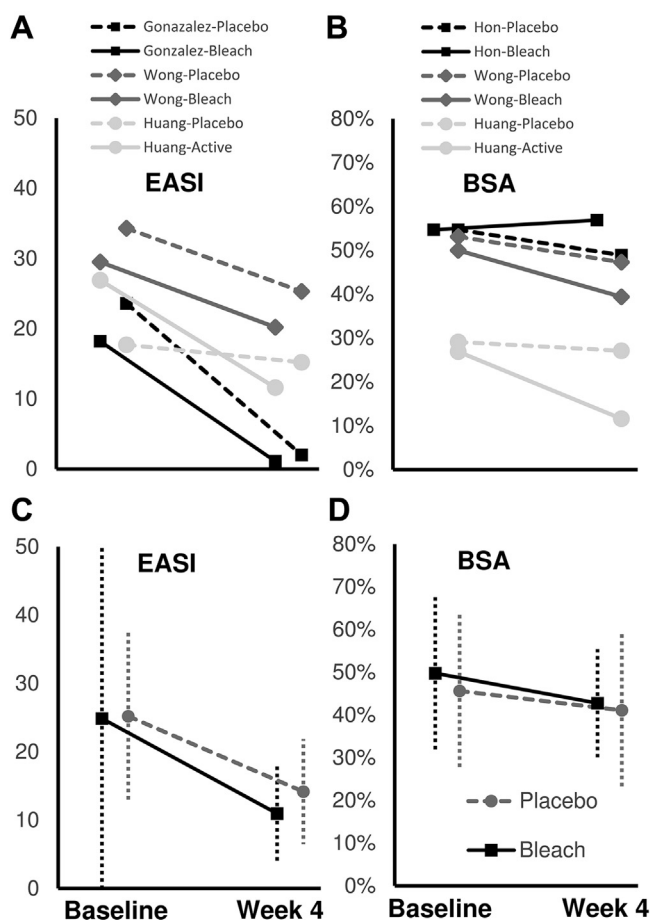


**Figure 2.** Eczema Area and Severity Index (EASI) and body surface area (BSA) for bleach vs water baths at 4 weeks compared with baseline. Mean (A) EASI and (B) BSA of bleach baths (solid lines) and water baths (dashed lines) are presented for individual studies. (C) EASI and (D) BSA of bleach baths (solid lines) and water baths (dashed lines) are presented for 3 combined studies (pooled mean  $\pm$  SD).

prehydration, “soak and seal,” or “soak and smear”) can seal moisture in the stratum corneum, increase permeability, and enhance drug absorption.<sup>25,26</sup> Previous studies have shown good efficacy for soak and smears,<sup>27–29</sup> although a recent RCT found no greater efficacy than topical corticosteroid on dry skin.<sup>30</sup> Water baths alone or the soak and smear regimen can be effective without the addition of bleach.

Bleach baths are commonly recommended because they are inexpensive, relatively safe, and easily accessible. When reviewing the results of this study, clinicians might wonder whether bleach baths or water baths alone should be recommended. However, there are several important considerations. Exposure to dilute bleach can result in stinging, burning, and transient worsening of itch. Ocular exposure to bleach can be particularly uncomfortable and hinders prehydration of the face. There is additional cost and time spent acquiring bleach, albeit fairly minimal. Bleach can stain towels, linens, and/or clothing. Bleach baths emit caustic fumes. One of the authors (J.S.) had 2 patients with reported asthma exacerbations from inhalation of fumes from bleach baths. Bleach bath instructions may be complicated for patients and result in prolonged patient encounters and consume valuable time for counseling patients on other important treatments. It is important to recognize that water baths alone might accomplish similar efficacy as bleach baths without these additional concerns.

Comparison of study results is hindered by differences of inclusion criteria, patient phenotype, interventions, and outcome measures across studies. Different diagnostic criteria and severity assessments were used to recruit patients, which could have resulted in study populations with different phenotypes.<sup>31,32</sup> Active cutaneous infections were used as inclusion criteria in half the studies and exclusion criteria in the other half. Blinding protocols and success varied across studies. Only half the RCTs exclusively compared bleach with water baths without other concurrent interventions. One study concurrently administered mupirocin and cephalexin, which could be confounding factors.<sup>9</sup> Different severity measures were used to evaluate efficacy outcomes across studies, showing inconsistent efficacy between studies and within individual studies. Differences in bathing protocol could have affected the study results. Bathing is a multicomponent process consisting of soap, water and bleach exposure factors (eg, duration, frequency, temperature, etc), and aftercare such as drying, emollients, and topical medications. There was no documented effort to standardize most of these variables, except frequency and duration of baths in all studies and soap use in 1 study. Only 1 study standardized topical corticosteroid use, and no studies coordinated the use of topical corticosteroid and emollient with bath regimens. As the principal intervention of interest, the bathing protocol should be thoroughly documented, standardized, and isolated from the effect of confounding factors such as additional concurrent interventions. Future studies are needed that properly address these concerns.

Current primary care provider recommendations advocate for infrequent bathing in AD.<sup>33</sup> However, the results of this systematic review indicate that regular bathing and emollient use is an effective treatment for AD and better than infrequent bathing. These results provide evidence to support the recommendations of the American Academy of Dermatology guidelines for regular bathing in the care of AD.<sup>34</sup> These guidelines also recommend the use of dilute bleach baths in patients with frequent bacterial infections.<sup>34</sup> Interestingly, bleach baths were not more effective than water baths in studies that recruited patients with clinically infected AD. Water baths alone might decrease the risk of bacterial infection in patients with AD and future studies are needed to elucidate this point.

The studies included in this systematic review showed no significant difference between bleach and water bath interventions in

decreasing *S aureus* epidermal colonization or density. These findings are unexpected because AD exacerbations are correlated with epidermal *S aureus* density and bleach baths are hypothesized to decrease AD severity through their antibacterial properties.<sup>14,35</sup> In contrast, bleach baths and mupirocin were found to eradicate *S aureus* colonization in an RCT of patients without AD but with community-acquired staphylococcal skin or soft tissue infections compared with controls at 1 and 4 months (63% vs 38% and 71% vs 48%, respectively).<sup>36</sup> A recent Cochrane review concluded there are no discernable benefits of anti-staphylococcal interventions in decreasing *S aureus* density in patients with AD compared with anti-inflammatory medications,<sup>37</sup> which is consistent with the results of our study.

Our study has several strengths including the use of a comprehensive search strategy and examination of studies from all countries and languages. Pooled analysis was performed at 4 weeks using random-effects regression models to address issues of heterogeneity. This pooled analysis provided novel insight by demonstrating that water baths alone were effective at decreasing AD severity. However, there are several limitations to our study, including a small number of studies, small study populations, short follow-up durations, and each study being conducted at a single center. Moreover, there was a lack of uniformity with respect to AD diagnostic and inclusion criteria, demographics, study interventions, and outcome measures across studies, which require cautious interpretation.

In conclusion, although bleach baths are effective in decreasing AD severity, they do not appear to be more effective than water baths alone. However, there are a number of limitations with the currently available studies. Future larger-scale RCTs are needed that address these limitations.

## References

- [1] Eichenfield LF. Consensus guidelines in diagnosis and treatment of atopic dermatitis. *Allergy*. 2004;59(suppl 78):86–92.
- [2] Garg N, Silverberg JL. Epidemiology of childhood atopic dermatitis. *Clin Dermatol*. 2015;33:281–288.
- [3] Silverberg JL, Garg NK, Paller AS, et al. Sleep disturbances in adults with eczema are associated with impaired overall health: a US population-based study. *J Invest Dermatol*. 2015;135:56–66.
- [4] Silverberg JL, Hanifin JM. Adult eczema prevalence and associations with asthma and other health and demographic factors: a US population-based study. *J Allergy Clin Immunol*. 2013;132:1132–1138.
- [5] Clausen ML, Edslev SM, Andersen PS, et al. Staphylococcus aureus colonization in atopic eczema and its association with filaggrin gene mutations [published online ahead of print March 19, 2017]. *Br J Dermatol*. <https://doi.org/10.1111/bjd.15470>.
- [6] Totte JE, van der Feltz WT, Hennekam M, et al. Prevalence and odds of Staphylococcus aureus carriage in atopic dermatitis: a systematic review and meta-analysis. *Br J Dermatol*. 2016;175:687–695.
- [7] Guzik TJ, Bzowska M, Kasprócz A, et al. Persistent skin colonization with Staphylococcus aureus in atopic dermatitis: relationship to clinical and immunological parameters. *Clin Exp Allergy*. 2005;35:448–455.
- [8] Hauser C. The role of Staphylococcus aureus in atopic dermatitis. *Int J Dermatol*. 1986;25:573–574.
- [9] Huang JT, Abrams M, Tlough B, et al. Treatment of Staphylococcus aureus colonization in atopic dermatitis decreases disease severity. *Pediatrics*. 2009;123:e808–e814.
- [10] Jung MY, Chung JY, Lee HY, et al. Antibiotic susceptibility of staphylococcus aureus in atopic dermatitis: current prevalence of methicillin-resistant Staphylococcus aureus in Korea and treatment strategies. *Ann Dermatol*. 2015;27:398–403.
- [11] Chaptini C, Quinn S, Marshman G. Methicillin-resistant Staphylococcus aureus in children with atopic dermatitis from 1999 to 2014: A longitudinal study. *Australas J Dermatol*. 2016;57:122–127.
- [12] Barnes TM, Greive KA. Use of bleach baths for the treatment of infected atopic eczema. *Australas J Dermatol*. 2013;54:251–258.
- [13] Fisher RG, Chain RL, Hair PS, et al. Hypochlorite killing of community-associated methicillin-resistant Staphylococcus aureus. *Pediatr Infect Dis J*. 2008;27:934–935.
- [14] Eriksson S, van der Plas MJ, Morgelin M, et al. Antibacterial and anti-biofilm effects of sodium hypochlorite against Staphylococcus aureus isolates derived from patients with atopic dermatitis. *Br J Dermatol*. 2017;177:513–521.
- [15] Shi VY, Foolad N, Ornelas JN, et al. Comparing the effect of bleach and water baths on skin barrier function in atopic dermatitis: a split-body randomized controlled trial. *Br J Dermatol*. 2016;175:212–214.

- [16] Weitz NA, Brody E, Lauren CT, et al. Management of infectious aspects of atopic dermatitis in primary care: a resident survey. *Clin Pediatr (Phila)*. 2016; 55:1295–1299.
- [17] Chong M, Fonacier L. Treatment of eczema: corticosteroids and beyond. *Clin Rev Allergy Immunol*. 2016;51:249–262.
- [18] Mohan GC, Lio PA. Comparison of dermatology and allergy guidelines for atopic dermatitis management. *JAMA Dermatol*. 2015;151:1009–1013.
- [19] Ophir D, Elad Y, Dolev Z, et al. Effects of inhaled humidified warm air on nasal patency and nasal symptoms in allergic rhinitis. *Ann Allergy*. 1988;60: 239–242.
- [20] Hon KL, Tsang YC, Lee VW, et al. Efficacy of sodium hypochlorite (bleach) baths to reduce *Staphylococcus aureus* colonization in childhood onset moderate-to-severe eczema: a randomized, placebo-controlled cross-over trial. *J Dermatol Treat*. 2016;27:156–162.
- [21] Wong SM, Ng TG, Baba R. Efficacy and safety of sodium hypochlorite (bleach) baths in patients with moderate to severe atopic dermatitis in Malaysia. *J Dermatol*. 2013;40:874–880.
- [22] Ryan C, Shaw RE, Cockerell CJ, et al. Novel sodium hypochlorite cleanser shows clinical response and excellent acceptability in the treatment of atopic dermatitis. *Pediatr Dermatol*. 2013;30:308–315.
- [23] Gonzalez ME, Schaffer JV, Orlow SJ, et al. Cutaneous microbiome effects of fluticasone propionate cream and adjunctive bleach baths in childhood atopic dermatitis. *J Am Acad Dermatol*. 2016;75:481–493.e488.
- [24] Liberati A, Altman DG, Tetzlaff J, et al. The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: explanation and elaboration. *PLoS Med*. 2009;6:e1000100.
- [25] Schaefer H, Zesch A, Stüttgen Gn. *Skin Permeability*. New York: Springer-Verlag; 1982.
- [26] Rothman S. *Physiology and Biochemistry of the Skin*. Chicago: University of Chicago Press; 1954.
- [27] Hajar T, Hanifin JM, Tofte SJ, et al. Prehydration is effective for rapid control of recalcitrant atopic dermatitis. *Dermatitis*. 2014;25:56–59.
- [28] Rustad K, Henning S. Direct observed “soak and smear” therapy for severe eczematous dermatitis in the combat setting. *Dermatitis*. 2009;20:275–277.
- [29] Gutman AB, Kligman AM, Sciacca J, et al. Soak and smear: a standard technique revisited. *Arch Dermatol*. 2005;141:1556–1559.
- [30] Kohn LL, Kang Y, Antaya RJ. A randomized, controlled trial comparing topical steroid application to wet versus dry skin in children with atopic dermatitis (AD). *J Am Acad Dermatol*. 2016;75:306–311.
- [31] Vakharia PP, Chopra R, Silverberg JL. Systematic review of diagnostic criteria used in atopic dermatitis randomized controlled trials [published online ahead of print June 17, 2017]. *Am J Clin Dermatol*. <https://doi.org/10.1007/s40257-017-0299-4>.
- [32] Chopra R, Vakharia PP, Simpson E, et al. Severity assessments used for inclusion criteria and baseline severity evaluation in atopic dermatitis clinical trials: a systematic review [published online ahead of print July 27, 2017]. *J Eur Acad Dermatol Venereol*. <https://doi.org/10.1111/jdv.14483>.
- [33] Cardona ID, Kempe E, Hatzenbeuhler JR, et al. Bathing frequency recommendations for children with atopic dermatitis: results of three observational pilot surveys. *Pediatr Dermatol*. 2015;32:e194–e196.
- [34] Eichenfield LF, Tom WL, Berger TG, et al. Guidelines of care for the management of atopic dermatitis: section 2. Management and treatment of atopic dermatitis with topical therapies. *J Am Acad Dermatol*. 2014;71:116–132.
- [35] Alsterholm M, Strombeck L, Ljung A, et al. Variation in *Staphylococcus aureus* colonization in relation to disease severity in adults with atopic dermatitis during a five-month follow-up. *Acta Derm Venereol*. 2017;97: 802–807.
- [36] Fritz SA, Camins BC, Eisenstein KA, et al. Effectiveness of measures to eradicate *Staphylococcus aureus* carriage in patients with community-associated skin and soft-tissue infections: a randomized trial. *Infect Control Hosp Epidemiol*. 2011;32:872–880.
- [37] Bath-Hextall FJ, Birnie AJ, Ravenscroft JC, et al. Interventions to reduce *Staphylococcus aureus* in the management of atopic eczema: an updated Cochrane review. *Br J Dermatol*. 2010;163:12–26.