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ORIGINAL PAPER

A study on dermatologists' self-assessment of the efficacy of a 1% selenium disulfide—0.9% salicylic acid -based shampoo for scalp seborrheic dermatitis

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Abstract
Scalp seborrheic dermatitis (SSD) is a common inflammatory condition requiring effective topical treatment options. To evaluate the efficacy and acceptability of a 1% selenium disulfide (SeS2)-0.9% salicylic acid shampoo in treating mild to moderate SSD among dermatologists. 95 dermatologists with mild to moderate SSD used the shampoo thrice weekly for 4 weeks. Symptoms were assessed using Visual Analog Scale (VAS) at baseline, Day 14, and Day 28. After 4-week treatment, severe dandruff cases decreased from 28.4% to 3.2%, with 90.5% participants reporting only mild or no dandruff. VAS scores showed significant improvement in all symptoms ($p < 0.01$). Product satisfaction reached 88.5%, with 90.5% willing to recommend it clinically. The findings of this study suggest that a shampoo based on 1% selenium disulfide (SeS2) and 0.9% salicylic acid is effective in helping alleviate the symptoms of seborrheic dermatitis (SSD).

Keywords Seborrheic dermatitis · Selenium disulfide · Salicylic acid · Dandruff · Anti-inflammatory · Clinical efficacy · Dermatologist self-assessment

Introduction

Seborrheic dermatitis (SD) is a common chronic inflammatory dermatosis, affecting 1%-5% of the adults [1]. SD is characterized by scaly, reddish-brown, pruritic patches primarily located in sebaceous gland-rich regions such as the scalp, face, and trunk, typically exhibiting a symmetric distribution. The severity of lesions can range from mild, patchy dandruff to extensive, thick, adhesive crusts. When the scalp and its peripheries are involved, the condition is referred to as scalp seborrheic dermatitis (SSD). The incidence of SSD is notably increasing among healthcare professionals due to their high-stress daily life. [1] The pathogenesis of SSD involves multiple factors, including excessive sebum production, bacterial proliferation (e.g., Staphylococcus and Streptococcus species), fungal colonization (e.g., Malassezia species), immune system activation (NK1 + , CD16 + cells, interleukin-1 [IL-1], and IL-8), and environmental influences such as high humidity. [2] Recent studies also highlight the role of the scalp microbiome imbalance in SSD development. [3] Chronic symptoms, including persistent dandruff, scalp pruritus, and greasiness, significantly impact patients' psychological well-being and quality of life. Current therapeutic strategies primarily rely on topical antifungal and anti-inflammatory treatments. While long-term use of some treatments, particularly corticosteroids, may be associated with side effects such as scalp atrophy and skin thinning, the potential impact of long-term antifungal use on the scalp's microbiome remains a topic of ongoing research. Thus, there is an urgent requirement for an effective anti-inflammatory and anti-dandruff shampoo suitable for home use in managing mild to moderate SSD.

Selenium sulfide (SeS_2) is a topical antifungal agent that mitigates dandruff by exfoliating the affected stratum corneum. It inhibits sebum production by reducing the binding of thymine to the DNA of epidermal cells, thereby decelerating the renewal cycle of epithelial cells [4]. Salicylic acid, known for its lipophilic properties, penetrates hair follicle sebaceous glands to dissolve keratin and exert anti-inflammatory effects [5, 6]. This study examines the efficacy of a 1% SeS_2-0.9% salicylic acid shampoo in treating mild to

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moderate SSD among dermatologist individuals. Improvements in symptoms such as scalp dandruff, erythema, pruritus, and greasiness of the scalp and hair were assessed. Additionally, the study evaluated the participatants' satisfaction, overall tolerance, and subjective experiences with the product.

Materials and methods

Patients

A cohort of 95 Chinese dermatologists participated in this online survey-based study. The participants were recruited through an online questionnaire that included self-reported assessments of scalp symptoms commonly associated with seborrheic dermatitis (SD).

The study population comprised 15 males and 80 females, with a mean age of 39.9 ± 7.7 years. Participants were included if they reported experiencing one or more of the following scalp symptoms: dandruff, erythema, pruritus, or excessive oiliness. The severity of these symptoms was self-assessed by the participants using a Visual Analog Scale (VAS) ranging from 1 (no symptoms) to 10 (very severe symptoms).

Exclusion criteria for the study were: (1) those with known immune deficiency disorders; (2) those with severe local scalp infections; (3) pregnant or lactating women; (4) those with known allergies to any component of the study product; (5) those with hepatic or renal dysfunction, or severe cardiovascular and cerebrovascular diseases; (6) those with other concurrent scalp conditions that might interfere with the assessment of the study product.

Treatment protocol

A self-controlled study design was implemented, recommending participants to use a 1% SeS_2-0.9% salicylic acid shampoo (Vichy Dercos Anti-Dandruff DSShampoo, containing 1% SeS_2, 0.9% salicylic acid, ceramide R, and vitamin E, manufactured by L'Oreal). Participants were instructed to apply the shampoo to cleanse the scalp and hair three times weekly for a duration of four weeks. Participants were instructed to lather the shampoo and leave it on the scalp for approximately 3–5 min before rinsing. At baseline, dermatologists conducted a self-assessment of all SSD-related symptoms, including dandruff, scalp erythema, pruritus, and greasiness of the scalp and hair, establishing baseline levels. Symptom severity was quantified using the Visual Analog Scale (VAS) at baseline, on Day 14, and Day 28.

Outcomes and assessments

The VAS was utilized to measure the severity of dandruff, scalp erythema, pruritus, and greasiness of the scalp and hair. Scores ranged from 1 to 10, where 1 indicated no symptoms and 10 indicated very severe symptoms. A custom "Satisfaction Feedback Form" was employed on Day 28 to evaluate product usage experience and overall satisfaction.

Tolerability of the product was monitored through self-reporting by participants throughout the study period. Any adverse effects or discomfort were to be reported immediately.

To provide visual documentation of the treatment effects, participants were requested to submit dermoscopic images of their scalp at baseline and on Day 28. These images were used for qualitative comparison of the scalp condition before and after the treatment period. Participants were given the option to take these images themselves or have them taken by a colleague. No specific imaging equipment was mandated, allowing participants to use whatever means were available to them to capture these images. Participants were instructed to take dermoscopic images of the same area of their scalp each time.

Statistical methods

The statistical analysis was conducted using SPSS 26.0 software. The distribution of dandruff severity scores among subjects was described using percentages. The VAS scores for dandruff, scalp erythema, pruritus, and greasiness of the scalp and hair at baseline, on Day 14, and Day 28 were reported as mean ± standard deviation. A paired-samples t-test was employed to compare the scores over time, with a P-value of less than 0.05 considered indicative of statistical significance.

Results

Distribution of severity scores for dandruff

At baseline, 28.4% of subjects exhibited severe or very severe dandruff symptoms, 47.3% had moderate dandruff, and 24.3% presented with mild or no dandruff. Following a continuous 4-week treatment with the test shampoo, only 3.2% of subjects continued to experience severe or very severe dandruff, 6.3% had moderate dandruff, and 90.5% reported no or only mild dandruff, as illustrated in Fig. 1.

VAS scores for SSD-related symptoms

The VAS scores for the severity of dandruff, scalp erythema, scalp pruritus, and greasiness of scalp hair (Fig. 2) indicated significant improvements over time. By Day 14, VAS scores had decreased notably from baseline ($p < 0.01$). Further

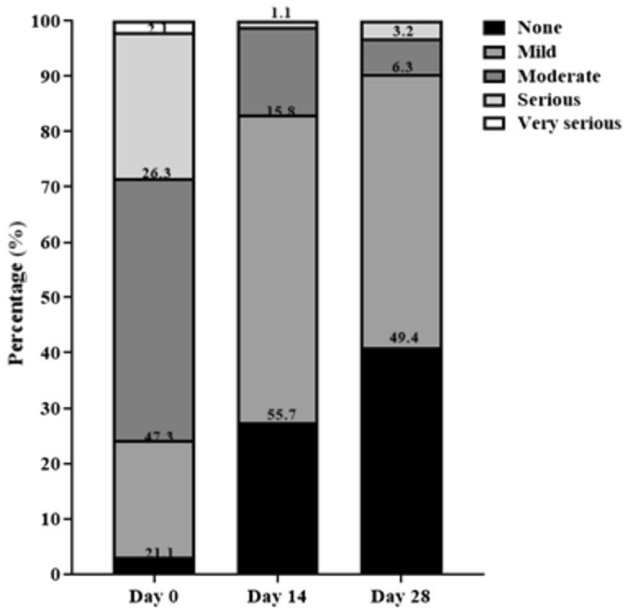

Fig. 1 Distribution of severity scores for dandruff on Days 0, 14, and 28

significant reductions were observed on Day 28 compared to Day 14 ($p < 0.01$).

Dermoscope examination

Dermatoscopic evaluations at baseline revealed the presence of red, inflamed scalp areas with white, greasy dandruff (Fig. 3, *left* and Fig. 4, *left*). By Day 28, the scalp showed improved scalp erythema or dandruff, and a marked reduction in lipid secretion on the skin surface was observed (Fig. 3, *right* and Fig. 4, *right*).

Satisfaction and tolerance

Overall, 88.5% of subjects expressed satisfaction with the product. Additionally, 86.3% reported improvements in various scalp symptoms, 80.0% noted enhanced hair quality, and the product was well-tolerated. The formulation was deemed highly attractive by 88.6% of subjects. Furthermore, 87.4% believed the shampoo could be used as a standalone treatment for SSD, 86.3% supported it can be used as an adjunct

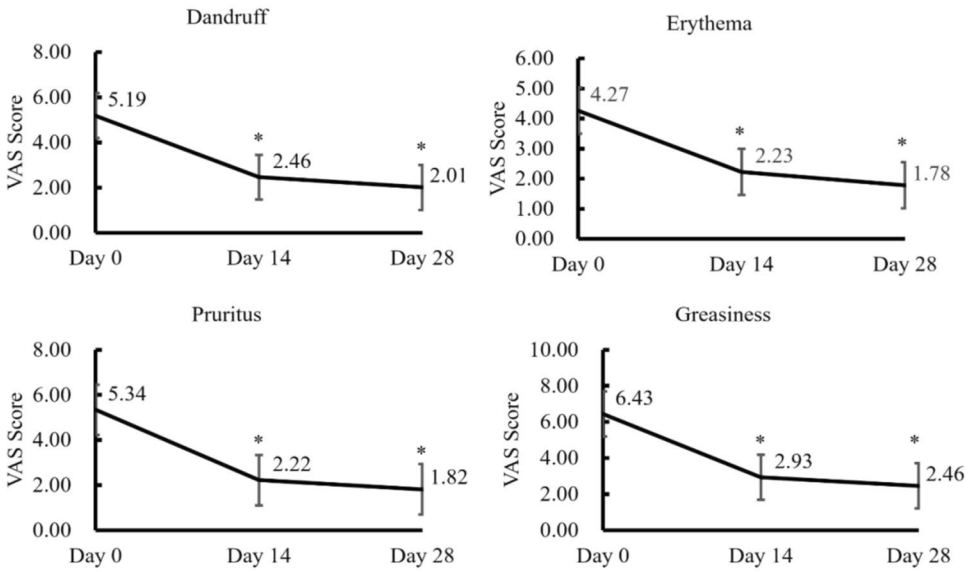

Fig. 2 Average severity of dandruff, scalp erythema, scalp pruritus and greasiness of scalp hair on Days 0, 14, and 28 (mean ± standard deviation). *Note: Compared with Day 0, *$p < 0.01$ on Day 14; compared with Day 14, $p < 0.01$ on Day 28

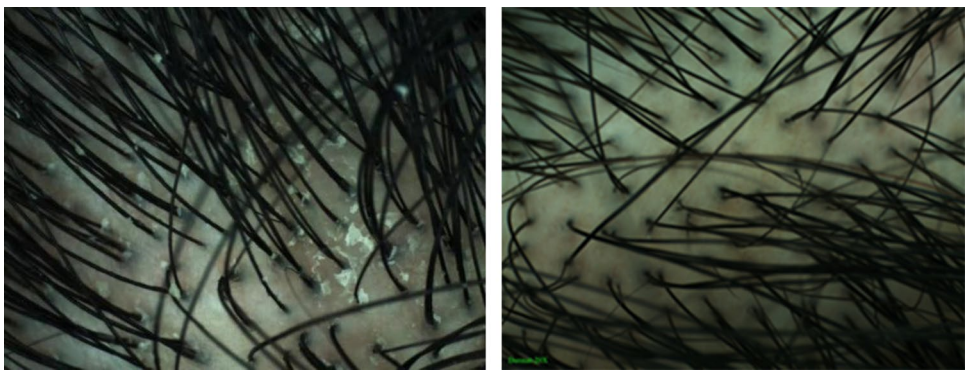

Fig. 3 Dandruff, erythema, and skin lesion manifestations of subjecta on Day 0 (*left*) and Day 28 (*right*)

Fig. 4 Dandruff, erythema, and skin lesion manifestations of subject b on Day 0 (*left*) and Day 28 (*right*)

therapy to enhance overall treatment outcomes, and 90.5% of dermatologists indicated a willingness to recommend the product in clinical practice.

Discussion

SSD is a prevalent, recurrent chronic inflammatory dermatosis characterized by diffuse yellowish-white oily dandruff, erythema, exudation, and scabbing on the scalp. The pathogenesis is multifaceted, involving increased sebaceous gland secretion, impairment of skin barrier function, immune responses, scalp micro-ecological imbalances, and genetic predispositions [7]. Studies have identified 11 species of Malassezia within the human microbiome, with an altered ratio of restrictive Malassezia species to Malassezia globosa-being implicated in the development of SD [8]. Malassezia is a lipophilic fungus that thrives in high-lipid environments, where it invades the stratum corneum and secretes lipases. These enzymes hydrolyze triglycerides into free fatty acids and lipid peroxides, triggering an inflammatory response. This leads to excessive proliferation of the stratum corneum, resulting in dandruff and disruption of the skin barrier function. The compromised barrier permits the entry of microorganisms and harmful substances, which activate the immune system and elicit local inflammatory reactions. Additionally, bacterial involvement has been documented in SSD pathogenesis. Zhong and colleagues conducted metagenomic sequencing to analyze skin flora, revealing an imbalance in the bacterial communities at lesion sites in SD patients. The study reported increased levels of seven pathogenic bacteria, including Staphylococcus aureus (S. aureus), Staphylococcus epidermidis (S. epidermidis), and Streptococcus haemolyticus (S. haemolyticus) [9]. One commonly reported drawback of selenium sulfide formulations is their characteristic odor. However, none of the participants in this study reported concerns about the smell of the test shampoo. This could be attributed to the presence of ceramide R and vitamin E, which may help mitigate the typical sulfur-like scent of selenium sulfide.

The typical treatment for SSD included antifungal agents, anti-inflammatory medications, keratolytics, traditional herbal washes, and phototherapy. Among antifungal treatments, agents such as ketoconazole, miconazole, and 2.5% SeS_2 shampoo are commonly utilized. Keratolytic options include coal tar, salicylic acid, and pyrithione zinc shampoos. Medicinal shampoos and cosmetics both play significant roles in daily management. SeS_2 exhibits multifaceted properties, including antifungal, antibacterial, and anti-parasitic effects on the skin surface. It mitigates lipid production, thereby attenuating inflammatory responses [10, 11]. Additionally, SeS_2 inhibits dermal fibroblast proliferation and turnover, facilitating the repair of the stratum corneum. Ketoconazole, another antifungal agent, inhibits the growth of Malassezia and Bacillus species. Clinical evidence suggests that ketoconazole effectively reduces scalp dandruff and erythema, decreases Malassezia populations, and enhances skin fungal diversity. However, symptom recurrence is common post-treatment discontinuation. Sequential application of ketoconazole and SeS_2 shampoo has been shown to be efficative in reducing scalp dandruff and inhibiting Malassezia and Staphylococcus epidermidis activity [12]. Gabriela et al. conducted an international multicenter observational study involving 1407 adults, which indicated that using SeS_2-based shampoo 2–3 times per week significantly improved hair quality, dandruff, and erythema symptoms in SSD patients, with good tolerability [13]. Salicylic acid, an organic acid also known as o-hydroxybenzoic acid, is extracted from the bark of plants such as willow, sweet birch, and Gaultheria. It enhances the metabolism of hyperkeratotic stratum corneum, promotes surface convergence, and shows topical anti-inflammatory properties along with mild antibacterial and antifungal effects. Salicylic acid is widely used in treating folliculitis, seborrheic dermatitis, and rosacea [14]. Hu et al. investigated the use of salicylic acid wash and care products over four weeks in 15 SD patients, observing significant reductions in adhesive scalp flake

ten-point scale (ASFS) scores, sebum secretion rates, and pruritus severity [15]. This indicates the efficacy of salicylic acid in decreasing dandruff, pruritus, and scalp sebum secretion. In summary, SeS_2 and salicylic acid, either alone or in combination, exhibit significant therapeutic benefits in managing SD.

Our findings indicate that prior to using the test shampoo, 28.4% of subjects exhibited severe or very severe dandruff, 47.3% had moderate dandruff, and 24.3% had mild or no dandruff. This distribution underscores the high prevalence of moderate to severe squamous symptoms among SSD patients. Following a 4-week treatment with the 1% SeS_2-salicylic acid shampoo, the proportion of subjects with severe or very severe dandruff decreased to 3.2%, those with moderate dandruff decreased to 6.3%, and 90.5% of subjects reported mild or no dandruff. These results suggest that the test shampoo is highly effective in relieving SSD-related dandruff symptoms. VAS scores were used to quantify the severity of SSD symptoms, including dandruff, scalp erythema, pruritus, and scalp hair greasiness. A significant reduction in VAS scores was observed on day 14 compared to baseline ($p < 0.01$), with further significant decreases on Day 28 compared to Day 14 ($p < 0.01$). These findings indicate progressive improvement in SSD symptoms, with extended use of the 1% SeS_2-salicylic acid shampoo leading to significant relief of scalp dandruff, erythema, pruritus, and hair greasiness.

There were also some limitations in this study. The lack of a control group restricted direct comparison between selenium sulfide alone and its combination with salicylic acid. Additionally, no objective tool was used to assess improvement. Future research using randomized controlled trials (RCTs) could determine the added benefit of salicylic acid. Further comparative studies investigating different active ingredient combinations, such as selenium sulfide with ketoconazole or ciclopirox, may optimize SSD treatment strategies. Besides, the exclusive inclusion of dermatologists as study participants may introduce a selection bias. Their clinical expertise may enable them to detect subtle improvements in symptoms more readily than the general population, potentially overestimating the product's perceived efficacy. Future studies should aim to include a broader participant pool to enhance generalizability. Finally, this study relied primarily on subjective self-assessments without incorporating objective biomarkers. While VAS scores provide valuable insight, future studies could be strengthened by including direct clinical measurements such as microbial analysis, sebum quantification, or inflammatory markers. These objective measures would enhance the validity of the findings and provide a more comprehensive understanding of treatment efficacy.

Given the limitations inherent in self-assessment methodologies, the involvement of dermatologists as study subjects provided a higher level of scientific rigor and consistency in data collection. The dermatologists' own experience with the product also enhances its relevance for patient education. Over 80% of participants expressed satisfaction with the shampoo, and 90.5% were willing to recommend it clinically. Participants noted that post-treatment, their hair felt fresher and less greasy, sebum secretion was reduced, and overall quality of life was significantly improved. These positive outcomes support the use of the shampoo as an adjunct in SSD management.

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Author contribution X.Chen and JX Li wrote the main manuscript text , YR Li and AH Wei prepared Figs. 1–4. All authors reviewed the manuscript.

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Data availability No datasets were generated or analysed during the current study.

Declarations

Conflict of interest The authors declare no competing interests.

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