

The Impact of Shampoo Wash Frequency on Scalp and Hair Conditions

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Keywords

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Abstract

Background: How frequently should the scalp and hair be cleansed? A dearth of objective data has led to confusion both among lay people and experts. Each extreme has potential detrimental effects: overcleaning may lead to surface damage while undercleaning may lead to buildup of harmful stimuli. This situation is complicated because both objective and subjective criteria are relevant to assess optimal cleaning. **Objectives:** The objective of this work was to combine epidemiological and treatment data with both objective and subjective end points to yield clear data to guide both the consumer and expert as to optimal scalp and hair cleaning practices. **Methods:** Two studies were conducted with Asian populations without any specific scalp pathologies. An epidemiological study was conducted as a function of natural wash frequency. This was combined with a controlled wash frequency study. In both cases, objective measures of hair and scalp condition were assessed. These were combined with self-assessments of all participants. **Results:** In the epidemiological study, it was observed that overall satisfaction

with hair and scalp condition was achieved when washing 5–6 times per week. This was consistent for both objective and subjective end points. Controlled treatment likewise showed that a daily wash regimen was superior to once per week cleansing for all end points. No objective detrimental effects to hair at this level of cleansing were observed. **Conclusions:** Two different studies led to the same conclusion: higher wash frequency is both beneficial and more preferred to lower wash frequency among the Asian populations studied. Concerns related to “overcleaning” were unfounded both objectively and subjectively. © 2021 S. Karger AG, Basel

Introduction

There are few questions in personal care that elicit more debate than “How frequently should I use a shampoo?” The opinions can vary from one end of the spectrum (as infrequently as possible) to the other (daily). For example, in one 3-month period, 2 relevant articles were published in the New York Times – one suggesting hair is washed too frequently [1] and the other suggesting the exact opposite [2]. Consumers appear to be responding more strongly to recommendations to reduce shampoo-

ing as declining shampoo wash frequency is observed in industry habit and practice studies and documented in the popular press [3, 4].

The reason for these divergent opinions is that little objective data exists to facilitate informed decision-making. For those recommending low wash frequency, the most often cited reasons are beliefs that hair is damaged due to surfactant-induced extraction of beneficial lipid components and stimulation of excessive compensatory scalp sebum production. Taken to the extreme, there are those that recommend avoiding the use of shampoos altogether; this has been colloquially termed “no poo.” At the other end, those that recommend higher wash frequencies usually assert the benefits of removing a wide range of potentially detrimental “dirt” residues. This position is reinforced by acknowledging that scalp is just an extension of the face, which is almost universally washed at least daily.

The buildup of “dirt” on hair and scalp has multiple origins: endogenous sources such as sebum excretion and skin exfoliative processes as well as exogenous sources such as certain hair treatment products, airborne pollution, and pollen as well as exposure to volatile materials such as those arising from tobacco smoke. The covering of the scalp by hair creates a unique skin surface micro-environment that facilitates microbial growth (dark, moist, and sebum rich), leading to a unique microbiome [5]. These microbes use components of the “dirt” as food sources which fuel their metabolic activity, enhancing their impact on the underlying skin [6].

Existing Literature Relating Wash Frequency and Scalp Condition

Decreased wash frequency results in longer accumulation times for secreted sebum. Sebum begins to be chemically altered as soon as it reaches the scalp surface; the longer its residence time, the greater these modifications. Specifically, modified sebum contains free fatty acids and oxidized lipids, which are known to be irritating to skin [6, 7].

Two extreme cases of low wash frequency have been evaluated relative to scalp impact. An Antarctic research team was monitored for changes in scalp microbe content and resultant symptoms [8]; during the expedition, scalp itch and flakes increased dramatically, which was also accompanied by a 2–3 order of magnitude increase in scalp *Malassezia* levels. These same authors subsequently studied International Space Station astronauts [9] and found a dramatic rise in *Malassezia* levels over time with them as well.

Even in less-extreme low-wash-frequency situations, impacts to scalp condition have been observed. In an epidemiological work studying Caucasian, Chinese, and African American individuals, lower shampoo wash frequency was associated with a higher prevalence of scalp issues such as dandruff [10]. Low wash frequency has also been observed to result in increased prevalence of seborrheic dermatitis in African Americans (AA) [11]. In a treatment study of individuals having a normal habit of low wash frequency and experiencing seborrheic dermatitis or psoriasis, wash frequency was deliberately increased, first with a cosmetic shampoo and then with a scalp treatment product [12]. Increased wash frequency, even if just using a cosmetic shampoo, resulted in decreased flaking, redness, itching, *Malassezia* amount, and the level of inflammatory cytokines.

Sebum accumulation and itch severity was studied as a function of time post-shampoo [13]. It was observed that itch severity increased significantly during 72 h post-shampoo, coincident with increases in sebum accumulation, supporting the model that *Malassezia* metabolism leads to the resultant accumulation of irritating stimuli such as oxidized free fatty acids that initiate itch. Higher scalp sebum levels have been shown generally to be related to the prevalence of scalp sensitivity [14], suggesting a cause-and-effect relationship.

Existing Literature Relating Wash Frequency and Hair Condition

There are less rigorous data available to address the impact of low wash frequency on hair condition. In a study of the consumer perception of hair quality expressed as good or bad “hair days,” it was found [15] that lower wash frequency led to a higher frequency of “bad hair days.” This was hypothesized to be due to an accumulation of scalp sebum which is subsequently transferred to the hair leading to a general greasy appearance characterized by oily shine and hair fiber-fiber adhesion.

In a comparative study of technical and perceived hair quality between Caucasians and AA [16], it was found that a much lower wash frequency amongst AA was associated with greater hair fragility and decreased growth rates. Similar observations were reported in a study of Nigerian females [17]. As mentioned above [11], seborrheic dermatitis is also more prevalent in this group, which has been demonstrated to impact the quality of hair emerging from the scalp [18]. Scalp sensitivity, which has been shown to be increased by low wash frequency and accumulated sebum [14], has been shown to associate with increased hair loss [19].

Summary of Relevant Literature

A general interpretation begins to emerge from the published literature. Low wash frequency allows scalp sebum level to increase as well as the proportion of chemically modified potentially harmful components within the sebum (such as oxidized free fatty acids). This material tends to increase the prevalence of scalp-related issues, which can be manifested in common itch or more defined etiologies such as seborrheic dermatitis. Either directly or indirectly (via scalp-impacted hair growth effects), low wash frequency tends to have detrimental effects on hair, but much of this comes specifically from evaluating AA hair and the typical low wash frequency habit.

The Need for Objective Data

The increasing perception that shampoo has the potential to harm the hair has led to a decrease in wash frequency globally. Paradoxically, this behavior may have the opposite effect on hair (and scalp). The research reported herein is aimed at generating objective data relating wash frequency to resultant effects on scalp and hair condition. We report here two studies aimed at adding objective data to enable informed decisions of optimum wash frequency. One is an epidemiological study while the other is a treatment study, both of which combined objective technical assessments with self-perception evaluations.

Materials and Methods

Epidemiological Study Study Design

A 2-week epidemiological study was conducted in Xi'an, China, with 1,500 healthy male and female subjects of Chinese ethnicity with no known scalp pathologies, aged 18–75 years old after obtaining the informed consent under the principles of Good Clinical Practice (see Tables 1 and 2 for a summary of population demographics and Fig. 1 for a visual summary of hair textures). No treatments were involved in this epidemiological study. Recruitment resulted in 200–300 subjects in each wash frequency group: $\leq 1\times/\text{week}$, $2\times/\text{week}$, $3-4\times/\text{week}$, $5-6\times/\text{week}$ and $7\times/\text{week}$. This enabled the evaluation of the impact of wash frequency on scalp and hair conditions. Figure 1 demonstrates the hair type and texture of recruited females in the epidemiological study.

Measures

Dandruff flaking severity was quantified using the Adherent Scalp Flaking Score (ASFS) as described [20]. The baseline visit included a self-perception assessment questionnaire designed to capture subject-relevant outcomes (e.g., severity of scalp flaking) using a categorical scale that varied from “none” to “very severe” (0 = none, 1 = slight, 2 = slight to moderate, 3 = moderate, 4 =

Table 1. Epidemiological-study wash-frequency population distribution

Age range, years	% wash frequency (male and female)				
	7×/ week (daily)	5–6×/ week	3–4×/ week	2×/ week	≤1×/ week
18–30	68	79	20	2	0
31–45	24	15	27	15	7
46–60	7	6	43	55	56
61–75	1	0	10	28	37

Table 2. Epidemiological study wash frequency population hair length distribution

Hair length	Male, %	Female, %
Close cut	87	2
Ear length	12	8
Ear length to shoulder length	1	13
Shoulder length	0	12
Greater than shoulder length	0	65

Table 3. Treatment clinical population parameters

	Phase 1: “7-day refrain”	Phase 2: “daily wash”
Subjects, <i>N</i>	60	60
Female, <i>n</i> (%)	56 (93)	56 (93)
Male, <i>n</i> (%)	4 (7)	4 (7)
Age, years, mean (SD)	43.4 (6.2)	43.4 (6.2)

moderate to severe, 5 = severe, and 6 = very severe). Subjects were asked to refrain from shampooing and using any hair styling products prior to scheduled visits during which they underwent ASFS measurement and completed self-assessment questionnaires.

Treatment Study Study Design

This was a 5-week, double-blind, IRB-approved study conducted in Xi'an, China, with 60 healthy male and female participants between the ages of 18–50 with no known scalp pathologies. Enrolled subjects habitually washed their hair with low frequency (≤ 2 times per week) and refrained from use of scalp treatments, medications, hair oils, serums, or anti-dandruff shampoos in the past 4 weeks. The study was conducted under the principles of Good Clinical Practice (see Table 3 for a summary of population demographics). The study was divided into sequential phases, differing in the frequency of use of a provided shampoo (a potentiated ZPT scalp care shampoo [21]). The first phase of the study, lasting one week, had one initial controlled shampoo application followed by a refrain of 7 days with no shampoo use. The second phase of the



Fig. 1. Example of hair type and texture of recruited females in the epidemiological study.

Table 4. Summary of measures and methods used for the treatment study

Measure	Method	Sampling	Description
Scalp flaking level	Expert grading	Direct visual	Expert visual grading of scalp surface flakes
Scalp surface lipids	FTIR	Direct surface probe	Spectroscopic identification of sebaceous lipids
Scalp odor	Expert grading	Direct sniffing	Expert olfactory grading
Scalp surface visual	Handheld microscope	Direct surface probe	Magnified scalp surface
Oxidative stress marker	MS	Scalp tape strip; Hair direct extraction	Quantitation of oxidized linoleic acid (HODE)
Hair lipids	GC	Extract of cut hair	Separation and quantitation of sebaceous and internal lipids
Hair water absorption	DVS	Directly on cut hair	Gravimetric analysis; controlled humidity and temperature
Hair shine	Gloss meter	Directly on cut hair	Evaluation of specular reflectance
Hair surface visual	SEM	Directly on cut hair	Highly magnified hair surface

FTIR, Fourier-transform infrared spectroscopy; MS, mass spectroscopy; GS, gas chromatography; DVS, dynamic vapor sorption; SEM, scanning electron microscopy.

study, lasting 4 weeks, comprised daily wash (controlled application) with the same shampoo. Subjects refrained from the use of any other scalp/hair products throughout the course of the study.

Hair Wash Protocol

Study personnel filled a 10 mL syringe with shampoo and adjusted water temperature between 32 and 38°C and flow rate at 5.1–6.3 L/min for hair wash. Subjects leaned over the front of the shampoo station to wet their scalp completely. The shampoo was dispensed equally across the subject's entire head, after which the subject gently massaged the shampoo into the entire scalp for 45 s. Subject rinsed shampoo from their hair until water ran clear. Subjects used a blow dryer to dry their hair.

Two assessment time points occurred: at the end of the 7-day refrain period ("7-day refrain") and 24 h after the last wash of 4 weeks of daily washing ("daily wash"). The 4-week period of daily washing enabled enough time for new hair to grow and emerge from the scalp under the new scalp condition resulting from daily washing. For analysis of hair samples, the most recently grown segment (approximately 1 cm) was used.

Measures

Measures included technical measures and self-assessments of both scalp and hair conditions. Most scalp assessments were made directly on scalp or on extracts of the scalp surface. Hair samples were collected from a 2.5 × 2.5 cm square area on both sides of the scalp. At the end of phase 1, a template was used to mark the hair collection area and a cosmetologist clipped the hair with scissors and placed the hair in glassine envelopes, keeping the orientation of the fiber bundle consistent. The hair collection procedure was repeated at the end of phase 2 after ~2 cm of new growth. For hair analysis, the length of the sample was measured, and the portion of the sample that was closest to the scalp (representing newest growth) was utilized. An equal length of hair was cut from the proximal end of the phase 1 hair sample. The phase 1 and 2 visits included a self-perception assessment questionnaire designed to capture subject-relevant outcomes (e.g., severity of scalp flaking) using a categorical scale that varied from "none" to "very severe." Table 4 summarizes the measures, the details of which can be found in the online suppl. Material (for all online suppl. material, see www.karger.com/doi/10.1159/000512786).

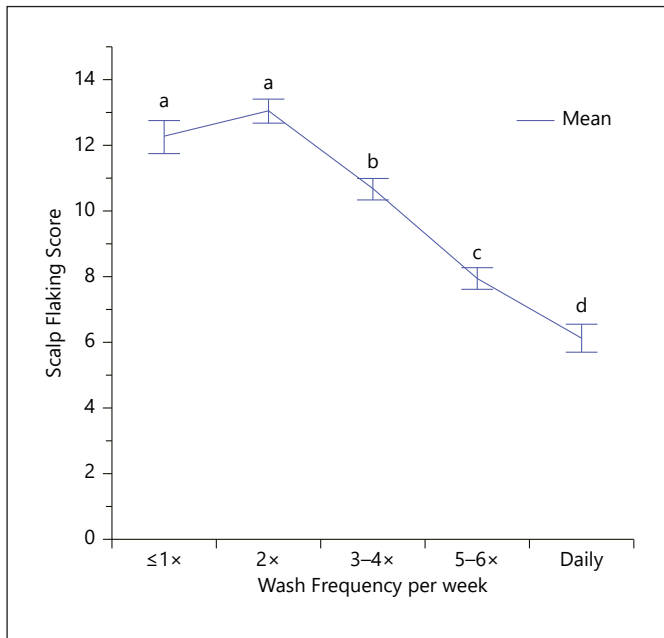


Fig. 2. Scalp Flaking Score graded by experts as function of wash frequency in epidemiological study. The mean ASFS is plotted with standard error bars. Results not connected by same letter are significantly different. ASFS, Adherent Scalp Flaking Score.

Statistical Analysis

After completion of the epidemiological and treatment study, data were checked for accuracy and completeness. All subjects were evaluated for compliance with study protocol at each visit, and their evaluability was determined prior to database locking. Statistical analyses were performed on evaluable data. Logarithm transformation was applied to biomarker data prior to analysis to stabilize the variance. A statistical test was determined to be significant if a two-sided p value <0.05 .

Results

Scalp Technical Results (Epidemiological Study)

Scalp flaking severity, as determined by the ASFS method, decreased significantly with increase in wash frequency (Fig. 2). These data represent the results of the total panel and are independent of either age or gender (online suppl. Table 1).

Scalp Condition Self-Perception Results (Epidemiological Study)

Self-perception assessment questionnaires completed for different wash frequencies revealed statistically significant reduction in the severity of self-perceived scalp

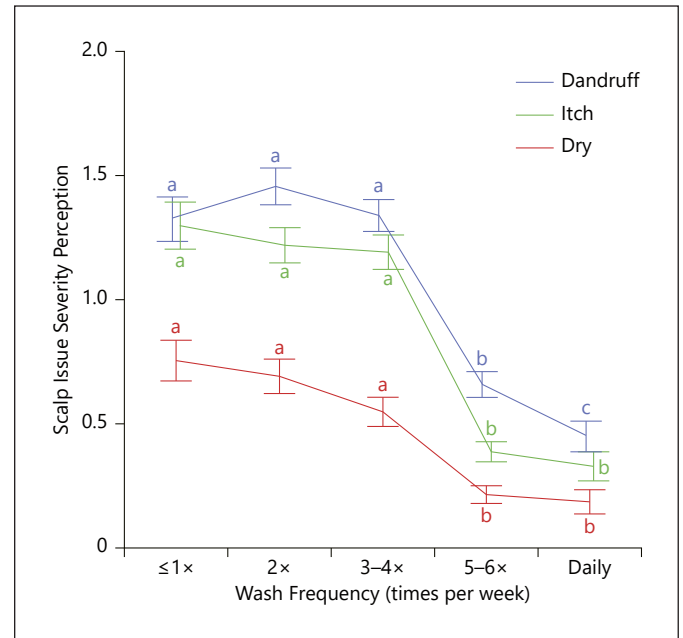


Fig. 3. Self-perceived scalp parameters dandruff, itch, and dryness of $n = 1,500$ males and females as function of wash frequency in the epidemiological study. The mean is plotted with standard error bars. Results not connected by same letter are significantly different.

dandruff, itch, and dryness with increases in wash frequency (Fig. 3). The reduction in scalp dandruff perception coincided with the improvements observed in technical dandruff severity based on the ASFS grading method. These data represent the results of the total panel and are independent of either age or gender. Please refer online suppl. Table 2 for total (male and female) and gender-wise data.

Hair Condition Self-Perception Results (Epidemiological Study)

Hair condition self-perception assessment revealed no discernible negative outcomes as a result of increased wash frequency. Specific parameters summarized in Figure 4 are hair loss, hair brittleness (both of which slightly improved at high wash frequency), and hair smoothness. Please refer online suppl. Table 3 for total (male and female) and gender-wise data.

A comprehensive parameter that reflects self-perception of hair condition was evaluated and termed “great hair days,” representing the overall satisfaction of the panelist with their hair look and feel. Using this metric, the number of days per week a panelist has overall satisfaction with their hair condition increases significantly

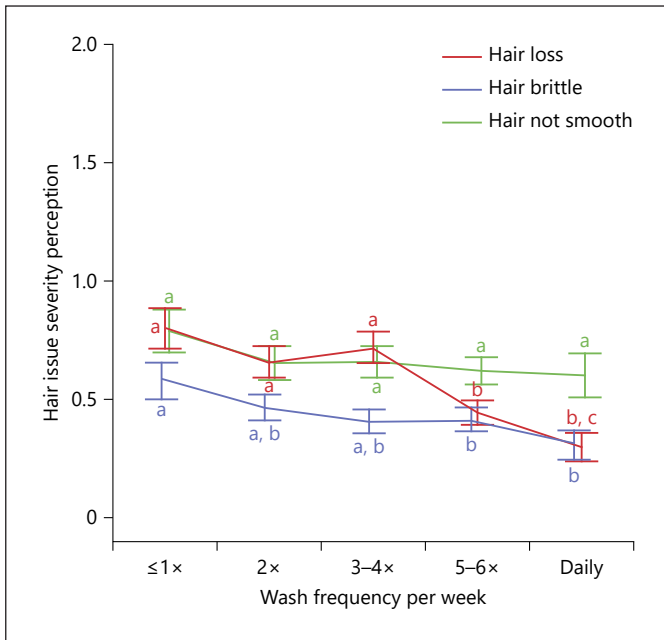


Fig. 4. Self-perceived hair attributes hair loss, hair brittleness, and hair not smooth of $n = 1,500$ males and females as function of wash frequency in the epidemiological study. The mean is plotted with standard error bars. Results not connected by the same letter are significantly different.

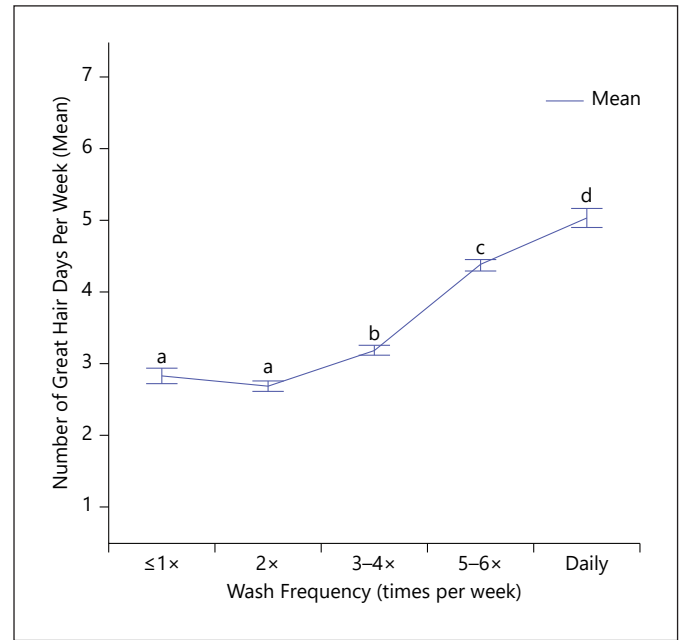


Fig. 5. Self-perceived of number of “great hair days” improved for $n = 1,500$ males and females as function of wash frequency. The mean is plotted with standard error bars. Results not connected by the same letter are significantly different.

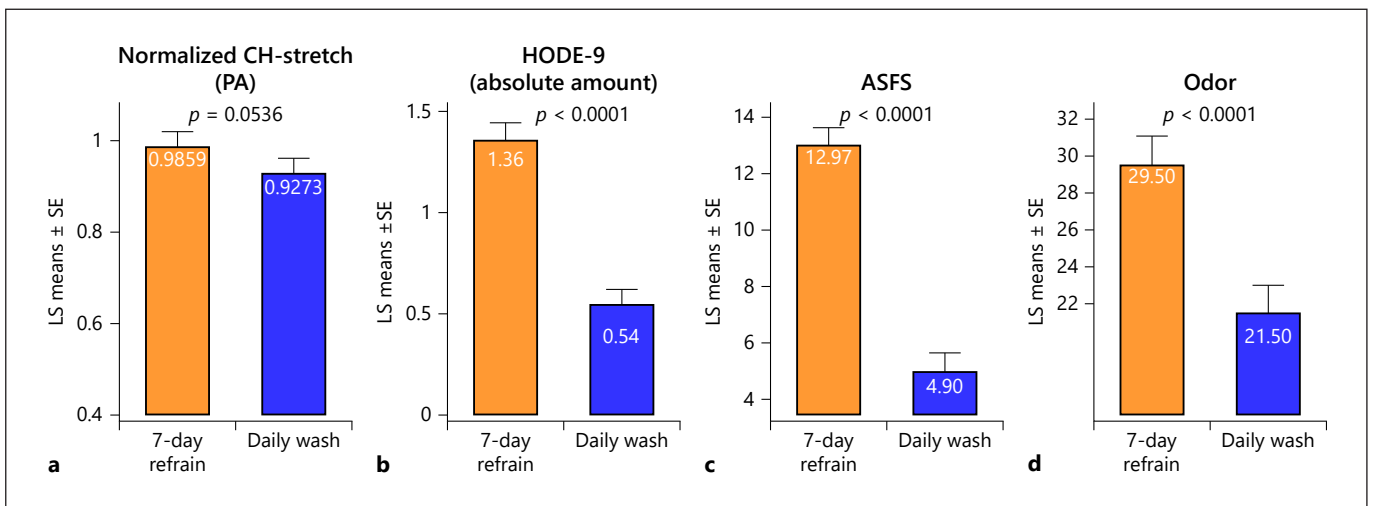


Fig. 6. Technical scalp measurements for total sebum lipids (normalized CH-stretch PA) (a), oxidized lipids (HODE-9) (b), flaking score (ASFS) (c), and odor intensity at 7-day refrain (yellow bar) and daily wash (blue bar) (d). For each measurement, lower value indicates healthier scalp. ASFS, Adherent Scalp Flaking Score.

the more frequently they wash their hair (Fig. 5). These results were independent of age and gender. Please refer online suppl. Table 4 for total (male and female) and gender-wise data.

Scalp Condition Technical Results (Treatment Study)
 Compared with the 7-day refrain period, daily wash with a potentiated ZPT shampoo resulted in the expected significantly lower amounts of overall scalp surface lipid

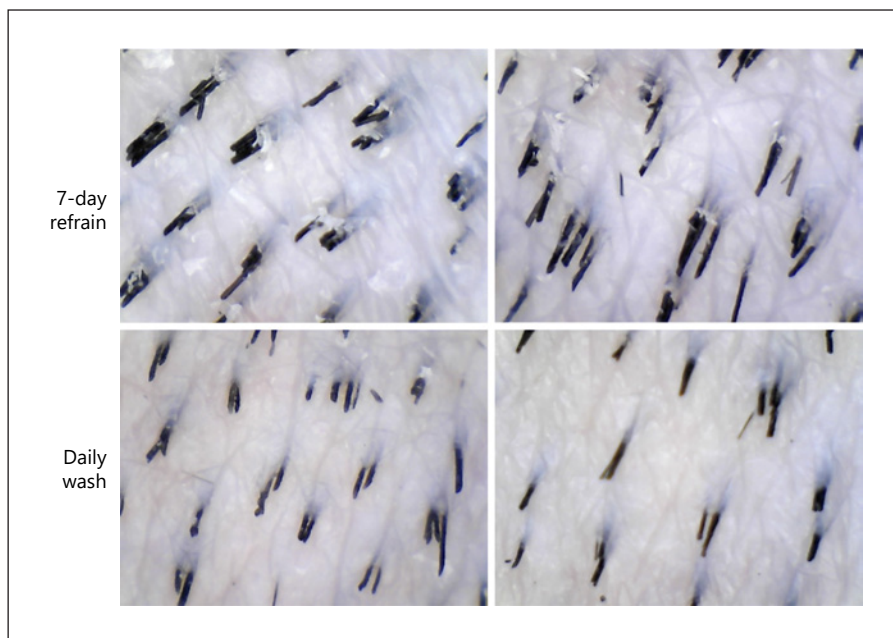


Fig. 7. Selected scalp images comparing the oil accumulation representative of the 7-day refrain and daily wash protocols.

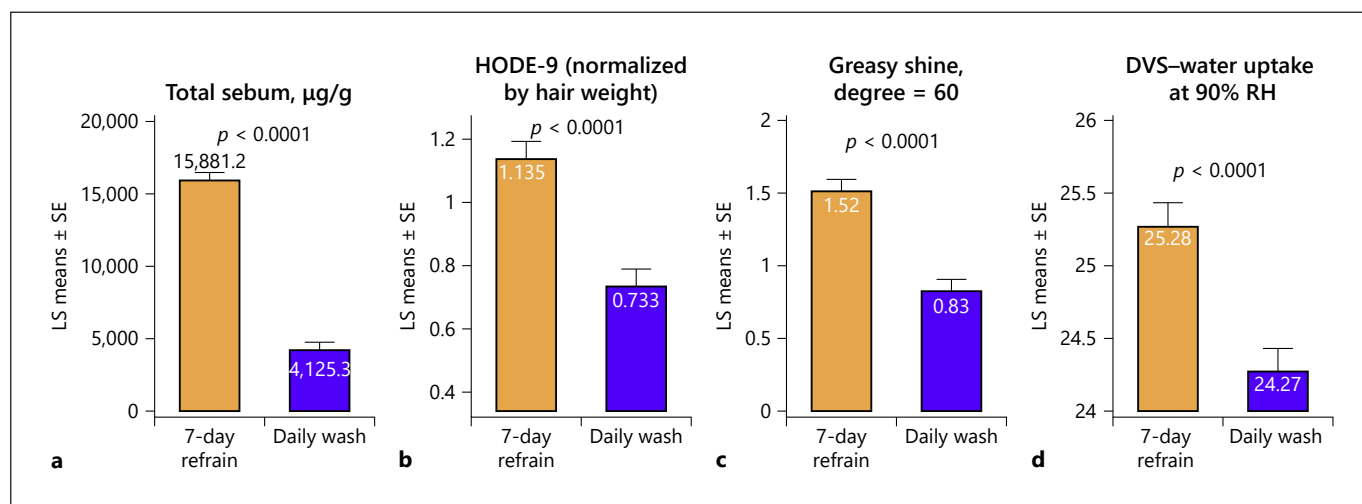


Fig. 8. Technical hair measurements for total sebum lipids (a), oxidized lipids (HODE) (b), greasy shine (c), and % water uptake at 7-days refrain (yellow bar) and daily wash (blue bar) (d). For measurements in (a, b, d), lower value indicates healthier hair. For measurement in (c), lower value indicates a less greasy shine on hair.

and fatty acid of sebum as measured on scalp (Fig. 6a). The level of a scalp health biomarker of oxidized lipid (HODE) is also significantly reduced with daily wash versus 7-day refrain (Fig. 6b). Even though the subjects were not dandruff sufferers with high incoming flaking levels, daily wash lowered the level of flaking on scalp as measured by ASFS (Fig. 6c). Expert assessment of scalp odor was also improved by the daily wash regimen relative to the 7-day refrain (Fig. 6d).

Images of the scalp were captured to visually summarize the oil accumulation representative of the low wash protocol and the improvement because of daily wash. Representative sample images are summarized in Figure 7.

Hair Condition Technical Results (Treatment Study)

The daily wash protocol resulted in significantly less sebum on hair than the 7-day refrain as expected (Fig. 8a).

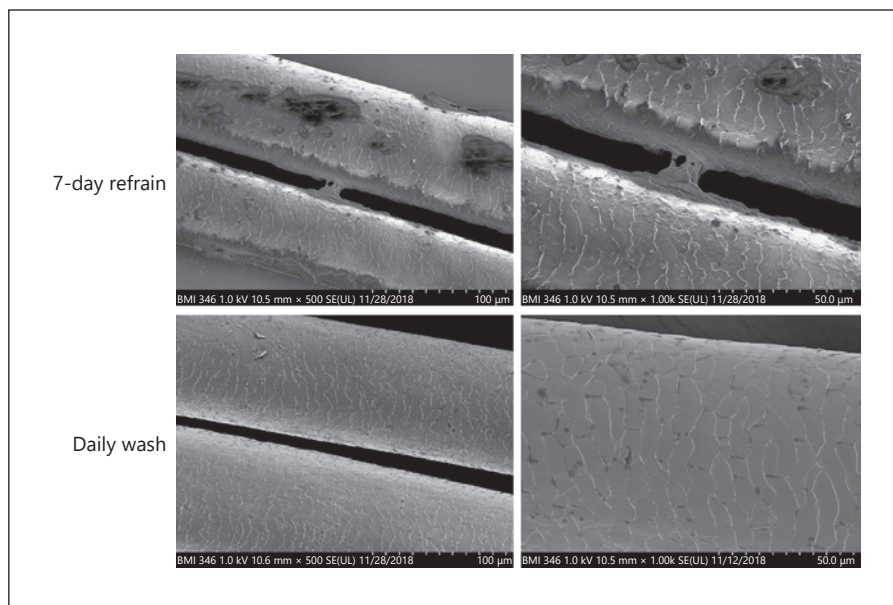


Fig. 9. Selected hair images comparing the oil accumulation representative of the 7-day refrain and daily wash protocols.

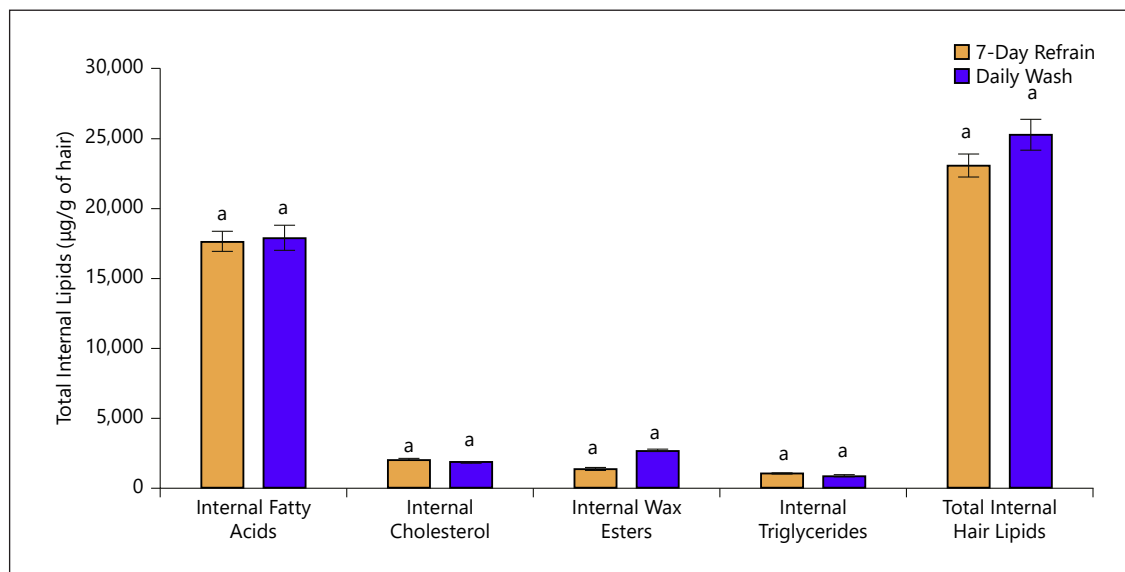


Fig. 10. Quantification of internal hair lipids using GC method as a result of 7-day refrain and daily wash protocols. No significant differences were observed.

Evaluation of the proportion of sebum that has been oxidized (using the established biomarker HODE), it was observed that daily wash resulted in significantly less oxidation (Fig. 8b), both paralleling the scalp results. Measurement of greasy hair shine demonstrated daily wash left the hair with a less oily (specular) shine (Fig. 8c). Finally, use of DVS to probe hair cuticular surface integrity and daily wash resulted in lower hair water vapor absorption indicating a more effective cuticular barrier (Fig. 8d).

Images of the hair were captured to visually summarize the oil accumulation representative of the low wash protocol and the improvement because of daily wash. Representative sample images are summarized in Figure 9.

Internal hair lipids were quantified using GC method to determine whether the two wash protocols affected the amount of beneficial internal hair lipids. There were no significant differences observed between the 7-day re-

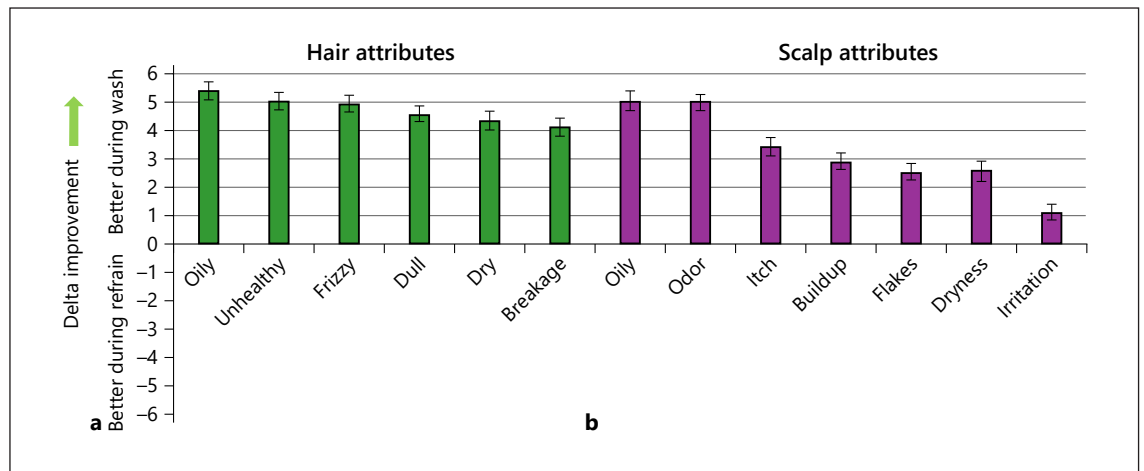


Fig. 11. Improvement of self-perception of hair (a) and scalp (b) attributes upon switching from 7-day refrain versus daily wash protocol. A categorical scale 0–10 was used for the worst of the conditions panelists had during the last 24 h, where 0 = none and 10 = worst imaginable. *p* values are based on pairwise *t* test.

frain and daily wash protocols in any of the classes of internal hair lipids (Fig. 10).

Self-Perception Evaluation (Treatment Study)

Validating the objective technical assessments, self-assessments indicate whether subjects noticed the impact of these technical measures on scalp and hair properties. All attributes evaluated had dramatic improvements upon transition from the 7-day refrain to the daily wash protocol (in some cases, over half of the full rating scale). While the reduction in oil buildup on both hair and scalp are likely obvious, the interpretations of the implications are less obvious: improved perception of hair health and attributes related to it and reduced scalp irritation and itch. The results are summarized in Figure 11.

Discussion

The question “How frequently should scalp and hair be washed?” has been difficult to answer definitively due to lack of relevant objective technical information. There are concerns among both professionals as well as consumers that washing with surfactant-based products has the potential to harm either or both the hair and scalp. We sought to generate data, both technical and panelist self-assessed, to understand the impact of wash frequency on the resultant conditions of both hair and scalp. Two different study designs were conducted to address this question. In one study (the Epidemiological Study), wash fre-

quency varied based on the normal habits and practices of a recruited population. A second study (the Treatment Study) was conducted in a population of low-frequency shampooers, who were switched to a higher frequency of shampooing for 1 month. These studies substantially and uniquely add to the existing literature to enable informed decision-making regarding optimum wash frequency for hair and scalp care.

Impact of Wash Frequency on Scalp Condition

In the Epidemiological Study, those washing with a higher frequency experienced less flaking as judged both by experts as well as self-perceived less flaking, itch, and dryness. In the Treatment Study, switching from low to high wash frequency resulted in significant decreases in the technical parameters of scalp sebum level, degree of flaking, amount of oxidized sebaceous lipids, and scalp odor. These were accompanied by corresponding self-perceived improvements in these same attributes as well as more composite parameters (such as irritation).

The data from these two studies are entirely consistent with the studies existing already [10–12] supporting the observation that increased wash frequency results in decreased scalp flaking and itching. These studies, however, extend the beneficial scalp impacts to considerably more technical and self-assessment measures. For example, new measures of decreased oxidative stress (using the biomarker HODE) may add to the mechanistic explanations as to why sebum accumulation on the scalp is generally detrimental to its condition. This work also extends

the symptomatic observations to include malodor generation. Taken together, there is a strong group of data that consistently supports the understanding that low wash frequency allows sebum to accumulate, become progressively chemically modified and irritating leading to increased prevalence of resultant symptoms (flakes, itch, and dryness). A significant aspect of the irritation likely originates from the formation and accumulation of species such as oxidized lipids that lead to oxidative stress [22]. These observations are consistent in both technical measures and individual self-assessments. As a whole, the data support that increased scalp washing is beneficial for both normal scalps as well as those exhibiting pathologies such as seborrheic dermatitis.

Impact of Wash Frequency on Hair Condition

While the conclusions regarding the detrimental impact of low wash frequency on scalp condition are widely accepted, the impact on hair condition is considerably more controversial, largely due to the paucity of existing data. In the Epidemiological Study, the panelists observed no negatives to hair condition with increased wash frequency and the trend was always in the direction that increased wash frequency decreased hair issues. Smooth feel perception did not statistically significantly improve, but both hair loss perception and brittleness perception did significantly improve with increasing wash frequency. These attributes, and likely many more, can be combined into a global colloquial term “great hair days.” [15] Using this global metric, increasing wash frequency resulted in dramatic improvement of overall hair satisfaction: 2 or less washes per week resulted in less than 3 great hair days per week whereas daily washing led to over 5 great hair days per week.

In the Treatment Study, objective technical parameter measurement provides important insights to definitively address the impact of wash frequency on hair condition. Reduction of sebum level and greasy shine are to be expected. As with the scalp, a reduction in oxidative stress has been observed with increased wash frequency. The relationship between the oxidative stress status of the scalp and resultant oxidative stress of the hair has been previously established [18] and has been confirmed here, with wash frequency being the driver of improved conditions of both. Continuing the parallel, the hair obtained from those with higher wash frequency was in better condition in that the protective cuticular barrier was more functionally effective, enabling reduced water vapor absorption. Again, this has previously been observed as a result of reduced oxidative stress to scalp and resultant hair produced from it [23].

An important measure of impact of treatments on hair condition is the impact on internal lipids that build the cuticular structure. Harsh treatments are known to cause the reduction of these beneficial lipids [24]. Removal of these beneficial lipids has been shown to cause greater roughness, permeability, and reduced structural integrity [25]. Shampoo products can be formulated to inhibit any such effects [26]. In the treatment study, daily wash for 28 days with a well-formulated, mild scalp care shampoo showed that no significant loss in internal lipids occurred as a result of increased wash frequency. The subjects in this study self-assessed their condition as dramatically better at the higher wash frequency: reduced oiliness, more healthy, less frizz, less dull, less dry, and reduced breakage.

Taken together, the data from these two studies strongly support the conclusion that increased wash frequency is beneficial to self-perceived hair condition and not detrimental to technically assessed hair quality for the Asian population studied. One of the primary technical concerns reported with excessive washing has been loss of internal beneficial lipids; this was not observed in this work. Both of these studies consisted of Asian individuals with straight or low-texture hair (visually exemplified in Fig. 1). It is not known whether the results observed here are generalizable to hair types with much higher texture/curl. However, preliminary data from an epidemiological study involving Nigerian women demonstrated higher wash frequency was associated with less hair complaints [27]. It is also possible that greater use of styling implements than used in these studies could contribute to hair damage separate from washing itself.

Summary

These two studies significantly increase the rigorous objective data available to assess the impact of shampoo wash frequency on scalp and hair conditions. There is little doubt that increased wash frequency is beneficial to scalp condition. However, the data also strongly support that for the Asian populations studied, hair condition is not negatively affected by increased wash frequency and that the self-perception is toward marked improvement. The overall model of detrimental effects of sebum, especially oxidized versions, is consistent with other observations relating scalp to hair health. Thus, these data should serve as an important asset to offset the unfounded concerns that high shampoo wash frequency is detrimental in any way.

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Statement of Ethics

Studies were conducted in concordance with the World Medical Association Declaration of Helsinki. All subjects provided informed, written consent. The treatment study was reviewed and approved by Beijing Health Tech Research Co., Ltd. as study CSD 2018037.

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Conflict of Interest Statement

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Author Contributions

All authors contributed equally to study design, data interpretation, and drafting the manuscript.

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