

Burning Sensation and Facial Blood Flow in Rosacea Patients: An Exploration of an Invisible Symptom That Cannot Be Overlooked

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Background: Rosacea presents with visible symptoms and subjective symptoms like burning and itching; among these, burning may seriously impair patients' quality of life. Current research has focused primarily on visible manifestations, with insufficient attention given to studying subjective symptoms such as burning. The aim of this study is to investigate the characteristics of burning, as well as the potential changes in facial blood flow of patients.

Methods: A questionnaire survey and retrospective study were employed. 177 patients answered questions related to their burning sensation. Laser speckle contrast imaging was used to investigate the differences in facial blood perfusion.

Results: Among 177 patients, 87.0% reported that the subtype of rosacea associated with burning was ETR, 58.8% experienced burning before their diagnosis, and the most commonly associated symptom was exacerbated erythema (85.3%). Dietary habits and behavioural practices can trigger burning. The onset of burning exhibits a certain seasonality, being most prevalent in winter (December, January, and February), and it is more likely to occur in the afternoon and during significant temperature fluctuations. Among five groups of patients matched by baseline characteristics and disease severity, four groups displayed higher facial blood perfusion in burning patients compared to non-burning patients within the same timeframe.

Conclusion: Burning sensation can be influenced by specific dietary or lifestyle habits and changes in external temperature. Burning may be related to increased facial blood perfusion.

Keywords: rosacea, burning, laser speckle contrast imaging

Introduction

Rosacea is a chronic inflammatory skin condition primarily affecting the central face, characterized by flushing, persistent erythema, papule pustule, and telangiectasia, and may involve ocular manifestations.¹ In addition to visible signs, individuals with rosacea may experience sensations like burning, stinging, and itching.² The self-perceived symptoms/sensations of rosacea impact patients' lives, as evidenced by a global survey (N = 710) assessing the impact of facial signs and sensations on overall disease burden, revealing a significant association between sensations and higher disease burden, with high-burden patients spending more time on daily skincare routines.³

Burning in rosacea presents as an uncomfortable or painful sensation of heat, usually in the central facial area. This sensation is quite common among rosacea patients, with reported occurrence rates varying widely from 10% to 85% in different studies.^{4,5} According to our clinical observations, burning sensations often become a complaint among patients with rosacea. For instance, some patients report that nighttime burning affects their sleep, severely impacting their quality of life. In fact, rosacea patients often face a lower quality of life and poorer mental health compared to healthy individuals.^{6,7} The burning sensation, as a distinctly felt subjective symptom, may exacerbate the negative experience

of the condition, thereby affecting the patients' psychological state. Rosacea-related burning and stinging arise from interrelated pathophysiological mechanisms. Transient receptor potential (TRP) channels—especially TRPV1 and TRPA1—are overexpressed in rosacea skin, lowering sensory thresholds so mild stimuli trigger burning. Neurogenic inflammation also plays a role: activated sensory nerves release neuropeptides, which amplify inflammation and vasodilation.

However, research on rosacea focusing more on visible symptoms such as erythema and hyperplasia tends to overlook subjective symptoms like burning and stinging,⁸ and there is currently no widely accepted scale for assessing the burning sensation in rosacea. In rosacea, dilated cutaneous blood vessels elevate local skin temperature, while increased blood perfusion delivers pro-inflammatory mediators and vasoactive neuropeptides to cutaneous sensory nerves. These molecules sensitize nerve endings, lowering the threshold for perceiving thermal or chemical stimuli as burning. To further explore the phenomenon of burning in rosacea, this study conducted a questionnaire survey and a retrospective study, performed laser speckle imaging to measure facial blood flow in some patients. The application of laser speckle contrast imaging (LSCI) technology allows us to further investigate whether the burning sensation, which may be associated with blood vessels, is accompanied by changes in facial blood flow.^{9,10} The aim is to clarify the characteristics, risk factors, impact on patients' quality of life and psychological status, as well as potential vascular changes related to the burning in rosacea patients.

Methods

Study Design and Patients

This study investigated the characteristics of burning in patients with rosacea through a cross-sectional study. According to the 2019 ROSacea COnsensus (ROSCO) and the 2017 National Rosacea Society phenotype recommendations, dermatologists diagnosed all patients included in the study with rosacea.^{11,12} In the cross-sectional study, we conducted a questionnaire survey on burning to all eligible patients: I) diagnosed with rosacea at the Dermatology Department of West China Hospital, Sichuan University, between June 2022 and January 2024; II) experiencing burning for 3 months or more, and still present; III) having the cultural literacy and ability to describe their symptoms in detail.

Questionnaire Design and Data Collected

The survey questionnaire distributed in the outpatient clinic was designed by dermatologists. Its content includes the patients' baseline information, the occurrence and duration of burning sensations, accompanying symptoms, and triggering factors related to burning. The questionnaire was designed in such a way that patients cannot submit it unless all questions are completed when entering the survey system, ensuring that the responses provided by all participating patients are comprehensive.

When comparing facial vascular metrics across groups, the five rosacea patients with burning were analyzed. We selected 5 patients with burning (from the enrolled patients) using a strict 1:1 matched-pair design: each was individually matched to 5 patients without burning. We matched them individually based on gender, age, rosacea subtype, Clinician's Erythema Assessment (CEA) score, and Investigator's Global Assessment (IGA) score with five similar non-burning patients, and five healthy controls were enrolled. The monitoring of cutaneous blood flow is conducted using laser speckle contrast imaging (LSCI), which reflects the patient's facial blood flow condition through the average blood perfusion amount over 30 seconds.⁵ The VISIA system was employed to determine CEA and IGA scores. We defined two regions of interest (ROIs): one is a manually delineated area of high perfusion, and the other is a fixed rectangular area defined by the intersection of two vertical lines (respectively extending downward from the inner canthus and outer canthus of the eye) and a horizontal line passing through the widest point of the nasal wing.⁶ Prior to VISIA measurements, all enrolled patients received standardized instructions to avoid behaviors that could potentially interfere with vessel dilation and confound assessment results. Specifically, they were required to refrain from physical exercise for at least 30 minutes, avoid consuming caffeine-containing substances, smoking and avoid exposure to extreme temperatures for 1 hour before the measurement. These precautions were strictly implemented to ensure the stability and reliability of vessel-related indicators captured.

Statistical Analyses

Quantitative variables are expressed as mean±standard deviation (SD), while categorical data are presented as frequencies and percentages. Categorical variables are assessed using Fisher's exact test or the χ^2 test. All reported P-values are based on two-sided tests with a significance level of $\alpha = 0.05$. All statistical analyses were performed using SPSS version 28.0.

Result

Characteristics of Burning in Rosacea Patients

A total of 177 patients who met the criteria completed the questionnaire. The baseline characteristics of enrolled patients are shown in Table 1 and Figure 1a, with the majority of rosacea patients being female (93.2%), presenting with erythematotelangiectatic rosacea (ETR, 87.0%), and lesions mainly located on the cheeks (71.8%); over half of the patients experienced burning sensations before their rosacea diagnosis (58.8%). The most correlated accompanying symptom with burning was worsening erythema (85.3%), while Figure 1b shows other reported accompanying symptoms. In terms of diet and burning, over half of the patients reported that alcohol and spicy foods may trigger burning (Figure 1c); in terms of behavior, taking hot baths, sports, bad moods, using cosmetics, and frequent face washing were identified as significant trigger factors (Figure 1d). Winter (December, January, February) was found to be the peak season for burning sensations (Figure 1e and f), and the afternoon (14:00–17:59) was the peak time for burning (Figure 1g). Alternating cold and hot temperatures or intense sunlight were identified as the most common weather conditions triggering burning (Figure 1h).

Table 1 Baseline Characteristics of Enrolled Patients (n=177)

Characteristic	n (%) / Mean ± Variance (n=117)
Gender	
Female	165 (93.2)
Male	12 (6.8)
Age	
<30 years	57 (32.2)
30–45 years	74 (41.8)
>45 years	46 (26.0)
Fitzpatrick Phototypes	
Type II	58 (32.8)
Type III	119 (67.2)
Rosacea Subtypes	
ETR	154 (87.0)
ETR + PPR	21 (11.9)
PPR	2 (1.1)
Lesion Distribution	
Cheeks	127 (71.8)
All face	39 (22.0)
Cheeks + Nose	11 (6.2)
Burning Onset Timing Relative to Diagnosis	
Appear before diagnosis	104 (58.8)
Appear around diagnosis	47 (26.5)
Appear after diagnosis	26 (14.7)
IGA Score	2.34 ± 0.94
CEA Score	2.63 ± 1.09

Abbreviations: ETR, Erythematotelangiectatic rosacea; PPR, Papulopustular rosacea; IGA, Investigator's Global Assessment; CEA, Clinical Erythema Assessment.

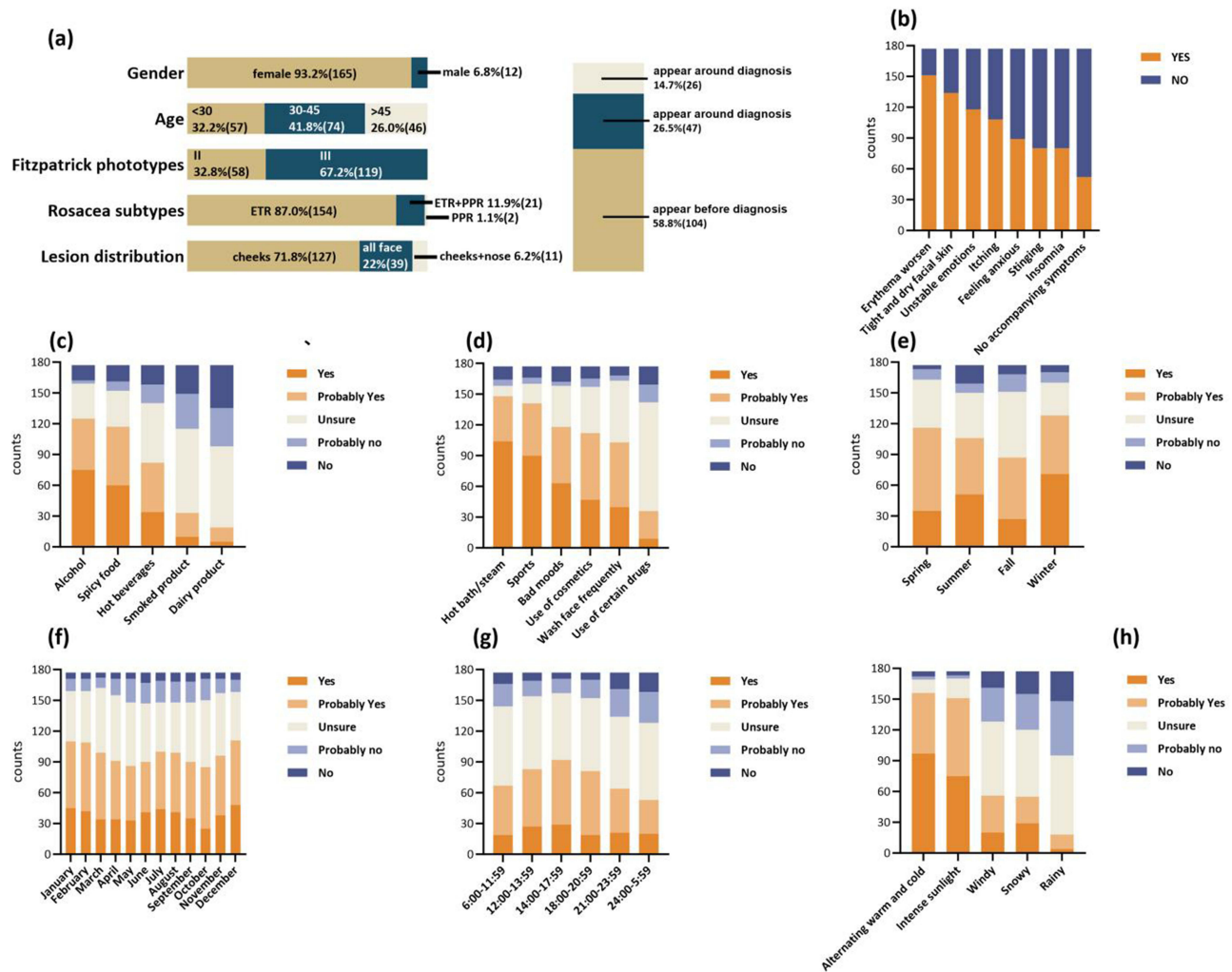


Figure 1 (a) Participants' baseline and comparison of the onset time of burning sensation in participants with their diagnosed time of rosacea; (b) Accompanying symptoms reported by patients experiencing burning; (c) Question: Does consuming this food cause you to experience burning?; (d) Question: Does this behaviour cause you to experience burning?; (e) Do you experience burning during the following seasons?; (f) Do you experience burning during the following months?; (g) Do you experience burning at the following times?; (h) Do you experience burning in the following weather conditions?
Abbreviations: ETR, erythematotelangiectatic rosacea; PPR, papulopustular rosacea.

Changes in Facial Blood Vessels in Patients with Burning

Patients in the burning sensation group reported experiencing a burning sensation during the measurement of facial blood perfusion. Compared with the control group, both rosacea patients with burning and those without burning exhibited significantly increased facial blood perfusion in ROI1 and ROI2 (all $p < 0.001$); notably, rosacea patients with burning showed the highest blood perfusion levels among the three groups (all $p < 0.001$) (Figure 2).

Discussion

Neurovascular dysregulation and changes in immune responses are considered key pathophysiological factors in the occurrence of burning. Current research suggests that there is an increase in transient receptor potential ion channels of vanilloid type (TRPV) in patients with rosacea, where the release of vasoactive neuropeptides induces TRPV activation, leading to burning.^{13,14} Our findings indicate that burning is associated with factors that may trigger capillary dilation or changes in facial blood flow, such as reported alcohol consumption and spicy foods by most patients, as well as hot baths or exercise, which could increase facial blood flow and induce burning, aligning with current theories about TRPV. Additionally, burning exhibits a high correlation with temperature, with the highest number of patients reporting burning

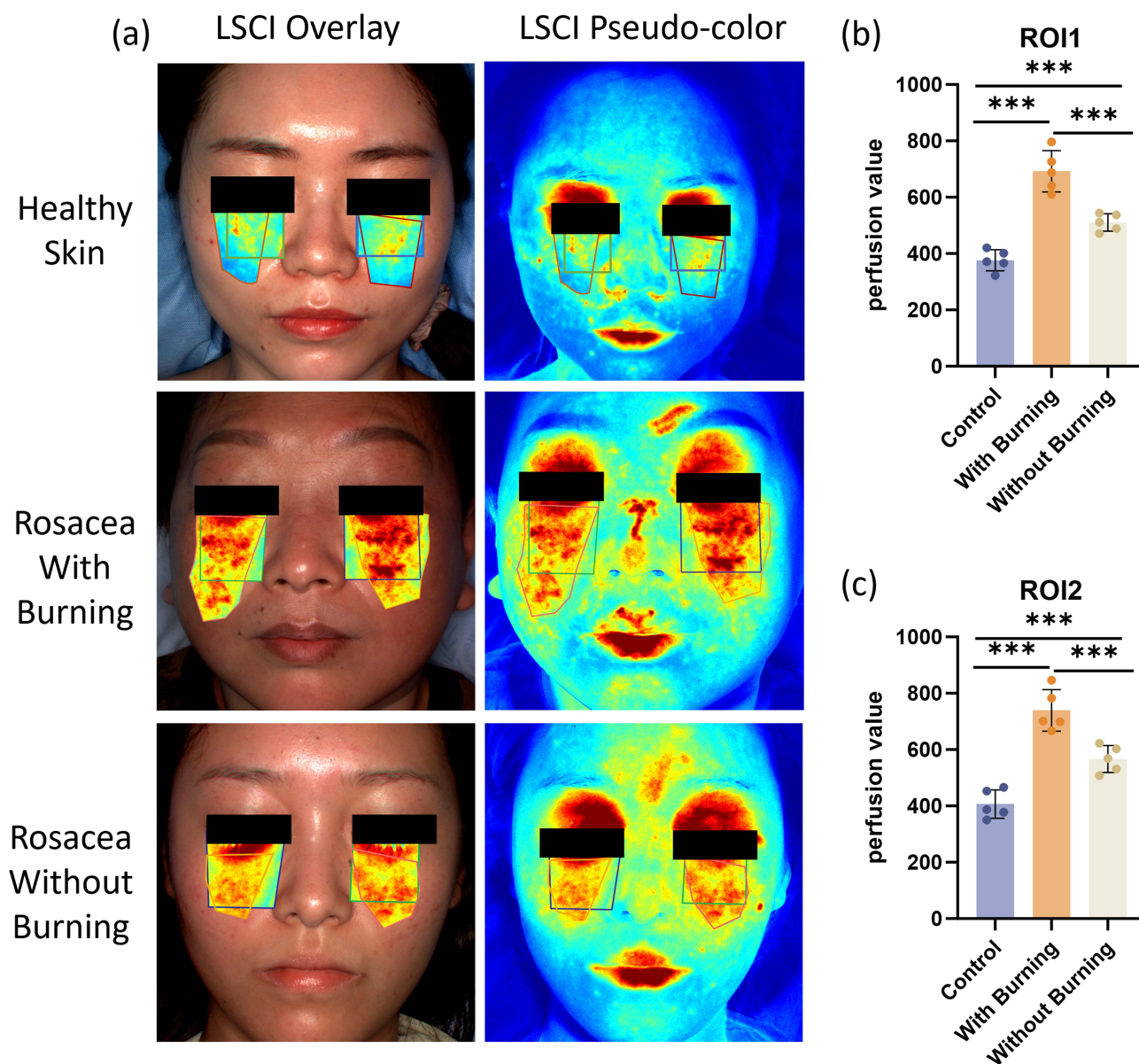


Figure 2 Comparison of facial laser speckle contrast imaging in patients with rosacea. (a) ROIs of LSCI and VISIA images. (b) Matched data from five groups of comparison patients. (c) Comparison data of facial blood perfusion value in patients. *p-value<0.05; **p-value<0.01; ***p-value<0.001.

Abbreviations: ROI, regions of interest; LSCI, laser speckle contrast imaging.

occurrences in winter (Dec, Jan, Feb), possibly due to temperature differences indoors and outdoors inducing changes in blood flow. Burning is more likely to occur during the afternoon, the most active period, rather than at night or during deep sleep, providing evidence that changes in facial blood flow can lead to burning.

In the detection of facial blood perfusion, we defined two regions of interest (ROIs). Rosacea patients with burning showed the highest blood perfusion levels among the three groups. This somewhat indicates a correlation between burning sensations and increased facial blood perfusion, which aligns with the factors such as temperature reflected in our questionnaire that can influence facial blood flow and trigger burning sensations. Unfortunately, due to limitations in the outpatient conditions, we were unable to measure facial blood perfusion in the same patients during the occurrence and non-occurrence of burning sensations. Although we matched the baseline information and conditions of patients within the same group, there still exists a possibility of bias.

While our findings demonstrate that increased facial blood perfusion is associated with burning sensations in rosacea, it is important to acknowledge that vascular changes alone may not fully explain the pathogenesis of these subjective symptoms. Emerging evidence highlights neurogenic mechanisms as critical contributors to the sensory disturbances in rosacea, particularly burning and stinging sensations. Neurogenic rosacea (NR), a distinct subtype, is characterized by abnormal activation of cutaneous sensory nerve endings, where TRPA1, TRPV1, and TRPV4 channels trigger the release of vasoactive neuropeptides such as substance P, calcitonin gene-related peptide (CGRP), and pituitary adenylate cyclase-activating polypeptide (PACAP). These neuropeptides not only exacerbate vascular dilation but also directly sensitize nerve fibers, leading to heightened perception of pain and burning. Future research should integrate vascular assessments with neurophysiological measurements and molecular profiling of neuropeptides to dissect the complex interplay between vascular, neural, and immune pathways. Such multi-dimensional approaches may explain why conventional vascular-targeted therapies often fail to alleviate burning symptoms in neurogenic rosacea subtypes, supporting the need for neuro-modulatory interventions.

In addition to vascular and neurogenic factors, impaired skin barrier function represents another critical contributor to rosacea pathogenesis—one that warrants integration into the interpretation of our findings, particularly given patient reports of winter as the peak season for burning sensations. Rosacea skin is well-documented to exhibit structural and functional barrier defects, including reduced levels of stratum corneum ceramides, disorganized lipid lamellae, and increased transepidermal water loss (TEWL). Notably, the seasonal pattern of burning symptoms reported in our study—peaking in winter—aligns with the known impact of cold/dry climates on barrier function. In winter, low ambient humidity accelerates transepidermal water loss, further disrupting the stratum corneum's lipid structure; cold temperatures also trigger vasoconstriction followed by rebound vasodilation, which, when combined with a compromised barrier, exacerbates irritation and burning. This interplay helps explain why even mild vascular changes may manifest as more severe subjective symptoms in patients with impaired barriers: the damaged barrier lowers the threshold for irritant-induced inflammation, linking structural skin defects to both vascular hyperreactivity and sensory hypersensitivity. A key limitation of our current study is the lack of direct assessments of skin barrier function, such as measurements of TEWL, stratum corneum hydration, or ceramide composition. Without these data, we cannot fully disentangle the relative contributions of barrier impairment, vascular dysfunction, and neurogenic activation to burning sensations. Future research should incorporate these barrier-related metrics, alongside vascular and neural markers, to build a more comprehensive model of rosacea pathophysiology—especially in the context of seasonal environmental triggers. Such an approach may also inform targeted interventions, such as barrier-repairing moisturizers combined with vascular or anti-inflammatory therapies, to better alleviate winter-specific burning symptoms.

In this study, we explored the occurrence characteristics of burning sensation in rosacea and its potential association with facial blood flow. Existing rosacea research often takes the alleviation of visible symptoms as evidence of improvement, while patients' subjective sensations are sometimes overlooked due to the lack of consistent assessment criteria. Our findings highlight the importance of prioritizing these invisible subjective symptoms: they not only fill a gap in current rosacea research but also serve as a starting point for future studies, such as developing standardized tools for subjective symptom assessment or delving into their underlying mechanisms. This focus will help enhance the comprehensiveness of rosacea diagnosis and treatment, ultimately better addressing patients' actual discomfort beyond visible manifestations.

Ethics Statement

This study was reviewed and approved by the Medical Ethics Committee of West China Hospital, Sichuan University (ID: 2024–2499). All procedures involved in this study were conducted in strict compliance with the principles outlined in The Code of Ethics of the World Medical Association (Declaration of Helsinki). All eligible participants were fully informed and the intended use of study-related figures for academic publication. All participants voluntarily provided written informed consent, including explicit consent for the publication of de-identified figures derived from this study in peer-reviewed journals or academic conferences.

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Disclosure

The authors report no conflicts of interest in this work.

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