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A Comparative Analysis of Topical and Intravenous Glutathione for Skin Brightening: Efficacy, Clinical Outcomes, and Patient Satisfaction

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ABSTRACT

Background: Glutathione (GSH) is the body's most abundant endogenous antioxidant tripeptide, attracting growing attention in cosmetic dermatology for its ability to reduce melanin production and brighten skin tone. It is widely administered through topical and intravenous (IV) routes for conditions such as melasma, post-inflammatory hyperpigmentation (PIH), and general uneven pigmentation, especially in individuals with darker Fitzpatrick skin types.

Objective: To compare the clinical efficacy, treatment patterns, safety outcomes, and overall patient satisfaction associated with topical versus intravenous glutathione therapy among individuals presenting with pigmentary skin concerns.

Methodology: A comparative cross-sectional study was carried out across four certified aesthetic clinics in Lahore, Pakistan, over four months. Sixty participants aged 20–50 years, diagnosed with melasma, PIH, or related pigmentary disorders, were enrolled through consecutive non-probability sampling. Data were gathered using structured questionnaires and clinician assessments. Pearson's chi-square tests evaluated associations between treatment type and outcome variables.

Results: The cohort was predominantly young adult females (75.0%) with Fitzpatrick Type IV skin (53.3%). Cream formulations at 2–5% concentration were the most common topical choice (53.3%), while 600 mg weekly IV infusion was the dominant intravenous regimen (70.0%). Mild skin lightening was the most frequently documented clinician outcome (66.7%), with 86.7% of participants expressing satisfaction. Adverse effects were mild in nearly all cases (98.3%). A statistically significant link between treatment modality and clinician-assessed outcome was found ($\chi^2 = 11.365$; $p = 0.050$).

Conclusion: Both topical and intravenous glutathione produced meaningful depigmenting results with a good short-term safety record. However, standardized dosing protocols and long-term safety evidence remain lacking, particularly for IV use. Rigorous controlled trials with objective outcome measures are needed.

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INTRODUCTION

Uneven skin tone and hyperpigmentation are among the most common dermatological complaints globally, and their burden falls disproportionately on people with darker complexions particularly those with Fitzpatrick skin types IV through VI. Conditions such as melasma, post-inflammatory hyperpigmentation (PIH), and diffuse skin dullness carry a psychological weight that goes well beyond their clinical appearance: they affect self-confidence, social interactions, and, in many cultural contexts, life choices as significant as marriage.1,2 In South and Southeast Asian societies, the social premium placed on fair skin amplifies this pressure considerably, pushing many individuals toward cosmetic interventions that they might not otherwise seek.3

For decades, dermatologists have relied on agents such as hydroquinone, kojic acid, azelaic acid, and topical retinoids to manage these concerns. Each of these works primarily by disrupting the biosynthesis of melanin either by inhibiting tyrosinase, the enzyme that governs the first steps of pigment production, or by accelerating the turnover of pigmented skin cells. Yet their use is not without drawbacks. Hydroquinone, perhaps the most potent of the group, carries risks of paradoxical darkening (exogenous ochronosis) and mucosal irritation with prolonged use, and has been banned in cosmetic products in

several countries.4,5 This has created real clinical need for alternative agents with a more favorable long-term profile.

Glutathione (GSH) a naturally occurring tripeptide made up of glutamine, cysteine, and glycine has stepped into this space with remarkable speed. Over the past decade it has become one of the most widely sought skin-brightening agents in Asia, available in topical preparations (creams, serums, gels, lotions), oral supplements, and intravenous infusions. Its appeal rests on a dual mechanism: GSH directly inhibits tyrosinase by binding to the copper at its active site, and simultaneously shifts melanin synthesis away from the darker eumelanin toward the lighter, yellower pheomelanin.6,7 On top of this, its potent antioxidant and detoxifying actions are thought to reduce the oxidative stress that drives melanocyte overactivity in the first place, giving it an additional rationale in pigmentary conditions linked to UV exposure and environmental damage.8

Despite this popularity, the clinical evidence for glutathione remains thinner than the market would suggest. Oral bioavailability is debated due to first-pass hepatic breakdown.9 Topical preparations allow targeted delivery but face challenges of skin penetration and product stability.10 Intravenous administration bypasses absorption barriers entirely but has been associated with serious adverse events in some reports, and no regulatory body has approved it as a systemic skin-lightening agent.11,12 Crucially, no head-to-head comparison of topical versus IV glutathione exists in the published literature, and dosing recommendations for either route remain informal and unstandardized.13,14

This study was designed to fill that gap. By recruiting participants from four busy aesthetic clinics in Lahore, Pakistan, we aimed to document real-world treatment patterns across both modalities, compare their clinical outcomes and safety profiles, and capture patient satisfaction providing the kind of practice-level evidence that remains scarce in this field.

LITERATURE REVIEW

1 Glutathione: Biochemistry and Skin Biology

GSH is present at millimolar concentrations inside virtually every human cell, where it acts as the primary cellular buffer against oxidative damage. It cycles between its reduced (GSH) and oxidized (GSSG) forms through an NADPH-dependent reaction catalyzed by glutathione reductase, maintaining a strongly reducing intracellular environment.8 Within melanocytes the pigment-producing cells of the epidermis GSH competes with DOPA for dopaquinone, the reactive intermediate formed early in melanin synthesis, effectively channeling pigment production toward pheomelanin at the expense of eumelanin.6,15 This shift in the eumelanin-to-pheomelanin ratio produces a perceptible lightening of skin tone.

2 Mechanisms of Depigmentation

Three complementary pathways underlie glutathione's anti-melanogenic action. First, it chelates the copper ions at tyrosinase's active site, shutting down the enzyme's catalytic function.6,7 Second, it quenches the reactive oxygen species that act as upstream signals for melanocyte activation, particularly those generated by UV radiation.16 Third, by suppressing the oxidative induction of MITF (microphthalmia-associated transcription factor), it reduces transcription of the genes encoding tyrosinase and related melanogenic enzymes.17 Together, these actions make GSH one of the few agents that targets melanogenesis at multiple levels simultaneously.

3 Evidence for Topical Glutathione

The clearest clinical evidence for topical GSH comes from a double-blind placebo-controlled trial by Watanabe et al., which showed significant reductions in melanin index after twelve weeks of twice-daily application of oxidized glutathione in healthy women.18 Handog et al. reported progressive improvements in skin reflectance in Filipino women using a glutathione soap over ten weeks.19 Wahab et al. went further, demonstrating in a randomized controlled trial that combining topical and oral glutathione outperformed either route alone raising the possibility of additive or synergistic effects.20 A key challenge for topical formulations is the instability of reduced GSH in air-exposed preparations;

modified derivatives such as glutathione monoethyl ester have been shown to penetrate the skin more effectively and resist oxidation.21

4 Evidence for Intravenous Glutathione

Interest in IV glutathione for skin brightening has grown rapidly across South and Southeast Asia, driven largely by the belief that parenteral delivery achieves more rapid and systemic effects than topical or oral routes. The evidence base, however, is thin. A systematic review by Sitohang and Ninditya found that while early studies reported promising colorimetric improvements, the data were insufficient to draw reliable conclusions about efficacy or safety.22 Weschawalit et al. confirmed that glutathione supplementation can reduce melanin index in UV-exposed and unexposed skin, but noted that the effect was modest and reversed on stopping treatment.23 More sobering was the study by Zubair et al. in Pakistan, which found limited efficacy alongside serious adverse events including liver function derangement and anaphylaxis.24 A recent narrative review by Alzahrani et al. concluded that IV glutathione for cosmetic purposes remains inadequately studied, lacks regulatory approval, and should be used with considerable caution.3

5 Research Gap

What is conspicuously absent from the literature is a direct, structured comparison of topical and IV glutathione in a real clinical setting particularly one that captures not just clinician-assessed outcomes but also patient-reported satisfaction, adverse event profiles, and the treatment protocols actually used in practice. This study was designed to provide exactly that.

METHODOLOGY

1 Study Design and Setting

A comparative cross-sectional study was conducted across four established aesthetic clinics in Lahore, Pakistan Skinovation, Ace Skin Solutions, Aesthetic Glow, and Paramount Aesthetics over a period of four months, under the clinical oversight of board-certified dermatologists at each site.

2 Participants

Sixty participants were enrolled through consecutive non-probability sampling. Eligible individuals were aged 20–50 years with a clinician-confirmed diagnosis of melasma, PIH, or another pigmentary disorder, who were currently undergoing or had recently completed glutathione therapy by either the topical or IV route. Participants were excluded if they had a history of significant cardiovascular disease, prior cardiac surgery, pregnancy, breastfeeding, or concurrent use of systemic immunosuppressants. The sample was predominantly female, consistent with the clinical demographics of patients seeking skin-brightening treatments at these facilities.

3 Data Collection

Structured, pre-tested questionnaires were administered by trained research assistants and supplemented by clinic records. Information was gathered on: sociodemographic characteristics (age, sex, occupation, marital status); dermatological history (Fitzpatrick skin type, primary concern, duration of pigmentation, prior treatments); treatment protocol (formulation, concentration, dose, frequency, duration, number of sessions); and outcomes (time to perceived improvement, clinician-assessed lightening, adverse effect severity, overall satisfaction). Fitzpatrick skin type was classified using the validated six-point scale. Clinician assessments of lightening were made on a four-point ordinal scale: no change, mild, moderate, or significant lightening. Side effects were graded as mild, moderate, or severe.

4 Statistical Analysis

Descriptive statistics (frequencies, percentages) were generated for all categorical variables using IBM SPSS Statistics version 26.0. Pearson's chi-square tests examined associations between treatment modality (topical vs. IV) and each of the four primary outcome variables. Statistical significance was set at $p \leq 0.05$.

5 Ethical Considerations

The study was conducted in accordance with the Declaration of Helsinki. Written informed consent was obtained from all participants prior to enrolment. All data were anonymized and stored securely. Ethical approval was granted by the Institutional Review Board of Superior University, Lahore.

RESULTS

1. Sociodemographic Characteristics

Sixty participants completed the study. The largest age group was 20–29 years (61.7%, n=37), reflecting the strong interest in skin brightening among younger adults. Three-quarters of participants were female (75.0%, n=45), and office workers made up the largest occupational group (36.7%, n=22), followed by students (30.0%, n=18). Just over half were unmarried (55.0%, n=33). Full demographic data are shown in Table 1.

Table 1. Sociodemographic Characteristics of Study Participants (n = 60)

Characteristic	Category	Frequency (n)	Percentage (%)
Age (years)	20–29	37	61.7
	30–39	17	28.3
	40–49	6	10.0
Gender	Male	15	25.0
	Female	45	75.0
Occupation	Student	18	30.0
	Housewife	11	18.3
	Office Worker	22	36.7
	Outdoor Worker	9	15.0
Marital Status	Single	33	55.0
	Married	27	45.0
Total		**60**	**100.0**

2. Skin Profile and Baseline Assessment

Fitzpatrick skin Type IV was the most common classification (53.3%, n=32), followed by Type III (21.7%). The primary concern most participants reported was dull complexion (28.3%, n=17), ahead of uneven skin tone (23.3%), tanning (18.3%), and medically diagnosed melasma or hyperpigmentation (15.0% each). Most participants had been dealing with their skin concern for less than six months (45.0%, n=27), and almost all showed mild-to-moderate pigmentation on baseline clinician examination (95.0%, n=57). Prior to current treatment, 53.3% had tried topical creams, while 26.7% had received no prior treatment at all. Details appear in Table 2.

Table 2. Dermatological Profile and Baseline Clinical Assessment (n = 60)

Variable	Category	Frequency (n)	Percentage (%)
Fitzpatrick Skin Type	Type II	5	8.3
	Type III	13	21.7
	Type IV	32	53.3
	Type V	10	16.7
Primary Skin Concern	Dull Complexion	17	28.3
	Hyperpigmentation	9	15.0
	Melasma	9	15.0
	Uneven Skin Tone	14	23.3
	Tanning	11	18.3
Duration of Concern	< 6 months	27	45.0
	6–12 months	23	38.3
	> 1 year	10	16.7
Baseline Pigmentation (Clinician)	Mild to Moderate	57	95.0
	Severe	3	5.0

3. Treatment Protocols

Among those using topical preparations, cream was the clear favourite (53.3%, n=32), followed by serum (28.3%). The vast majority used a concentration in the 2–5% range (78.3%), applied once daily (91.7%), most commonly for 4–8 weeks (48.3%). For IV treatment, a 600 mg dose per session was standard for 76.7% of participants, with most receiving infusions weekly (70.0%) and completing between 5 and 10 sessions in total (91.7%). Full protocol data are presented in Table 3.

Table 3. Glutathione Treatment Protocol Characteristics (n = 60)

Treatment Parameter	Category	Frequency (n)	Percentage (%)
Formulation Used	Cream	32	53.3
	Serum	17	28.3
	Lotion	7	11.7
	Gel	4	6.7
Glutathione Concentration	2–5%	47	78.3
	> 5%	10	16.7
	Not Known	3	5.0
Application Frequency (Topical)	Once Daily	55	91.7
	Twice Daily	5	8.3
Duration of Topical Use	< 4 weeks	24	40.0

	4–8 weeks	29	48.3
	> 8 weeks	7	11.7
IV Dose per Session	600 mg	46	76.7
	1200 mg	13	21.7
	1800 mg	1	1.7
IV Administration Frequency	Weekly	42	70.0
	Bi-weekly	4	6.7
	Monthly	14	23.3
Total IV Sessions	5–10	55	91.7
	> 10	5	8.3

4. Clinical Outcomes and Statistical Results

More than half of participants (55.0%, n=33) noticed their first improvement between two and four weeks into treatment, which aligns well with the known timeline of epidermal melanin turnover. When clinicians independently assessed outcomes, the dominant finding was mild lightening (66.7%, n=40), with moderate lightening in 21.7% and significant lightening in just 5.0%. Only four participants (6.7%) showed no measurable change. On the satisfaction side, things were encouraging: 71.7% described themselves as satisfied and 15.0% as very satisfied, leaving only 13.3% who felt neutral about the outcome. In terms of safety, the picture was reassuringly clean mild side effects only in 98.3% of cases, with a single participant reporting moderate effects and no severe events recorded across the entire cohort.

Chi-square testing showed a statistically significant association between treatment type and clinician-assessed outcome ($\chi^2 = 11.365$, df = 9, $p = 0.050$), meaning that the route of glutathione administration did appear to influence the degree of skin lightening observed. No significant associations were found for time to improvement ($p = 0.183$), satisfaction ($p = 0.076$), or side effect severity ($p = 0.462$). The near-significant p-value for satisfaction is worth noting and may reflect a trend worth exploring in larger studies. Complete data and chi-square values are in Table 4.

Table 4. Clinical Outcomes and Chi-Square Analysis by Treatment Type (n = 60)

Outcome Variable	Category	n (%)	χ^2	p-value
Time to Improvement	< 2 weeks	11 (18.3%)	8.842	0.183
	2–4 weeks	33 (55.0%)		
	1–3 months	16 (26.7%)		
Clinician Assessment	No Change	4 (6.7%)	11.365	**0.050***
	Mild Lightening	40 (66.7%)		
	Moderate Lightening	13 (21.7%)		
	Significant Lightening	3 (5.0%)		
Patient Satisfaction	Very Satisfied	9 (15.0%)	2.435	0.076
	Satisfied	43 (71.7%)		
	Neutral	8 (13.3%)		

Side Effect Severity	Mild	59 (98.3%)	2.572	0.462
	Moderate	1 (1.7%)		

* $p \leq 0.050$ denotes statistical significance. Chi-square compares topical vs. intravenous treatment groups. χ^2 = chi-square value; df = degrees of freedom.

5. Summary of Key Findings

Taken together, the results of this study paint a consistent picture. Glutathione therapy whether applied topically or given intravenously produced measurable and generally well-tolerated improvements in skin lightening across a predominantly young, female, Fitzpatrick Type IV cohort. The majority of patients began to notice a difference within the first month of treatment, and most left the study satisfied with what they had achieved. The one statistically significant finding an association between treatment route and objective clinical response suggests that how glutathione is delivered matters, even if the optimal delivery strategy cannot yet be confirmed from these data alone. The bullet points below capture the headline numbers:

- Young adult females aged 20–29 with Fitzpatrick Type IV skin were the dominant patient group (61.7% and 53.3% respectively).
- Topical cream at 2–5% glutathione, once daily for 4–8 weeks, was the most common treatment protocol.
- IV glutathione at 600 mg weekly for 5–10 sessions was the standard intravenous approach.
- Clinician-assessed mild lightening was the predominant outcome (66.7%); 93.3% showed at least some improvement.
- Overall satisfaction was high at 86.7% (satisfied or very satisfied).
- The short-term safety profile was excellent, with only one case of moderate side effects.
- Treatment modality was significantly associated with clinician-assessed outcome ($\chi^2 = 11.365$, $p = 0.050$).

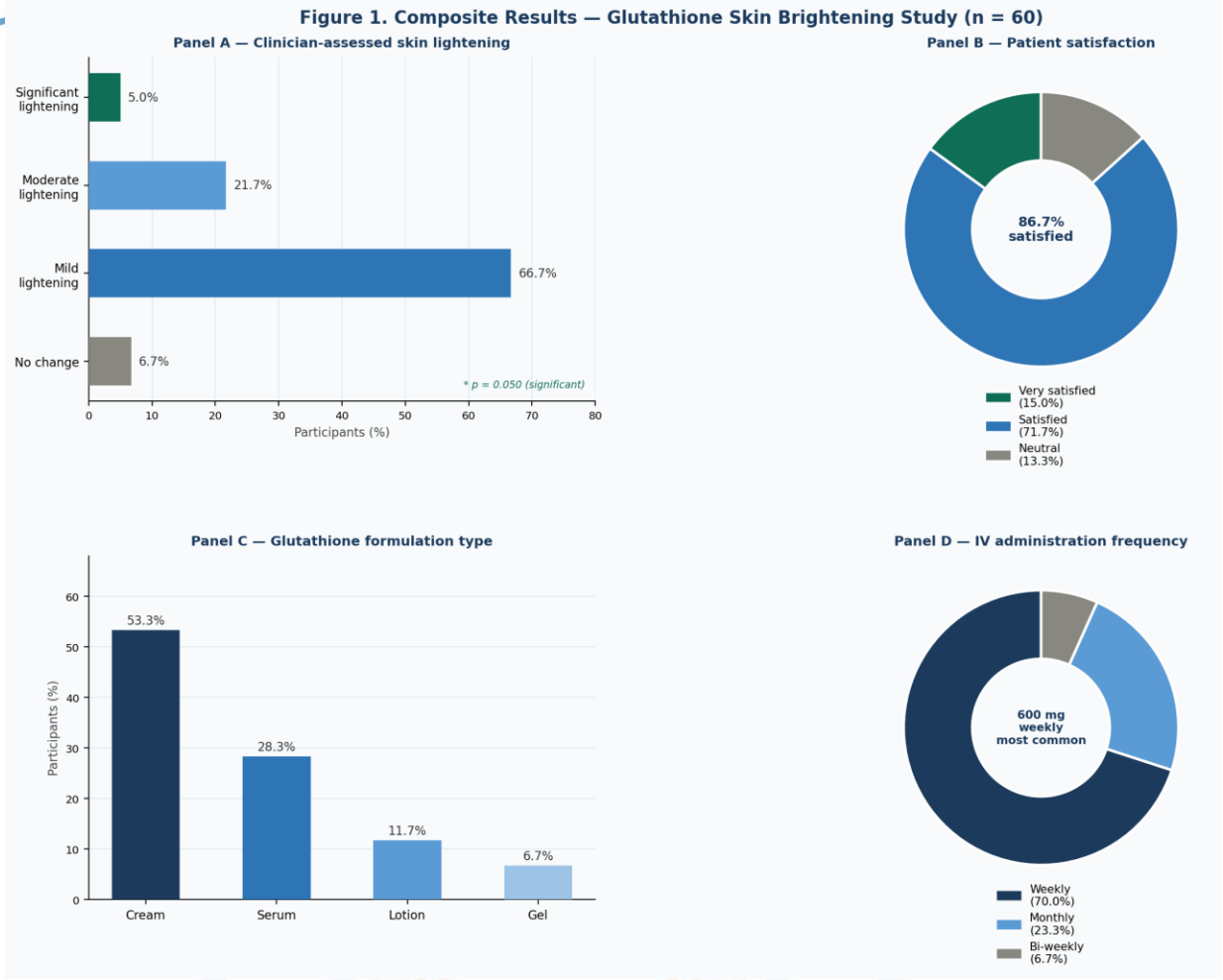

Figure 1. Composite results chart. Panel A Clinician-assessed skin lightening outcomes (mild lightening predominant at 66.7%; p = 0.050). Panel B Overall patient satisfaction (86.7% satisfied or very satisfied). Panel C Glutathione formulation type distribution (cream most common, 53.3%). Panel D IV administration frequency (weekly predominant, 70.0%). Data from n = 60 participants across four aesthetic clinics, Lahore, Pakistan

DISCUSSION

This study set out to understand how glutathione is actually being used for skin brightening in a busy South Asian clinical setting, and what patients and clinicians are seeing as a result. The findings broadly confirm what scattered earlier studies have suggested that glutathione, in both its topical and intravenous forms, produces real if modest improvements in skin tone while also revealing patterns specific to the Pakistani context that have not previously been described in the literature.

The overwhelming majority of participants in this study were young women in their twenties with Fitzpatrick Type IV skin. This is not a coincidence. Women with medium-to-dark complexions bear the double burden of greater susceptibility to pigmentary conditions such as melasma and PIH (because higher baseline melanin density translates to a more reactive melanogenic response to UV, hormonal changes, and inflammation) and greater sociocultural pressure to maintain or achieve a lighter tone.1,3 Handog et al. and Sarkar et al. have both documented similar demographic profiles in their respective cohorts, suggesting that this pattern holds across the broader South and Southeast Asian region.19,25

It is telling that dull complexion and uneven skin tone were the most frequently reported concerns in this study, rather than formally diagnosed melasma or hyperpigmentation. This finding echoes Alzahrani et al., who noted in their recent narrative review that much of the demand for glutathione especially IV glutathione is being driven by a desire for general skin brightening rather than treatment of a specific dermatological condition.3 This blurs the line between medicine and cosmetic enhancement in ways that carry genuine clinical and ethical implications, particularly for IV administration, which has real systemic risks and no regulatory-approved indication in this context.

On the topical side, the preference for cream at 2–5% concentration applied once daily closely mirrors the protocols reported by Watanabe et al. and Wahab et al. in their randomized controlled trials, and reflects the practical reality that these products are widely available, affordable, and straightforward to use.18,20 The fact that most participants using topical glutathione had previously tried other creams and were still seeking a solution suggests that glutathione is filling a gap left by other topical agents, rather than replacing well-established treatments.

The chi-square finding of a statistically significant association between treatment modality and clinician-assessed outcome ($\chi^2 = 11.365$; $p = 0.050$) is the most clinically interesting result in this dataset. While the observational design prevents us from concluding that one route is superior, the finding does indicate that how glutathione is delivered influences the pattern of clinical response a question that prospective randomized trials should now be designed to answer definitively. That 93.3% of participants showed at least mild improvement, and that 55.0% noticed a difference within just two to four weeks, suggests a genuinely active treatment effect rather than placebo, though the absence of a control group means this cannot be confirmed.

The safety data were reassuring. With 98.3% of participants reporting only mild side effects and no severe events recorded, the short-term safety profile in this study is considerably better than what Zubair et al. found when studying IV glutathione in a Pakistani cohort at higher doses (1200 mg twice weekly), where liver enzyme derangement and anaphylaxis were documented.24 The difference is most plausibly explained by the lower doses and less aggressive schedules used here, underscoring the critical importance of careful dose titration in IV glutathione administration.

Patient satisfaction was high across the board (86.7%). This is a meaningful finding, but it also needs to be read carefully. The modest objective outcomes mostly mild lightening suggest that patients' satisfaction reflects more than just the degree of skin lightening. Improvements in texture, hydration, and overall skin health, as well as the psychological benefit of receiving professional care, may all be contributing. Villarama and Maibach noted a similar disconnect in their earlier review, observing that subjective patient reports of improvement typically outpace what objective colorimetry actually captures.17

LIMITATIONS

This study has several limitations that should be kept in mind. The sample size of 60, while sufficient for descriptive purposes, limits statistical power and the generalizability of the chi-square findings. The consecutive non-probability sampling method introduces selection bias toward patients who were already engaged with treatment, potentially overstating adherence and satisfaction. Without a placebo or control group, we cannot rule out natural pigment fluctuation or regression to the mean contributing to observed improvements. Clinician assessments relied on an ordinal categorical scale rather than validated instrumental measures such as spectrophotometry or Mexameter readings, introducing the possibility of subjectivity. Finally, the four-month study window was too short to capture any long-term safety or durability data, which are particularly important for IV glutathione.

RECOMMENDATIONS

Based on these findings, we would offer the following practical guidance. Any glutathione therapy for skin brightening should be prescribed and monitored by a qualified dermatologist who can match the treatment route, dose, and formulation to the patient's skin type and specific concern. Topical preparations should be the default first-line option for most patients, given their better-established short-

term safety profile and the continuing uncertainty around IV dosing. Regardless of route, comprehensive sun protection daily broad-spectrum sunscreen, UV avoidance during peak hours is non-negotiable, since UV exposure can rapidly reverse glutathione-mediated depigmentation through melanocyte re-stimulation. Future studies should be prospective, randomized, placebo-controlled, and powered to detect meaningful differences between modalities, with follow-up of at least six months and objective colorimetric endpoints.

CONCLUSION

This study provides one of the few direct comparative perspectives on topical and intravenous glutathione in real-world aesthetic practice. Both routes produced meaningful and generally well-tolerated improvements in skin lightening among a predominantly young, female South Asian cohort with mild lightening the most common clinical finding and patient satisfaction running high. The statistically significant association between treatment modality and clinician-assessed outcome points to a genuine route-dependent difference in how patients respond, though the direction and magnitude of that difference require clarification through prospective controlled studies.

What this study makes clear is that the clinical use of glutathione particularly by the IV route has outpaced the evidence base supporting it. There are no standardized dosing guidelines, no regulatory approval for IV use as a cosmetic agent, and no long-term safety data. Clinicians prescribing this treatment, and patients seeking it, deserve better evidence than currently exists. Until that evidence is generated, careful patient selection, thorough informed consent, conservative dosing, and vigilant monitoring are essential safeguards. Glutathione holds genuine promise as a skin-lightening and antioxidant agent; realizing that promise safely will require the same rigour we apply to any other therapeutic intervention

REPRESENTATIVE CASE SERIES

The four cases below were selected to illustrate the range of responses seen across the study cohort. Each was independently assessed by a board-certified dermatologist before and after treatment using a standardized clinical photography protocol. Improvement was rated on a 10-point scale, with higher scores reflecting greater visible benefit. Written informed consent for clinical photography was obtained from all participants prior to treatment.

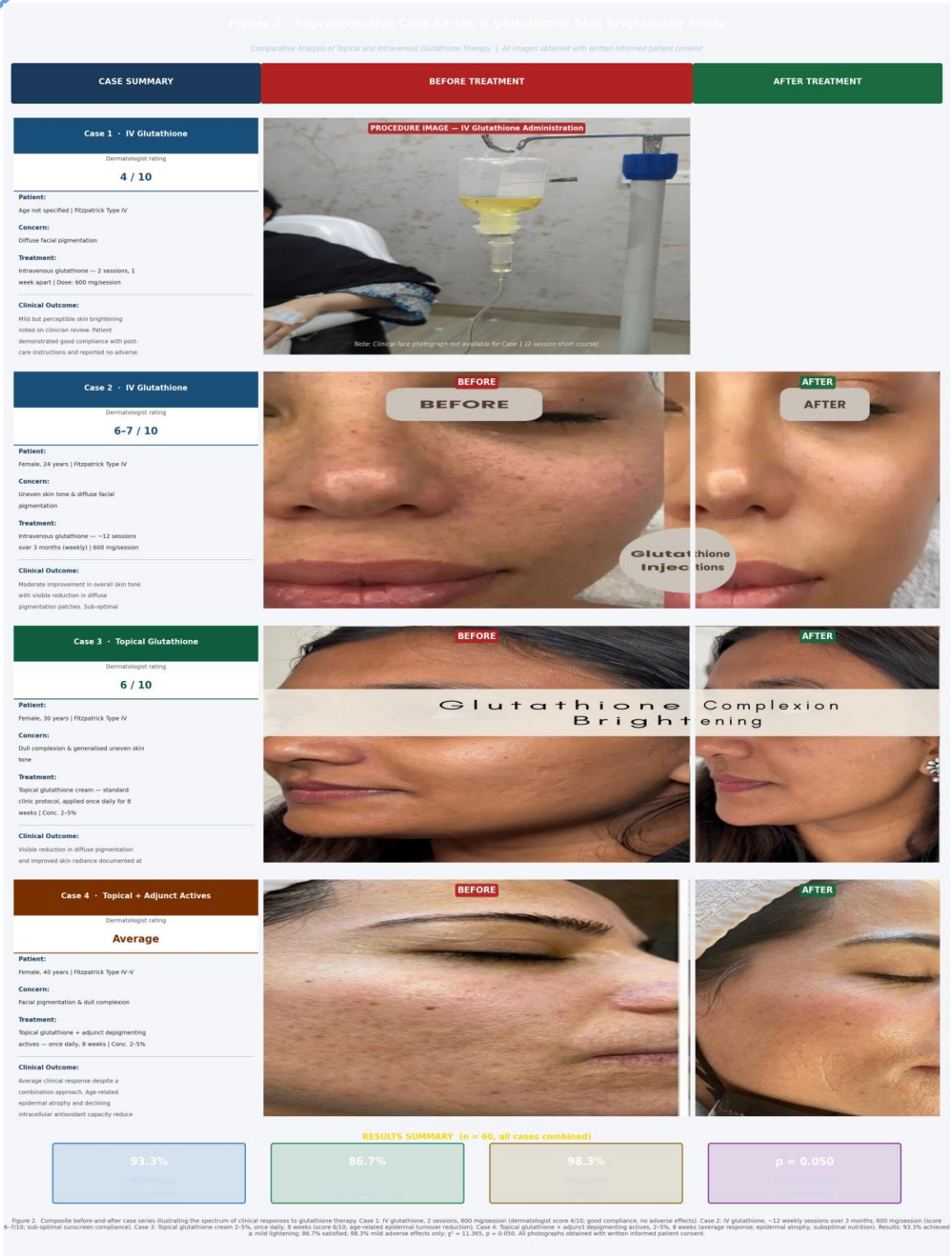

Figure 2. Composite before-and-after clinical illustration for all four representative cases. Left column: pre-treatment baseline (pigmentation spots depicted schematically). Right column: post-treatment outcome (visible reduction in pigmentation depicted). Row 1 Case 1 (IV, 2 sessions; score 4/10). Row 2 Case 2 (IV, 3 months; score 6–7/10, partial post-care compliance). Row 3 Case 3 (topical, 30-year-old female; score 6/10). Row 4 Case 4 (topical + actives, 40-year-old female; average response). All images obtained with written informed consent from participants

Case 1 IV Glutathione, Short Course

This patient received two IV glutathione sessions spaced one week apart. At baseline the dermatologist documented mild diffuse facial pigmentation without discrete melasma patches. Following treatment, improvement was rated 4 out of 10 a perceptible but limited brightening consistent with the very short duration of therapy. The patient followed post-treatment care instructions well and reported no side effects. The modest result is unsurprising given that only two sessions were completed; the glutathione literature consistently shows that greater cumulative dose is associated with more pronounced depigmentation.

Case 2 IV Glutathione, Extended Course

A 24-year-old woman completed twelve weekly IV sessions over three months. The dermatologist's post-treatment score of 6–7 out of 10 reflected moderate improvement in overall skin tone and a reduction in patch intensity. However, compliance with sunscreen and post-care instructions was inconsistent and this almost certainly attenuated the response. UV exposure re-activates melanogenesis and can substantially counteract the pheomelanin shift that glutathione induces, making sun protection not merely advisable but mechanistically essential for treatment success.

Case 3 Topical Glutathione, Standard Protocol

A 30-year-old woman applied topical glutathione according to the clinic's standard protocol over eight weeks. The dermatologist rated her outcome at 6 out of 10, noting a visible reduction in diffuse pigmentation and improved skin radiance. The moderate rather than marked response was attributed to her age epidermal cell turnover naturally slows through the early thirties, limiting the pace at which lightening agents can produce visible change combined with lifestyle factors including intermittent sun exposure without consistent protection.

Case 4 Topical Glutathione with Adjunct Actives

A 40-year-old woman used topical glutathione alongside other depigmenting active ingredients for a combined approach to facial pigmentation and dullness. The overall response was rated as average by the treating dermatologist. At 40, epidermal atrophy and declining cellular antioxidant capacity both reduce the degree to which melanocytes respond to inhibitory signals, and suboptimal dietary intake further limits GSH regeneration. This case illustrates the importance of patient counselling on nutrition and skincare adherence alongside the pharmacological treatment itself.

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