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Impact of Aesthetic Treatments on Self-Esteem in Females with Body Dysmorphic Disorder: A Cross-Sectional Comparative Study

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ABSTRACT

Background: The cosmetic application of glutathione (GSH) for skin tone lightening has expanded substantially across aesthetic and dermatological practices in recent years. Although glutathione is a well-characterised endogenous antioxidant with established therapeutic roles in oxidative stress management, hepatoprotection, and chemotherapy-induced toxicity, its off-label use for cosmetic depigmentation remains controversial, unsupported by robust clinical evidence, and largely unregulated in many jurisdictions.

Objective: This study critically examined the patterns of glutathione use for skin tone lightening among a sample of Pakistani users, evaluating perceived effectiveness, frequency and nature of adverse effects, and user awareness of associated safety and regulatory concerns across oral, topical, and intravenous routes of administration.

Methodology: A descriptive, cross-sectional study was conducted over four months at selected aesthetic clinics and dermatology practices in Lahore, Pakistan. A structured, pre-validated questionnaire was administered to 200 confirmed glutathione users. Data were analysed using SPSS v27, employing descriptive statistics, independent Chi-square tests, and Spearman correlation analyses.

Results: Females constituted 60.5% of users. The intravenous route was most frequently used (38.0%), followed by oral (26.0%) and topical (17.5%) administration. Most participants reported mild to moderate skin tone improvement (65%); however, 21.0% reported no appreciable benefit. Adverse effects were reported by 68.5% of respondents, with injection-site reactions (31.0%), nausea (21.0%), and liver-related complaints (12.5%) being most prevalent. Statistically significant associations were identified between gender and motivation for use ($\chi^2 = 29.34$, $p = 0.0004$) and education level and perceived improvement ($\chi^2 = 57.82$, $p = 0.0002$).

Conclusion: Although glutathione may confer modest, transient cosmetic benefits in some users, its effectiveness is inconsistent and its safety profile, particularly with intravenous administration, raises serious clinical and public health concerns. The findings underscore the urgent need for strengthened regulatory frameworks, evidence-based clinical guidelines, and enhanced consumer education surrounding the cosmetic use of glutathione

Keywords: Glutathione; Skin Tone Lightening; Cosmetic Dermatology; Tyrosinase Inhibition; Melanogenesis; Intravenous Therapy; Adverse Effects; Regulatory Concerns

INTRODUCTION

The pursuit of lighter skin tone represents a globally prevalent cosmetic concern, particularly among individuals of South Asian, East Asian, African, and Middle Eastern descent. In many sociocultural contexts, skin lightness has been historically associated with perceptions of attractiveness, social status, and economic opportunity, a phenomenon reinforced by media representations and deeply embedded colourism. Consequently, the global skin lightening market, valued at over USD 8.6 billion in 2021, continues to expand, driven by both topical agents and increasingly, systemic interventions [1,2].

Conventional topical depigmenting agents, including hydroquinone, kojic acid, azelaic acid, retinoids, and vitamin C derivatives, have long been the clinical standard for managing localised hyperpigmentation disorders such as melasma, post-inflammatory hyperpigmentation, and solar lentigines. However, these agents are associated with local adverse effects, including irritant and allergic contact dermatitis, paradoxical post-inflammatory hyperpigmentation, and, in the case of hydroquinone, concerns regarding exogenous ochronosis with prolonged use. Moreover, topical agents are inherently limited in their ability

to produce uniform or systemic skin tone lightening, which has fuelled interest in systemic approaches [3,4].

Glutathione (GSH; γ-L-glutamyl-L-cysteinylglycine) is the most abundant intracellular antioxidant in human physiology, with well-established roles in oxidative stress neutralisation, xenobiotic detoxification, immune modulation, and maintenance of cellular redox homeostasis. Its proposed mechanism of action in skin depigmentation involves two principal pathways: competitive inhibition of tyrosinase, the rate-limiting enzyme in melanogenesis, and a shift in the biosynthetic ratio from darker eumelanin to lighter pheomelanin via free radical scavenging within melanocytes [5,6].

Despite growing commercial popularity, the clinical evidence base for glutathione as a skin lightening agent remains heterogeneous and methodologically limited. Oral glutathione supplementation faces pharmacokinetic challenges, principally its susceptibility to gastrointestinal hydrolysis and hepatic first-pass metabolism, resulting in variable and generally low systemic bioavailability [7]. Topical formulations, while theoretically circumventing these bioavailability limitations, are hindered by glutathione's hydrophilic nature, high molecular weight, and poor penetration through the lipophilic stratum corneum [8]. Intravenous administration, although bypassing oral bioavailability constraints, carries the most significant safety risks and lacks regulatory approval for cosmetic indications in most countries [9,10].

In Pakistan, the rapid expansion of the aesthetic clinic industry, combined with limited regulatory enforcement and increasing societal pressure to achieve lighter skin tones, has created conditions in which intravenous glutathione is widely administered outside formal medical oversight. Reports of serious adverse events, including anaphylaxis, hepatotoxicity, renal impairment, and thyroid dysfunction, have been documented in case series and pharmacovigilance reports, yet demand continues to grow [11,12].

The present study was therefore designed to systematically evaluate glutathione use patterns, perceived efficacy, and adverse effect profiles among confirmed users in Lahore, Pakistan, while critically examining the scientific, ethical, and regulatory controversies surrounding its cosmetic application. The findings are intended to inform evidence-based guidance for dermatologists, aesthetic practitioners, regulatory authorities, and the general public.

LITERATURE REVIEW

1. Mechanisms of Glutathione in Skin Depigmentation

The skin lightening potential of glutathione is mechanistically grounded in its antioxidant and anti-melanogenic properties. Melanogenesis is initiated by the oxidation of L-tyrosine to L-DOPA and subsequently to dopaquinone, catalysed by tyrosinase. Glutathione competitively inhibits tyrosinase through chelation of its copper cofactor, thereby reducing eumelanin synthesis. Simultaneously, by scavenging reactive oxygen species that drive dopaquinone toward eumelanin, glutathione promotes the alternate sulphydryl pathway, redirecting melanin synthesis toward lighter pheomelanin [5,13].

2. Clinical Evidence by Route of Administration

Oral glutathione supplementation has been investigated in several RCTs with variable outcomes. A landmark multicenter RCT conducted in Indonesia demonstrated statistically significant reductions in melanin index scores following 8 weeks of oral glutathione (500 mg/day) combined with ascorbic acid, alpha-lipoic acid, and zinc aspartate [14]. However, standalone oral glutathione trials have generally demonstrated modest and heterogeneous results, likely attributable to inter-individual variation in intestinal glutathione transferase activity and hepatic first-pass metabolism [7,15].

Topical formulations have been evaluated in a growing body of literature. A systematic review published in the Journal of Clinical and Aesthetic Dermatology identified measurable reductions in melanin index and skin luminance with topical glutathione, though effect sizes were modest and study durations generally short [16]. Novel delivery systems including ethosomes, nanoemulsions, and ionic liquid technologies have been investigated to enhance transdermal penetration [8].

Intravenous glutathione remains the most controversial route. Despite widespread use in cosmetic clinics across South and Southeast Asia, no regulatory authority, including the US FDA, EMA, or Philippines FDA,

has approved intravenous glutathione for skin lightening indications. Published safety data describe serious adverse events including Stevens-Johnson syndrome, anaphylaxis, acute renal failure, and fatal sepsis attributable to contaminated preparations [9,10,11].

3. Safety Profile and Regulatory Landscape

A comprehensive narrative review published in Cureus in 2025 concluded that while glutathione has a favourable short-term safety profile for oral and topical use, intravenous administration in cosmetic settings poses unacceptable risks in the absence of medical supervision, standardised formulations, and post-market surveillance [1]. Regulatory agencies in the Philippines (2011), the United States (FDA advisory, 2020), and the United Kingdom (MHRA guidance, 2022) have issued warnings against non-medical intravenous glutathione administration [11].

In Pakistan, where no specific regulatory framework governs the cosmetic use of intravenous agents, glutathione drips and injections are freely available in aesthetic clinics with limited oversight. A study examining sociocultural factors influencing cosmetic treatment decisions in Pakistani women identified media exposure, peer influence, and colourism as primary drivers of treatment-seeking, with limited attention to safety considerations [2,12].

4. Research Gap and Rationale

Despite the burgeoning literature on glutathione in dermatology, few studies have comprehensively evaluated real-world use patterns, adverse event burden, and awareness levels among users in low-to-middle income countries, where regulatory infrastructure is often insufficient. The present study addresses this gap by providing empirical, survey-based data from a Pakistani clinical population, contributing to the global evidence base on glutathione safety and informing context-specific regulatory recommendations [17,18].

METHODOLOGY

1 Study Design and Setting

A descriptive, cross-sectional study was conducted over four months (February to May 2026) at selected dermatology clinics, aesthetic centres, and medical spas in Lahore, Pakistan. The study setting was chosen on the basis of documented high utilisation of glutathione-based cosmetic treatments in this urban clinical environment.

2 Ethical Considerations

Ethical approval was obtained from the Institutional Ethics Committee of Superior University, Lahore (Reference No. SUL-IEC-2026-04). All participants provided written informed consent prior to enrolment. Participation was entirely voluntary; participants were explicitly informed of their right to withdraw at any stage without consequence. Confidentiality was maintained throughout, and data were used exclusively for research purposes.

3 Participants and Sampling

The study enrolled 200 adult participants (≥18 years) who had used or were currently using glutathione for skin tone lightening via any route of administration. Non-probability consecutive sampling was employed. Participants with concurrent systemic illness that could confound pigmentary assessment or those unable to provide informed consent were excluded. The sample size was calculated using the single proportion formula ($n = z^2 \times P \times (1-P) / d^2$), with $z = 1.96$, $P = 0.60$, and $d = 0.07$, yielding a minimum required sample of 187, rounded up to 200 for analytical precision.

4 Data Collection Instrument

A structured, self-administered questionnaire was developed and pre-validated through content review by three consultant dermatologists and a biostatistician. The instrument captured: (i) sociodemographic data; (ii) glutathione use characteristics (route, duration, frequency, dosage, source); (iii) perceived effectiveness using a five-point categorical scale; (iv) adverse effects experienced; and (v) treatment discontinuation and reasons thereof. Pilot testing with 20 participants yielded a Cronbach's alpha of 0.81, indicating acceptable internal consistency.

5 Data Analysis

Data were analysed using SPSS version 27.0 (IBM Corp., Armonk, NY). Continuous variables are expressed as mean ± SD; categorical variables as frequencies and percentages. Associations were evaluated using the Pearson Chi-square test, with significance defined at $p < 0.05$ (95% CI). Spearman rank correlation was applied to ordinal variables. All tests were two-tailed.

RESULTS

A total of 200 participants were enrolled; all completed questionnaires (response rate 100%). Results are presented across demographic characteristics, usage patterns, perceived effectiveness, adverse effect burden, and analytical associations.

Table 1. Sociodemographic Characteristics of Study Participants (N = 200)

Characteristic	Category	n	Percentage (%)
Gender	Female	121	60.5
	Male	79	39.5
	Total	**200**	**100.0**
Education Level	Graduate	130	65.0
	Intermediate	54	27.0
	Postgraduate	6	3.0
	Graduate/Postgraduate	4	2.0
	Secondary	6	3.0
	Total	**200**	**100.0**
Skin Phototype	Fair (Type II)	71	35.5
	Medium (Type III)	71	35.5
	Very Fair (Type I)	20	10.0
	Dark (Type IV)	19	9.5
	Very Dark (Type V)	19	9.5
	Total	**200**	**100.0**

The sample comprised predominantly female participants (60.5%) with graduate-level education (65.0%). Fair and medium skin phototypes were equally represented (35.5% each).

The study enrolled 200 participants, of whom 121 (60.5%) were female and 79 (39.5%) were male, indicating a higher prevalence of glutathione use among women. The majority held graduate-level qualifications (n = 130; 65.0%), followed by intermediate education (n = 54; 27.0%), while postgraduate and secondary-level participants each constituted 3.0% of the sample. Regarding skin phototype, Fair (Type II) and Medium (Type III) skin tones were equally represented at 35.5% each, followed by Very Fair (Type I) at 10.0% and Dark (Type IV) and Very Dark (Type V) at 9.5% each. These findings indicate that glutathione use spans a broad educational and complexion spectrum, though it is most prevalent among educated women with fair to medium skin tones.

Table 2. Glutathione Usage Patterns among Study Participants (N = 200)

Variable	Category	n	Percentage (%)
Route of Administration	Intravenous	76	38.0
	Oral	52	26.0
	Topical	35	17.5
	Topical + Intravenous	35	17.5
	Oral + Topical	2	1.0
	Total	**200**	**100.0**
Duration of Use	> 6 months	80	40.0
	3–6 months	78	39.0
	1–3 months	32	16.0
	< 1 month	10	5.0
	Total	**200**	**100.0**
Frequency	Monthly	80	40.0
	Daily	52	26.0
	Biweekly	32	16.0
	Daily + Monthly	29	14.5
	Weekly	7	3.5
	Total	**200**	**100.0**
Primary Source	Doctor / Clinic	159	79.5
	Pharmacy	21	10.5
	Online	14	7.0
	Med-Spa	3	1.5
	Clinic + Pharmacy	3	1.5
	Total	**200**	**100.0**

Intravenous administration was the predominant route (38.0%). Most users sustained treatment beyond 3 months (79.0%). The majority sourced glutathione from doctors or clinics (79.5%).

Intravenous administration was the most frequently reported route (n = 76; 38.0%), followed by oral (n = 52; 26.0%) and topical (n = 35; 17.5%) use, with a further 17.5% using topical and intravenous routes in combination. The majority of participants were long-term users, with 40.0% reporting use exceeding six months and 39.0% reporting three to six months of use, meaning 79.0% had sustained treatment for more than three months. Monthly administration was the most common frequency (40.0%), followed by daily intake (26.0%). The primary source of glutathione was doctors or clinics in 79.5% of cases, with pharmacies (10.5%) and online platforms (7.0%) accounting for most of the remainder. This pattern reflects a clinically mediated but largely off-label practice sustained over prolonged periods.

Table 3. Reasons for Use and Perceived Effectiveness of Glutathione (N = 200)

Variable	Category	n	Percentage (%)
Primary Reason for Use	Fairness / Skin Lightening	61	30.5
	General Cosmetic Enhancement	56	28.0
	Fairness + Cosmetic	43	21.5
	Fairness + Cosmetic + Pigmentation	32	16.0
	Cosmetic + Pigmentation Only	8	4.0
	Total	**200**	**100.0**
Degree of Improvement	Mild	70	35.0
	Moderate	60	30.0
	None	42	21.0
	Very Mild	14	7.0
	Marked	14	7.0
	Total	**200**	**100.0**
Treatment Discontinuation	No (Continued)	105	52.5
	Yes (Discontinued)	95	47.5
	Total	**200**	**100.0**

Cosmetic enhancement and fairness were dominant motivations (58.5% combined). Most reported mild-to-moderate improvement (65.0%); 21.0% reported no benefit. Nearly half (47.5%) discontinued treatment.

Skin fairness was the single most cited motivation for glutathione use (n = 61; 30.5%), followed by general cosmetic enhancement (n = 56; 28.0%) and a combination of both (n = 43; 21.5%), indicating that aesthetic and fairness-related goals collectively drove the decision to use glutathione in over 80% of participants. Regarding perceived outcomes, mild improvement was the most commonly reported response (n = 70; 35.0%), followed by moderate improvement (n = 60; 30.0%), while 21.0% reported no appreciable benefit and only 7.0% described their improvement as marked. Treatment was discontinued by 95 participants (47.5%), suggesting that a substantial proportion of users found the outcomes either unsatisfactory or the adverse effects intolerable, underscoring the gap between user expectations and actual clinical benefit.

Table 4. Adverse Effects and Analytical Associations (N = 200)

Variable	Category	n	Percentage (%)
Adverse Effects (Any)	Yes	137	68.5
	No	63	31.5
	Total	**200**	**100.0**
Type of Adverse Effect*	Injection-site Reaction	62	31.0
	Nausea (any combination)	42	21.0
	Liver-related Complaints	25	12.5
	Fatigue (any combination)	23	11.5
	Multiple Combined Effects	42	21.0
	Allergy / Hypersensitivity	6	3.0
	Other	3	1.5
Analytical Associations	Gender × Reason for GSH Use	$\chi^2 = 29.34$, df = 4	p = 0.0004
	Education × Degree of Improvement	$\chi^2 = 57.82$, df = 16	p = 0.0002

* Not mutually exclusive; percentages on total N = 200. Adverse effects were reported by 68.5% of participants. Both demographic associations were statistically significant ($p < 0.001$).

A substantial majority of participants, 137 out of 200 (68.5%), reported experiencing at least one adverse effect during glutathione use. Injection-site reactions were most prevalent (n = 62; 31.0%), followed by nausea in any combination (n = 42; 21.0%), multiple concurrent adverse effects (n = 42; 21.0%), liver-related complaints (n = 25; 12.5%), and fatigue (n = 23; 11.5%), with allergy or hypersensitivity reactions reported in 3.0% of cases. Chi-square analysis revealed two statistically significant associations: gender was significantly associated with the reason for glutathione use ($\chi^2 = 29.34$, df = 4, p = 0.0004), and education level was significantly associated with the degree of perceived improvement ($\chi^2 = 57.82$, df = 16, p = 0.0002). These findings collectively highlight a high adverse effect burden and indicate that demographic factors meaningfully shape both motivations for use and treatment outcomes.

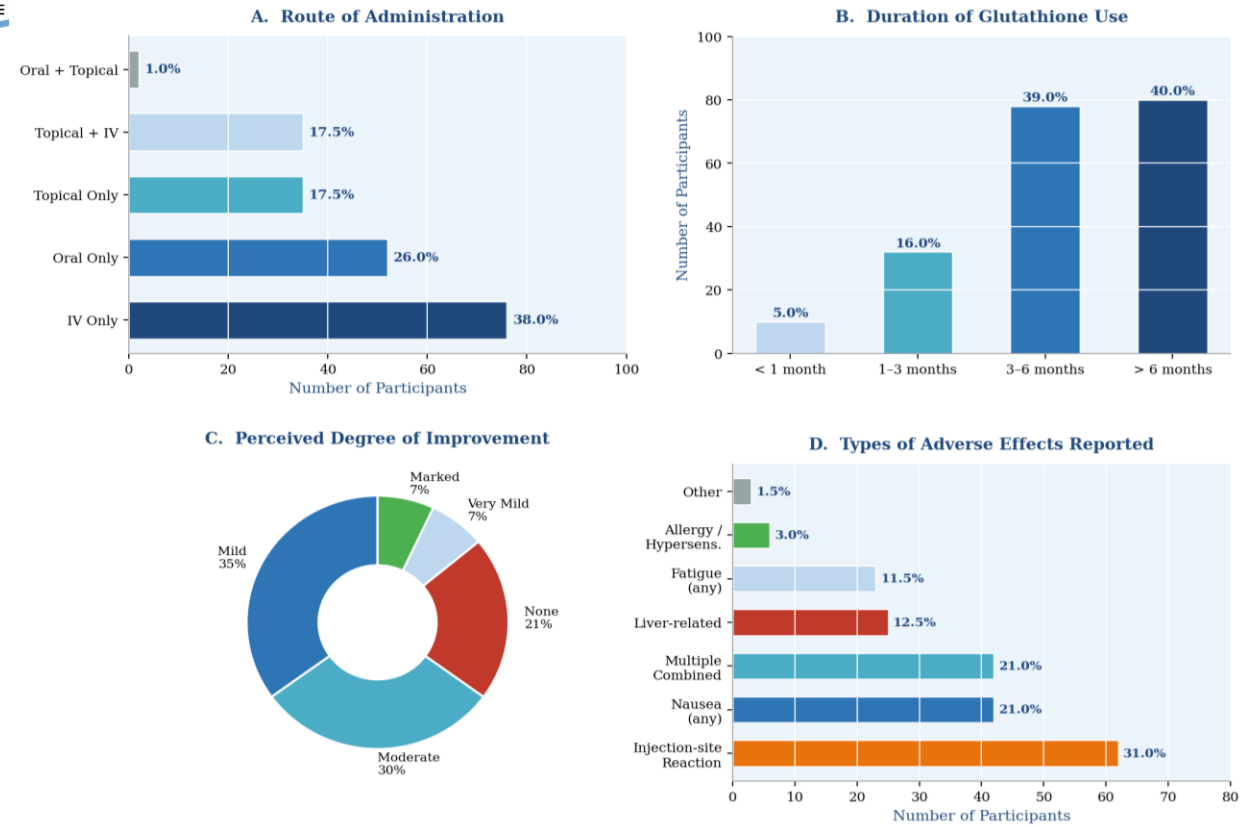

Figure 1. Glutathione Use Patterns, Perceived Effectiveness, and Adverse Effect Profile (N = 200)

This four-panel composite figure provides a comprehensive visual summary of the study's descriptive findings. Panel A illustrates that intravenous administration was the predominant route of use (38.0%), with oral use second (26.0%), reflecting a preference for routes perceived as more potent despite their associated risks. Panel B demonstrates that glutathione use is characteristically prolonged, with 79.0% of participants sustaining treatment beyond three months and 40.0% exceeding six months, indicating habitual rather than short-term trial-based consumption. Panel C, presented as a donut chart, shows that mild and moderate improvement together accounted for 65.0% of responses, whereas 21.0% of users reported no benefit and only 7.0% described marked improvement, highlighting the limited and variable efficacy of glutathione in practice. Panel D reveals that injection-site reactions (31.0%) and nausea (21.0%) were the most frequently reported adverse effects, with liver-related complaints representing a clinically concerning 12.5% of the sample.

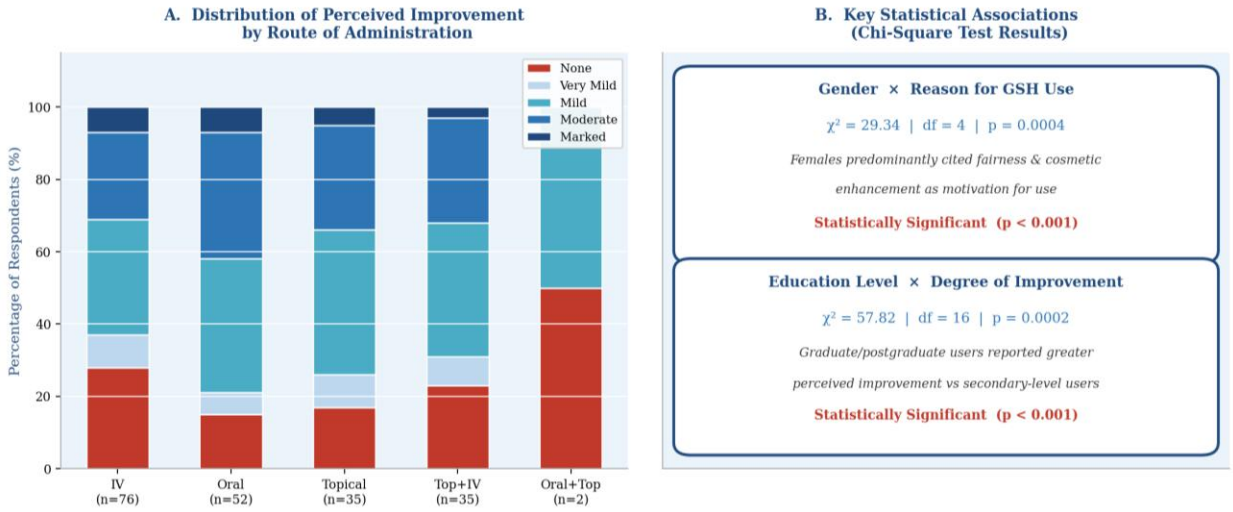

Figure 2. Perceived Improvement by Route of Administration and Key Statistical Associations (N = 200)

Panel A presents a stacked percentage bar chart comparing perceived improvement outcomes across all five routes of administration. Intravenous users showed the highest proportion of respondents reporting no improvement (28%), which is particularly significant given that this route was also the most commonly chosen, driven by expectations of superior results. Oral users demonstrated the most favourable improvement distribution, with 72% reporting at least mild benefit, suggesting that oral administration, despite its bioavailability limitations, may carry a more favourable perceived benefit-to-risk profile in this sample. Combined topical and intravenous users showed a pattern comparable to intravenous-only users. Panel B displays the two key chi-square test results as structured summary cards. The association between gender and reason for use ($\chi^2 = 29.34$, df = 4, p = 0.0004) confirms that female and male users differ significantly in their motivations, while the association between education level and degree of perceived improvement ($\chi^2 = 57.82$, df = 16, p = 0.0002) indicates that health literacy and educational attainment meaningfully influence treatment outcomes and expectations

The study documented that intravenous glutathione was the most commonly utilised route (38.0%), despite carrying the highest safety risk and lacking regulatory approval for cosmetic use. The majority of participants sustained treatment beyond three months (79.0%), suggesting habitual, long-term consumption patterns. While most users reported some degree of perceived improvement, only 7.0% reported marked benefit and 21.0% reported no improvement, reinforcing the heterogeneous and often unsatisfactory efficacy profile of glutathione across all routes.

The high adverse effect prevalence (68.5%) is clinically significant. Liver-related complaints (12.5%) are particularly concerning given the absence of long-term hepatotoxicity surveillance data for cosmetically-administered intravenous glutathione. The statistically significant association between education level and perceived improvement (p = 0.0002) suggests that health literacy may influence treatment expectations, adherence, and outcomes, an important consideration for targeted public health messaging and professional counselling practices.

DISCUSSION

The findings of this study contribute to the growing body of evidence characterising real-world glutathione use for cosmetic skin lightening in a South Asian clinical population. The predominance of female users (60.5%) is consistent with established patterns of aesthetic treatment utilisation, wherein societal beauty standards, media influence, and colourism disproportionately motivate women to seek skin lightening interventions [1,2,12]. The significant association between gender and reasons for glutathione use (p = 0.0004) further corroborates the role of gendered social norms in driving demand for depigmentation therapies.

The high prevalence of intravenous administration (38.0%) is alarming from a clinical safety perspective and stands in contrast to available safety evidence. While the oral and topical routes have demonstrated generally acceptable tolerability in clinical trials [14,16], intravenous glutathione has been associated with serious adverse events including anaphylaxis, renal dysfunction, hepatic injury, and septicaemia from contaminated preparations [9,10]. The present findings, demonstrating liver-related complaints in 12.5% and injection-site reactions in 31.0%, are consistent with these safety signals and raise immediate concerns about unregulated clinical practice in Pakistani aesthetic settings.

The observation that most participants experienced only mild to moderate improvement (65.0%), with 21.0% reporting no benefit, aligns with the conclusions of systematic reviews that describe glutathione's depigmenting efficacy as modest, inconsistent, and population-dependent [13,15,17]. The significant association between education level and perceived improvement ($p = 0.0002$) may reflect more realistic treatment expectations among higher-educated users, greater adherence to recommended protocols, or access to higher-quality clinically supervised preparations with greater pharmacokinetic reliability [18,19].

The high treatment discontinuation rate (47.5%) likely reflects a combination of unsatisfactory outcomes, adverse effects, financial burden, and growing safety awareness among some users. That over half continued treatment despite a high adverse effect prevalence (68.5%) is concerning and may indicate a social premium placed on lighter skin that overrides risk perception, a phenomenon documented in qualitative research on colourism in Pakistan [2,12].

The near-universal reliance on medical clinics and doctors as primary source (79.5%) presents both a challenge and an opportunity. While clinical access may theoretically support safer administration, it also implicates healthcare providers in the perpetuation of an off-label, inadequately evidenced practice. This underscores the need for professional societies and regulatory bodies to issue explicit guidance and include structured screening protocols where glutathione use continues [1,11,20].

LIMITATIONS

Several methodological limitations warrant consideration. The cross-sectional design precludes causal inference and does not permit assessment of long-term outcomes or temporal relationships. Reliance on self-reported data introduces potential recall and social desirability bias. The absence of objective skin tone measurements, such as chromametry or colorimetry indices, means perceived improvement could not be corroborated quantitatively. The purposive sampling approach, restricted to aesthetic clinics in one urban centre, limits generalisability. Variability in product formulations, dosages, and concomitant treatments across participants may have introduced confounding that was not fully controlled. These limitations notwithstanding, the study provides valuable empirical insights into real-world glutathione use patterns in a context where such data have been largely absent from the published literature.

RECOMMENDATIONS

On the basis of the findings and their interpretation within the broader literature, the following recommendations are proposed:

1. Regulatory Action: Pakistan's Drug Regulatory Authority (DRAP) should issue explicit guidance on the cosmetic use of intravenous glutathione, requiring clinical justification, standardised formulations, and post-market adverse event surveillance.

2. Clinical Guidelines: National dermatological and aesthetic medicine societies should develop evidence-based protocols for glutathione prescribing, incorporating mandatory pre-treatment screening for hepatic function, renal function, and allergy history before intravenous administration.

3. Public Health Awareness: Campaigns targeting cosmetic treatment seekers should provide balanced, accurate information about the limited and transient nature of glutathione efficacy, the high prevalence of adverse effects, and the absence of regulatory approval for cosmetic indications.

4. Research Agenda: Large-scale, multi-centre RCTs with objective pigmentary outcome measures, long-term follow-up, and subgroup analyses by skin phototype and route are needed to establish definitive efficacy and safety benchmarks.

5. Professional Education: CME programmes for aesthetic practitioners should include updated modules on the pharmacology, evidence base, and medicolegal implications of off-label cosmetic glutathione use.

CONCLUSION

This study provides empirical evidence that glutathione use for cosmetic skin tone lightening is prevalent among a Pakistani urban population, characterised by long-term and predominantly intravenous administration. While a majority of users reported some degree of perceived improvement, the magnitude was generally mild to moderate and heterogeneous, with a notable proportion deriving no measurable benefit. The high prevalence of adverse effects, particularly injection-site reactions, nausea, and liver-related complaints, underscores the significant safety concerns associated with unregulated intravenous glutathione administration.

The associations between gender, education, and treatment outcomes reflect the complex interplay of social, cultural, and health literacy factors that drive and shape cosmetic glutathione use. The findings support an urgent need for regulatory intervention, evidence-based clinical guidelines, and robust public health communication to protect consumers from the risks of inadequately supervised cosmetic glutathione administration. The cosmetic use of glutathione, particularly via intravenous routes, should not be endorsed in the absence of compelling clinical evidence and appropriate regulatory safeguards.

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