World Journal of Current Medical and Pharmaceutical Research
Content available at www.saap.org.in ISSN: 2582-0222

DERMATOLOGICAL MANIFESTATIONS ASSOCIATED WITH SOLID TUMOURS: PATTERNS, PREVALENCE AND CLINICAL IMPLICATIONS

USHA SREE[1], PRADEEP KUMAR REDDY[2], BILLAKANTI RAJKUMAR[3], E. MOUKTHIKA[4], K. ANUDEEP[4], CHIRUMALL ASAHITHI[4], HARSHA SURABI[4]*

[1]Associate Professor, Department of Pharmacy Practice, Smt. Sarojini Ramulamma College of Pharmacy, (Palamuru University), Seshadri Nagar, Mahabubnagar District, Telangana State, India.
[2]Consultant medical oncologist and hemato-oncologist, Continental Hospitals: Hyderabad, Telangana, India
[3]Consultant Surgical Oncologist at Mahabubnagar Cancer Hospital and SVS Medical College and Hospital, Mahabubnagar.
[4]Pharm. D Intern, Smt. Sarojini Ramulamma College of Pharmacy, (Palamuru University), Seshadri Nagar, Mahabubnagar District, Telangana State, India.

ARTICLE HISTORY
Received on: 13-05-2026
Revised on: 26-06-2026
Accepted on: 24-07-2026

ABSTRACT

Dermatological adverse effects are common in patients with solid tumours receiving chemotherapy and targeted therapy. These toxicities affect the skin, hair, and nails, impacting quality of life, treatment adherence, and overall patient care. This study evaluated the prevalence, patterns, severity, and clinical significance of dermatological manifestations in these patients. A prospective observational study was conducted among 100 patients with histologically confirmed solid tumours receiving chemotherapy or targeted therapy. Data on demographics, cancer type, stage, treatment modality, chemotherapy cycles, and dermatological manifestations were collected. Toxicity severity was graded using the Common Terminology Criteria for Adverse Events (CTCAE). Descriptive statistics and Chi-square tests were used for analysis. Adjuvant chemotherapy was the most common treatment modality, with most patients receiving 3–5 chemotherapy cycles. Paclitaxel and carboplatin were the most frequently administered agents. Dermatological manifestations occurred in 87% of patients, with a mean of 1.91 ± 1.28 manifestations per patient. Alopecia was the most frequent finding, followed by xerosis, hyperpigmentation, and melanonychia. Most toxicities were mild to moderate (CTCAE Grade 1–2). Dermatology referral was required in 24% of patients, while treatment modification was necessary in only 7%. No significant association was observed between dermatological toxicity and treatment modality ($p = 0.652$) or number of chemotherapy cycles ($p = 0.618$). Dermatological manifestations are highly prevalent in patients receiving chemotherapy and targeted therapy for solid tumours, with most experiencing multiple but mild-to-moderate toxicities. Early recognition and supportive management can improve patient comfort, maintain treatment adherence, and reduce the need for treatment modification.

Keywords: *Dermatological manifestations, chemotherapy, targeted therapy, CTCAE grading, solid tumours, prevalence, skin toxicity.*

***Corresponding Author**
Harsha Surabi

DOI: https://doi.org/10.37022/wjcmpr.v8i2.408

INTRODUCTION

Solid tumours are among the leading causes of cancer-related morbidity and mortality worldwide. Advances in surgery, chemotherapy, radiotherapy, targeted therapy, and immunotherapy have improved patient survival; however, these treatments are frequently associated with dermatological manifestations that adversely affect treatment adherence and quality of life. Cutaneous adverse effects may result from the tumour itself, metastatic disease, paraneoplastic syndromes, or anticancer therapies, making their early recognition clinically important [1–8]. Dermatological manifestations commonly involve the skin, hair, nails, and mucous membranes, presenting as xerosis, hyperpigmentation, alopecia, mucositis, radiation dermatitis, acneiform eruptions, nail abnormalities, hand–foot syndrome, and cutaneous metastases. The occurrence and severity of these manifestations depend on tumour type, treatment modality, and patient-related factors. Although rarely life-threatening, these conditions can cause significant physical discomfort, psychological distress, and interruption of cancer therapy [9-12]. Early identification and

appropriate management of dermatological toxicities are essential to improve treatment compliance and patient outcomes. However, data on the prevalence and pattern of these manifestations among patients with solid tumours remain limited in routine clinical practice. Therefore, the present study was undertaken to evaluate the prevalence, spectrum, and management of dermatological manifestations in patients with solid tumours receiving anticancer therapy.

MATERIALS AND METHODS

Study Design, Type, and Duration

This study was conducted using a prospective observational design, in which participants were followed throughout chemotherapy and radiotherapy treatment. Dermatological findings were assessed at baseline, after the third chemotherapy cycle, and during radiotherapy sessions. Severity was graded using CTCAE v5.0, and data on treatment details, skin toxicities, treatment modifications, and dermatology referrals were collected. This approach helped evaluate patterns of dermatological manifestations and their association with cancer therapies.

Study Setting and Source of Data

Study has been conducted at department of oncology at SVS medical college and hospital in Mahbubnagar.

Sample Size Determination

A total of 100 cancer patients with solid tumourwere included in the study. The sample size was determined based on feasibility and the availability of eligible participants during the study period.

Sample Selection Criteria

Inclusion Criteria

- Patients aged ≥18 years.
- Histopathologically confirmed solid tumour.
- Patients receiving treatment or follow-up care at the study hospital.
- Patients able to undergo dermatological examination.
- Cancer patients of any stage (I–IV).
- Patients willing to provide informed consent.
- Patients who completed more than three cycles of chemotherapy.

Exclusion Criteria

- Patients with haematological malignancies (leukaemia, lymphoma, multiple myeloma).
- Patients with pre-existing unrelated chronic skin diseases.
- Patients with completely resolved skin lesions and inadequate clinical information.
- Patients with only primary skin cancers and no internal solid tumour.
- Terminally ill patients with very limited life expectancy.

Methodology

This study is a prospective observational design conducted among adult patients with confirmed solid tumours. Each participant has undergone a single-timepoint dermatological assessment to document any skin manifestations, supported by relevant treatment and disease information obtained from medical records. Symptom severity has been graded using standardized scales, and details regarding treatment modifications or dermatology referrals has been noted. This methodology has helped identify the prevalence, patterns, and clinical relevance of skin changes associated with solid tumours and their treatments [13,14].

Study Procedure

Eligible patients with histologically or cytologically confirmed solid tumours attending outpatient clinics, inpatient wards, chemotherapy units, or radiotherapy units have been identified and screened based on inclusion and exclusion criteria. After obtaining written informed consent, relevant demographic, clinical, and treatment information has been collected through patient interviews and medical record review. Each participant has undergone a comprehensive dermatological examination, including skin, hair, nails, and mucosa, with lesions documented for morphology, distribution, size, number, and severity. Therapy-related skin toxicities have been graded using standardised scales such as CTCAE v5.0. Information on clinical outcomes, including dermatology consultations, any changes to cancer treatment, and the effects of skin conditions on the patient's daily life and well-being, has been recorded using a structured case-report form [15,16].

Materials, Investigations, and Interventions

No additional investigations, interventions, or procedures beyond routine clinical care were performed on study participants. Data collection was limited to surveys and interviews.

Anticipated Risks and Risk Minimization

The study posed no anticipated physical or psychological risks to participants. Confidentiality and anonymity were strictly maintained, and participation was entirely voluntary.

Data Analysis Procedure

All collected data were entered into Microsoft Excel and verified for completeness and accuracy before analysis. Statistical analysis was performed using SPSS version 25.0. Categorical variables were expressed as frequencies and percentages, while continuous variables were presented as mean ± standard deviation (SD) or median with interquartile range (IQR), as appropriate. The prevalence of dermatological manifestations was calculated, and their association with tumour type, stage, and treatment modality was evaluated. Comparisons between categorical variables were performed using the chi-square test, whereas continuous variables were analysed using the independent *t*-test. Multivariable logistic regression analysis was conducted to identify independent factors associated with dermatological manifestations, and adjusted odds ratios (AORs) with 95% confidence intervals (CIs) were reported. A *p*-value <0.05 was considered statistically significant, and the results were presented using appropriate tables and figures [17,18].

Statistical Methods

All collected data has been entered into a structured database and analysed using SPSS and equivalent software. Categorical variables, such as gender, tumour type, and type of dermatological manifestation, has been presented as frequencies and percentages, while continuous variables, such as age and duration of disease, has been expressed as mean ± standard deviation or median with interquartile range. The prevalence and patterns of dermatological manifestations have

been calculated, and associations with tumour type, stage, and treatment modality has been assessed using Chi-square. Comparisons of continuous variables between groups has been performed using t-tests for continuous variables. Multivariable logistic regression analysis has been conducted to identify independent factors associated with dermatological manifestations, and adjusted odds ratios with 95% confidence intervals has been reported. A p-value < 0.05 has been considered statistically significant. All analyses have been performed using SPSS software[19-22].

Statistical Software

The complete data analysis has been carried out by using the Statistical Package for the Social Sciences (SPSS) with version 23 and GraphPad Prism software with version 9.

Ethical Considerations

The ethical committee clearance was obtained from the SVS MEDICAL COLLEGE AND HOSPITAL before initiating the study. Reference number: IEC/DHR-03/ (04-5)/2025

Results and Discussion

A total of 100 patients were included in the study. Demographic characteristics, clinical characteristics of malignancies, treatment patterns, and dermatological manifestations associated with chemotherapy were analyzed.

Demographic Characteristics of the Study Population

Distribution Of Patients Based on Age

The age distribution of the study population is presented in Table 1. The majority of the patients belonged to the 40-60 years old age group, followed by patients aged above 60 years and below 40 years. This indicates that the incidence of solid tumours was higher among middle-aged individuals in the present study. The mean of the study population was 53.04 ± 12.48 years, reflecting a predominance of patients in the middle-aged group.

Table 01: Distribution of Patients Based on Age

Age Group (Years)	Frequency	Percentage (%)
<40 years	11	11%
40-60 years	62	62%
>60 years	27	27%
Mean age: 53.04 ± 12.48 years		

Distribution of Patients Based on Gender

Among the 100 patients included in the study, females constituted the majority, accounting for 63% of the study population, while males comprised 37%. This indicates a higher prevalence of solid tumours among female patients in the present study.

Clinical Characteristics of Solid Tumour

Distribution of Patients Based on Type of Solid Tumours

The distribution of patients by type of solid tumour is presented in Table 3. Breast cancer was the most common malignancy observed in the study population (32%), followed by Colorectal cancer (15%), Ovarian cancer (11%), Cervical cancer (11%), Lung cancer (7%), Gastric cancer (6%), Esophageal cancer (6%), and brain tumours (3%). Other less frequent malignancies were grouped under "others," which included tongue cancer, prostate cancer, pancreatic cancer, germ cell tumours, laryngeal cancer, thymoma, testicular cancer, and metastatic cancers. A higher number of female patients in the study population was observed to be associated with an increased frequency of breast, ovarian, and cervical cancers.

Table 03: Distribution of Patients Based on Type of Solid Tumours

Tumor Type	Frequency	Percentage
Breast Cancer	32	32%
Colorectal Cancer	15	15%
Ovarian Cancer	11	11%
Cervical Cancer	11	11%
Lung Cancer	7	7%
Gastric Cancer	6	6%
Esophageal Cancer	6	6%
Brain Tumor	3	3%
Others	9	9%
TOTAL	100	

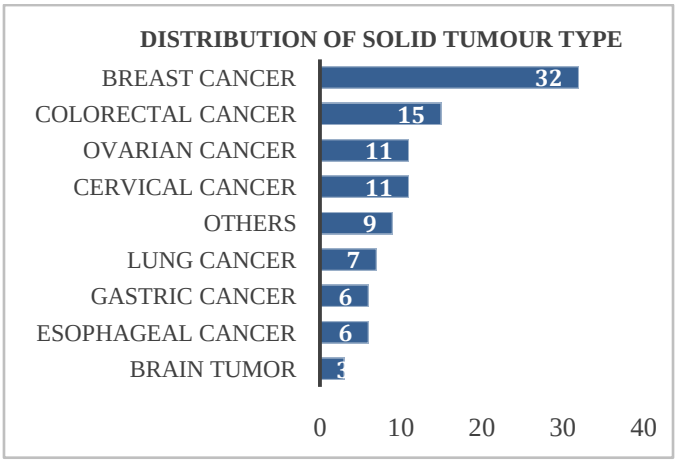

Figure 01: Distribution of Patients Based on Type of Solid Tumors

Distribution of Patients Based on Stage of Cancer

The majority of patients were diagnosed at Stage 3 (39%) of the study population, followed by Stage 2 (32%) and Stage 4 (29%). No patients were observed in Stage 1. These findings indicate that most patients in the present study were diagnosed at relatively advanced stages of the disease.

Treatment Characteristics

Distribution of Patients Based on Treatment Modality

The distribution of patients based on treatment modality is presented in Table 4 and Figure 2. Among the study population, Adjuvant chemotherapy was the most commonly administered treatment, accounting for 35% of patients, followed by Palliative chemotherapy (24%) and Concurrent Chemotherapy (20%). Targeted therapy was received by 11% of patients. Neoadjuvant chemotherapy and Curative chemotherapy were each administered to 5% of patients.

Table 03: Distribution of Patients Based on Treatment Modality

Treatment Modality	Frequency	Percentage
Adjuvant Chemotherapy	35	35%
Palliative Chemotherapy	24	24%
Concurrent Chemotherapy	20	20%
Targeted Therapy	11	11%
Neoadjuvant Chemotherapy	5	5%
Curative Chemotherapy	5	5%
TOTAL	100	

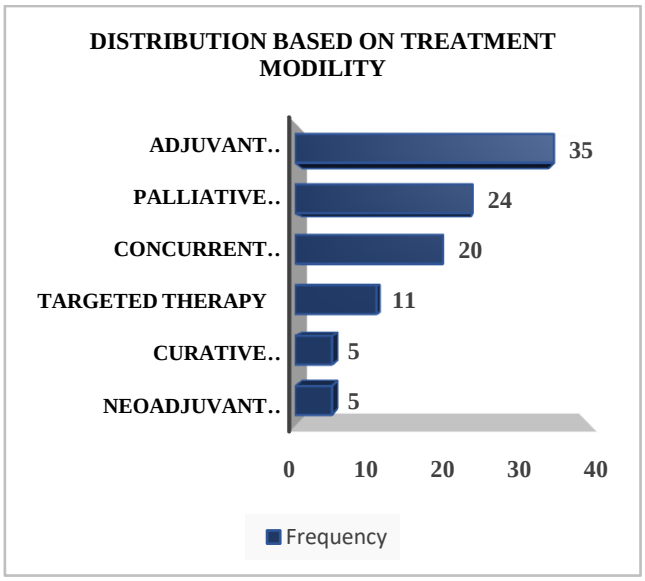

Figure 02: Distribution of Patients Based on Treatment Modality

Distribution of Patients Based on Number of Chemotherapy Cycles

The majority of patients received 3–5 cycles of chemotherapy, accounting for 59% of the study population, followed by 6–9 cycles (35%). A smaller proportion of patients (6%) received more than 10 cycles of chemotherapy.

Distribution of Patients Based on Chemotherapeutic Agent Used

The distribution of patients based on the commonly used chemotherapeutic agents is presented in Table 4 and Figure 3. Among the study population, paclitaxel was the most frequently administered agent, used in 65% of patients, followed by carboplatin in 50% of patients. Targeted agents such as trastuzumab and bevacizumab were used in 12% and 10% of patients, respectively, while irinotecan was administered to 9% of patients. Other chemotherapeutic agents were used less frequently and were not included individually in the table, as their inclusion would have added complexity to the analysis without significantly contributing to the overall interpretation.

Table 04: Distribution of Patients Based on Chemotherapeutic Agent Used

Chemotherapeutic Agents	Frequency	Percentage
Paclitaxel	65	65%
Carboplatin	50	50%
Trastuzumab	12	12%
Bevacizumab	10	10%
Irinotecan	9	9%

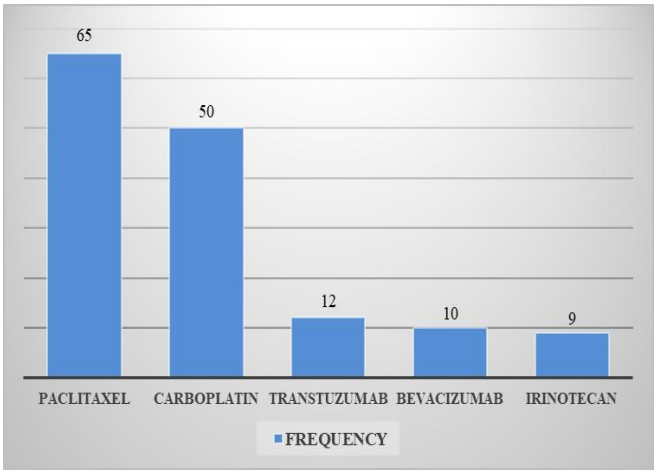

Figure 03: Distribution of Patient Based on Chemotherapeutic Agent Used

Patterns and Prevalence of Dermatological Manifestations

Overall Prevalence of Dermatological Manifestations

Out of the 100 patients included in the study, 87% developed dermatological manifestations, while 13% of patients did not exhibit any dermatological toxicity.

Patterns of Dermatological Manifestations in the Study Population

The pattern of dermatological manifestations observed in the study population is presented in Table 5 and Figure 4. Alopecia was the most common manifestation, observed in 55% of patients, followed by xerosis (47%). Other manifestations included hyperpigmentation (27%), melanonychia (26%), mucositis (17%), photosensitivity (11%), and ulceration (8%). These findings indicate that Alopecia and Xerosis were the predominant manifestations observed in the study population. In our present study, the mean number of dermatological manifestations per patient was found to be 1.91 ± 1.28. This indicates that, on average, each patient experienced nearly two dermatological manifestations during the course of treatment. The observed standard deviation suggests a moderate variation in the number of manifestations among patients, with some patients experiencing only a single manifestation, while others developed multiple dermatological toxicities. These findings highlight that the dermatological manifestations in patients receiving chemotherapy and targeted therapy is not limited to only one dermatological manifestation but often involve multiple concurrent manifestations

Table 05: Patterns of Dermatological Manifestations in Study Population

Dermatological Manifestations	Frequency	Percentage
Alopecia	55	55%
Xerosis	47	47%
Hyperpigmentation	27	27%
Melanonychia	26	26%
Mucositis	17	17%
Photosensitivity	11	11%
Ulcer	8	8%

Mean ± SD:1.91 ± 1.28		

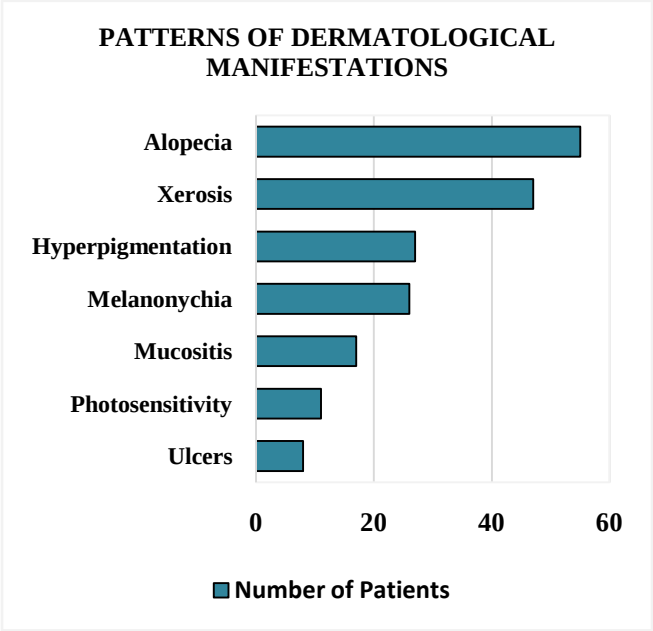

Figure 04: Patterns of Dermatological Manifestations in the Study Population

Severity Of Dermatological Manifestations (CTCAE Grade)

Among the study population, Grade 1 toxicity was the most commonly observed, accounting for 40% of patients, followed by Grade 2 toxicity (34%). Grade 3 toxicity was observed in 13% of patients, while 13% of patients had Grade 0, indicating the absence of dermatological toxicity. These findings suggest that most dermatological manifestations were of mild to moderate severity.

Dermatological Referrals and Treatment Modifications

Dermatology referral was required in 24% of patients, while treatment modification was necessary in 7% of patients. In the majority of cases, dermatological manifestations were managed symptomatically with topical therapies, including creams and emollients.

Association between Treatment Modality and Dermatological Manifestations

The association between treatment modality and dermatological manifestations is presented in Table 6 and Figure 5. Dermatological toxicity was most frequently observed in patients receiving chemotherapy alone, followed by those receiving combination therapy. All patients receiving targeted therapy alone developed dermatological manifestations, with no cases reported without toxicity in this group. A comparatively lower number of patients without dermatological toxicity were observed across all treatment modalities. These findings suggest that dermatological manifestations were commonly associated with all treatment modalities, particularly chemotherapy-based regimens. A Chi-square test was performed to assess the association between treatment modality and dermatological toxicity. In this study, no statistically significant association was observed between treatment modality and the occurrence of dermatological toxicity (p = 0.652). This indicates that dermatological manifestations were seen across all treatment modalities without a significant difference between groups.

Table 06: Association between Treatment Modality and Dermatological Manifestations

Treatment Modality	Toxicity Present	No Toxicity
Chemotherapy Alone	67	11
Targeted Therapy Alone	5	0
Combined Therapy	15	2

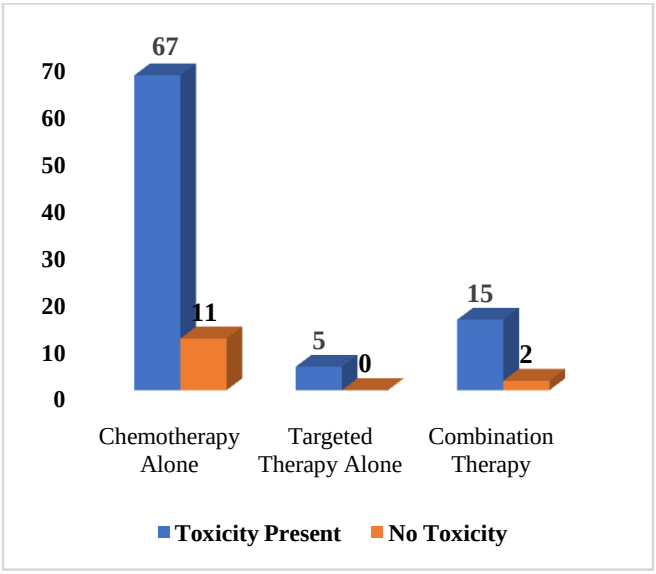

Figure 05: Association between Treatment Modality and Dermatological Manifestations

Association between Number of Chemotherapy Cycles and Dermatological Toxicity

Dermatological toxicity was observed across all cycle groups, with the highest number of cases seen in patients receiving 3–5 cycles, followed by those receiving 6–9 cycles. All patients receiving more than 10 cycles developed dermatological toxicity, with no cases observed without toxicity in this group. Patients without dermatological toxicity were comparatively fewer across all cycle groups. These findings indicate that dermatological manifestations were commonly observed irrespective of the number of chemotherapy cycles. A Chi-square test was performed to evaluate the association between the number of chemotherapy cycles and dermatological toxicity. The results showed no statistically significant association between the number of chemotherapy cycles and dermatological toxicity (p = 0.618). This suggests that dermatological manifestations occurred irrespective of the number of chemotherapy cycles received.

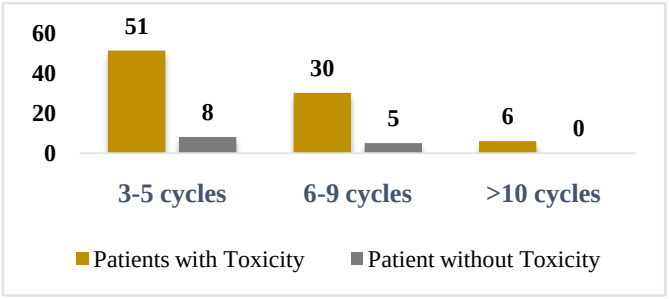

Figure 06: Association between Number of Chemotherapy Cycles and Dermatological Toxicity

CONCLUSION

The current study elucidates the high prevalence of dermatological manifestations among patients with solid tumors undergoing chemotherapy and targeted therapy, with a significant proportion experiencing multiple dermatological issues throughout treatment. Alopecia and xerosis were identified as the most frequently observed dermatological toxicities. The majority of these adverse effects were classified as mild to moderate in severity and were successfully managed through symptomatic treatment. Despite the frequent occurrence of dermatological toxicities, only a minority of patients required referral to dermatology specialists or modification of their treatment regimens, suggesting that such toxicities are generally manageable within clinical settings. Additionally, the analysis revealed no statistically significant correlation between the type of treatment modality or the number of chemotherapy cycles and the incidence of dermatological toxicities. Overall, these findings underscore the critical importance of early detection and appropriate management of dermatological adverse effects to enhance patient comfort and optimize treatment adherence.

LIMITATIONS AND RECOMMENDATIONS

This study was limited by its small sample size, single-centre design, and inclusion of only patients receiving chemotherapy and targeted therapy. The absence of baseline dermatological assessment and the heterogeneity of tumour types and treatment regimens may have influenced the findings. Routine baseline and follow-up dermatological evaluations using standardized grading systems (CTCAE), along with early dermatology referral and patient education, are recommended. Future multicentre studies with larger sample sizes and longer follow-up are needed to validate these findings.

FUNDING

Nil

CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest regarding the publication of this paper.

ACKNOWLEDGMENT

We also thank the patients who consented to participate in this research.

AUTHOR CONTRIBUTIONS

Usha Sree conceived and designed the study, supervised the research work, and drafted the manuscript. E. Moukthika, K. Anudeep, Harsha Surabi contributed to data collection, analysis, and manuscript preparation. All authors reviewed and approved the final version of the manuscript.

ETHICAL STATEMENT

The ethical committee clearance was obtained from SVS MEDICAL COLLEGE HOSPITAL before initiating the study. Reference number: IEC/DHR-03/ (04-5)/2025

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