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INVESTIGATING GENDER AND EDUCATION-BASED TOLERANCE OF CHEMOTHERAPY IN PATIENTS WITH CANCER: AN INSTITUTIONAL PERSPECTIVE

Original Research (ID: 1697)

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ABSTRACT

Background: Chemotherapy remains an essential treatment for many cancers, yet planned delivery is often affected by patient-related and treatment-related factors. Poor tolerance may lead to dose delays, dose reductions, or discontinuation, which can compromise treatment continuity. Gender and educational status may influence symptom reporting, health literacy, adherence, and timely use of supportive care. Identifying these associations may help oncology teams recognize vulnerable patients and provide more focused counselling, monitoring, and early toxicity management during chemotherapy treatment.

Objective: To evaluate the association of gender and educational status with chemotherapy tolerance among patients with cancer.

Methods: This retrospective cross-sectional study was conducted at the Oncology Department of Khyber Teaching Hospital, Peshawar, over six months. A total of 220 chemotherapy patients were included through consecutive sampling. Data were extracted from records using a structured proforma. Patients were grouped by gender and education. Tolerance was assessed through dose delays, dose reductions, discontinuation, and absence of interruption. SPSS version 26 was used for analysis. Chi-square or Fisher's exact test was applied, with $p < 0.05$ considered significant.

Results: Mean age was 49.3 ± 13.6 years. Females were 140 (63.6%) and males were 80 (36.4%). No formal, primary/secondary, and higher education were reported in 70 (31.8%), 90 (40.9%), and 60 (27.3%) patients, respectively. Dose delays occurred in 68 (30.9%), dose reductions in 62 (28.2%), discontinuation in 40 (18.2%), and good tolerance in 110 (50.0%). Females had higher dose delays than males (37.9% vs 25.0%, $p = 0.03$) and lower good tolerance (44.3% vs 60.0%, $p = 0.02$). Higher education showed better tolerance than no formal education (81.7% vs 55.7%, $p = 0.001$).

Conclusion: Gender and educational status were associated with chemotherapy tolerance. Lower education and female gender identified patients who may require closer monitoring, simplified counselling, and stronger supportive care.

Keywords: Antineoplastic Agents; Drug-Related Side Effects and Adverse Reactions; Educational Status; Medication Adherence; Neoplasms; Sex Factors; Treatment Outcome

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INTRODUCTION

Cancer remains one of the leading causes of illness and death worldwide, placing a substantial burden on patients, families, healthcare systems, and society. Despite major advances in screening, diagnosis, surgery, radiotherapy, immunotherapy, and targeted treatment, chemotherapy continues to play a central role in the management of many solid and hematological malignancies. However, the benefit of chemotherapy is closely linked to a patient's ability to tolerate treatment. When patients develop significant adverse effects, treatment may be delayed, doses may be reduced, or chemotherapy may be discontinued altogether, all of which can compromise treatment effectiveness and long-term clinical outcomes (1,2). Tolerance to chemotherapy is not determined by disease-related factors alone. It is influenced by a combination of biological, clinical, psychological, and socio-demographic characteristics. Among these, gender has received increasing attention as an important factor in treatment response and toxicity. Previous research suggests that female patients may experience chemotherapy-related adverse effects more frequently or more severely than male patients, possibly due to differences in body composition, drug metabolism, hormonal influences, and pharmacokinetic profiles (3,4). These variations may affect symptom burden, treatment adherence, and the likelihood of completing chemotherapy as planned.

Educational status is another important factor that may shape chemotherapy tolerance and continuation of care. Patients with higher levels of education may be better able to understand treatment instructions, recognize warning symptoms early, follow supportive care advice, and seek timely medical assistance when complications occur (5). In contrast, patients with limited formal education may face difficulties in understanding complex treatment schedules, identifying side effects, communicating symptoms effectively, and adhering to follow-up recommendations. These barriers may increase the risk of delayed reporting, unmanaged toxicity, poor adherence, and treatment interruption (6). The combined influence of gender and education is particularly relevant in settings where health literacy, social support, financial limitations, and access to healthcare services vary widely. In low- and middle-income countries, these differences may have a stronger impact on cancer care because patients often present late, travel long distances for treatment, and depend heavily on institutional guidance for managing chemotherapy-related complications (7,8). Understanding how these socio-demographic factors affect chemotherapy tolerance can help clinicians identify vulnerable patients earlier and provide more individualized counseling, monitoring, and supportive care.

Although international literature has explored chemotherapy-related toxicity and adherence, limited local evidence is available regarding the role of gender and educational status in determining chemotherapy tolerance within institutional oncology settings. This gap is important because patient characteristics, healthcare access, awareness levels, and treatment-support systems may differ across regions and institutions. Therefore, the present study was designed to investigate whether gender and educational level are associated with differences in chemotherapy tolerance among patients with cancer. The objective of this study was to evaluate the impact of gender and education level on chemotherapy tolerance among cancer patients treated at the institution.

METHODOLOGY

This retrospective cross-sectional study was conducted in the Oncology Department of Khyber Teaching Hospital, Peshawar, Pakistan, a tertiary care teaching hospital that provides diagnostic and treatment services to patients with different types of malignancies. The study was carried out over a period of six months after approval from the Institutional Review Board/Ethical Review Committee of Khyber Teaching Hospital, Peshawar. As the study was based on retrospective review of hospital records and did not involve direct patient contact or intervention, the requirement for written informed consent was waived by the ethical committee. Patient confidentiality was maintained throughout the study by using anonymized data, and no personal identifiers were included during data entry or analysis. A total of 220 patients diagnosed with cancer and treated with chemotherapy during the study period were included through non-probability consecutive sampling. All eligible records available during the defined study period were reviewed until the required sample size was achieved. Patients of either gender who had received at least one cycle of chemotherapy, irrespective of cancer type, disease stage, or chemotherapy regimen, were considered eligible for inclusion. Patients were excluded if their medical records were incomplete, if they had not completed at least one cycle of chemotherapy, or if adequate follow-up information regarding chemotherapy continuation, delay, dose modification, or discontinuation was not available.

Data were collected retrospectively from hospital medical records by using a structured data collection proforma. The proforma included socio-demographic and clinical variables such as age, gender, educational status, cancer diagnosis, and available treatment-related information. Chemotherapy tolerance was assessed through documented indicators of treatment interruption, including chemotherapy dose delay, dose reduction, and treatment discontinuation. For consistency, chemotherapy tolerance was categorized on the basis of whether the patient completed chemotherapy as planned or experienced any treatment interruption. Where available, the documented reason for interruption was reviewed to differentiate toxicity-related interruptions from other causes such as disease progression, patient refusal, financial constraints, or loss of follow-up. Data were entered and analyzed using the Statistical Package for Social Sciences version 26. Quantitative variables, such as age, were expressed as mean ± standard deviation after assessment of data distribution. Categorical variables, including gender, educational status, chemotherapy tolerance, dose delay, dose reduction, and treatment discontinuation, were presented as frequencies and percentages. The association of gender and educational level with chemotherapy tolerance was assessed using the chi-square test. Fisher's exact test was applied where the expected cell count was less than five. A p-value of less than 0.05 was considered statistically significant.

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RESULTS

A total of 220 patients who received chemotherapy were included in the final analysis. The mean age of the study population was 49.3 ± 13.6 years, with an age range of 18 to 75 years. Of the total patients, 118 (53.6%) were aged 50 years or below, while 102 (46.4%) were older than 50 years. Females represented the larger proportion of the cohort, comprising 140 (63.6%) patients, whereas 80 (36.4%) patients were male. Regarding educational status, 70 (31.8%) patients had no formal education, 90 (40.9%) had primary or secondary education, and 60 (27.3%) had higher education. Chemotherapy-related treatment interruptions were observed in a notable proportion of patients. Dose delays were documented in 68 (30.9%) patients, dose reductions in 62 (28.2%) patients, and treatment discontinuation in 40 (18.2%) patients. Overall, 110 (50.0%) patients showed good chemotherapy tolerance, defined as completion of treatment without documented interruption.

Gender-based analysis showed that treatment interruptions were more frequent among female patients than male patients. Dose delays were reported in 20 (25.0%) males and 53 (37.9%) females, showing a statistically significant association with gender ($p = 0.03$). Dose reductions were observed in 18 (22.5%) males and 44 (31.4%) females, and this difference was also statistically significant ($p = 0.04$). Treatment discontinuation occurred in 10 (12.5%) males and 30 (21.4%) females; however, this association did not reach statistical significance ($p = 0.08$). Good chemotherapy tolerance was recorded in 48 (60.0%) males and 62 (44.3%) females, with a statistically significant difference between the two groups ($p = 0.02$). Educational status also showed a significant association with chemotherapy tolerance indicators. Dose delays were most frequent among patients with no formal education, affecting 32 (45.7%) patients, followed by 28 (31.1%) patients with primary or secondary education and 8 (13.3%) patients with higher education ($p = 0.001$). Similarly, dose reductions were recorded in 28 (40.0%) patients with no formal education, 25 (27.8%) patients with primary or secondary education, and 9 (15.0%) patients with higher education ($p = 0.002$). Treatment discontinuation was observed in 18 (25.7%) patients with no formal education, 14 (15.6%) patients with primary or secondary education, and 8 (13.3%) patients with higher education, showing a statistically significant association with education level ($p = 0.04$). Good chemotherapy tolerance was reported in 39 (55.7%) patients with no formal education, 55 (61.1%) patients with primary or secondary education, and 49 (81.7%) patients with higher education ($p = 0.001$).

Table 1: Baseline Demographic Characteristics of Patients (n = 220)

Variable	Frequency (%) / Mean ± SD
Age (years)	49.3 ± 13.6
Age ≤50 years	118 (53.6%)
Age >50 years	102 (46.4%)
Gender	
Male	80 (36.4%)
Female	140 (63.6%)
Education Level	
No formal education	70 (31.8%)
Primary/Secondary	90 (40.9%)
Higher education	60 (27.3%)

Table 2: Chemotherapy Tolerance Indicators in Study Population (n = 220)

Variable	Frequency (%)
Dose delays	68 (30.9%)
Dose reductions	62 (28.2%)
Treatment discontinuation	40 (18.2%)
Good tolerance (no interruptions)	110 (50.0%)

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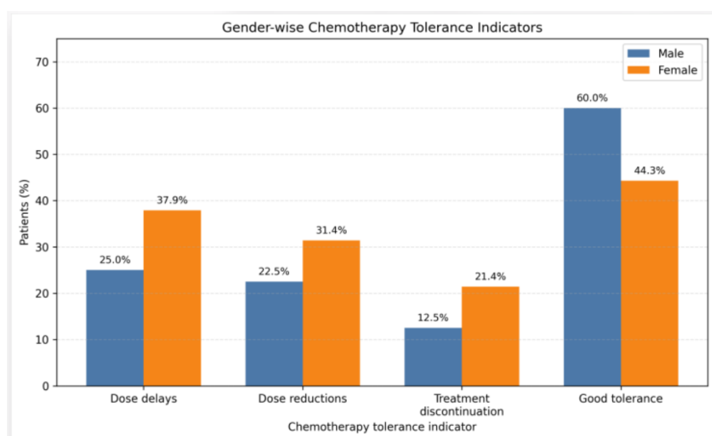
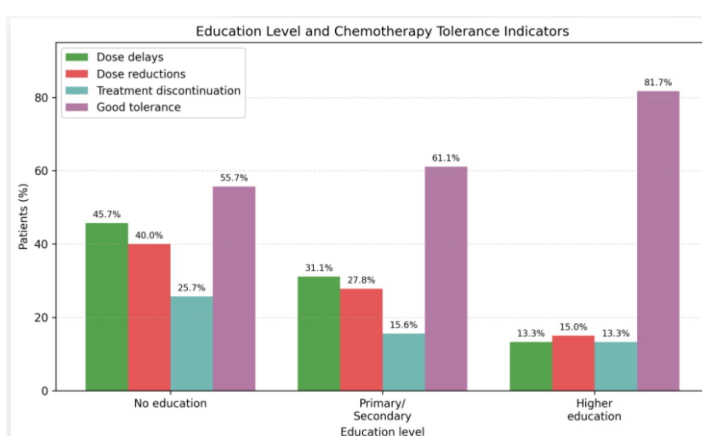
Table 3: Association of Gender with Chemotherapy Tolerance

Variable	Male (n=80)	Female (n=140)	p-value
Dose delays	20 (25.0%)	53 (37.9%)	0.03
Dose reductions	18 (22.5%)	44 (31.4%)	0.04
Treatment discontinuation	10 (12.5%)	30 (21.4%)	0.08
Good tolerance	48 (60.0%)	62 (44.3%)	0.02

Table 4: Association of Education Level with Chemotherapy Tolerance

Variable	No Education (n=70)	Primary/Secondary (n=90)	Higher Education (n=60)	p-value
Dose delays	32 (45.7%)	28 (31.1%)	8 (13.3%)	0.001
Dose reductions	28 (40.0%)	25 (27.8%)	9 (15.0%)	0.002
Treatment discontinuation	18 (25.7%)	14 (15.6%)	8 (13.3%)	0.04
Good tolerance	39 (55.7%)	55 (61.1%)	49 (81.7%)	0.001





Discussion

This study evaluated the influence of gender and educational status on chemotherapy tolerance among patients with cancer treated in a tertiary care institutional setting. The findings showed that treatment interruptions were common, and a substantial proportion of patients experienced dose delays, dose reductions, or treatment discontinuation. Female patients had comparatively higher rates of dose delays and dose reductions than male patients, while good chemotherapy tolerance was more frequently observed among males. Educational status also showed a clear association with treatment tolerance, as patients with higher education had fewer interruptions and better overall tolerance compared with patients with no formal education or lower educational attainment. The higher frequency of treatment interruptions among female patients was consistent with previous literature suggesting that women may experience chemotherapy-related toxicities more often or with greater severity than men (9,10). Several biological mechanisms may explain this difference, including variations in body composition, fat distribution, renal and hepatic drug handling, hormonal influences, and pharmacokinetic differences that may alter drug exposure and toxicity profiles. In addition to biological factors, psychosocial and behavioral factors may also contribute to gender-based differences in treatment tolerance. Female patients may report symptoms earlier or more frequently, while differences in pain perception, caregiving responsibilities, nutritional status, and access to family support may further influence treatment continuation and follow-up behavior (11). However, the association between female gender and poorer tolerance should be interpreted carefully, as gender-related toxicity may vary according to cancer type, chemotherapy regimen, dose intensity, menopausal status, and baseline performance status.

Educational level emerged as an important socio-demographic factor associated with chemotherapy tolerance. Patients with higher education showed lower rates of dose delays, dose reductions, and treatment discontinuation, while those without formal education experienced comparatively poorer tolerance. This finding agreed with existing evidence that education improves health literacy and

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enables patients to understand treatment instructions, recognize adverse effects earlier, follow supportive care advice, and seek medical attention before complications become severe (12,13). In contrast, patients with limited education may face greater difficulty in understanding complex chemotherapy schedules, warning symptoms, dietary advice, medication use, and follow-up requirements. These challenges may lead to delayed symptom reporting, poor adherence to supportive medications, missed visits, and greater risk of treatment interruption. The relationship between education and chemotherapy tolerance also reflected the broader role of communication in cancer care. Patients with lower educational status may not always receive information in a manner that matches their level of understanding, especially when counseling is delivered quickly or in technical language. Previous studies have emphasized that structured counseling, repeated education, written instructions in simple language, and family involvement can improve adherence and reduce avoidable treatment interruptions (14). Therefore, the present findings supported the need for patient-centered counseling strategies, particularly for patients with limited literacy. Such strategies may include pictorial instructions, local-language counseling, toxicity checklists, reminder calls, and early follow-up after chemotherapy cycles.

The overall burden of treatment interruption observed in this study was clinically important. Nearly one-third of patients experienced dose delays or dose reductions, indicating that chemotherapy tolerance remained a major challenge in routine oncology practice. This pattern was consistent with prior research showing that chemotherapy-related toxicity and non-adherence can interfere with planned treatment delivery and may affect clinical outcomes when dose intensity is reduced or treatment is discontinued prematurely (15). Although treatment modification is sometimes clinically necessary to protect patient safety, frequent or preventable interruptions may reduce the intended therapeutic benefit. These findings highlighted the importance of early toxicity assessment, nutritional optimization, timely management of adverse effects, and individualized supportive care during chemotherapy. Socioeconomic and cultural factors may also have contributed to the observed differences in chemotherapy tolerance across educational groups. Patients with no formal education may be more likely to face financial constraints, limited transport access, reduced family support, delayed hospital visits, and difficulty navigating healthcare services. These barriers can negatively affect treatment adherence and continuity of care (16). In many institutional settings, patients from lower educational backgrounds may also depend more heavily on verbal instructions, which can be forgotten or misunderstood after discharge. This emphasizes the need for a multidisciplinary approach involving oncologists, nurses, pharmacists, social workers, and patient navigators to support vulnerable patients throughout chemotherapy.

Despite the observed associations, the findings did not establish a direct causal relationship between gender, education, and chemotherapy tolerance. Chemotherapy tolerance is influenced by multiple clinical variables, including cancer type, stage of disease, chemotherapy regimen, number of cycles received, baseline hemoglobin level, nutritional status, comorbidities, renal and hepatic function, and performance status. These variables were not fully stratified in the present analysis and may have partly influenced the observed associations. Previous research has shown that more intensive regimens, advanced disease, poor functional status, and comorbid illness are associated with higher toxicity and greater likelihood of treatment discontinuation (17). Therefore, future studies should adjust for these clinical factors to determine whether gender and education independently predict chemotherapy tolerance. The findings had practical implications for oncology care in institutional and resource-limited settings. They suggested that patients with lower educational status and female patients may benefit from closer monitoring, clearer counseling, and more proactive toxicity management. Incorporating education-based risk assessment at the start of chemotherapy may help clinicians identify patients who require additional support. Simple interventions such as pre-chemotherapy counseling sessions, toxicity awareness cards, nurse-led follow-up calls, and family education may reduce preventable delays and improve treatment completion (18). At the same time, gender-sensitive supportive care may be useful where specific toxicity patterns are recognized, although such approaches should be guided by cancer type, regimen, and individual patient risk rather than gender alone.

A strength of this study was that it addressed an important and often under-recognized aspect of cancer care by focusing on socio-demographic determinants of chemotherapy tolerance in a real-world clinical setting. The inclusion of 220 patients provided useful institutional evidence and highlighted the relevance of gender and education in routine oncology practice. The use of practical treatment indicators, including dose delays, dose reductions, discontinuation, and absence of interruptions, also reflected outcomes that are directly relevant to clinical decision-making and service improvement. The study also had several limitations. Its retrospective and single-center design limited the generalizability of the findings to other populations and healthcare systems. The analysis was based on hospital records, which may have been affected by incomplete documentation or variation in how treatment interruptions were recorded. Chemotherapy tolerance was measured through indirect indicators rather than standardized toxicity grading systems, such as the Common Terminology Criteria for Adverse Events. Important confounders, including cancer diagnosis, stage, chemotherapy protocol, number of cycles, socioeconomic status, nutritional status, comorbidities, baseline laboratory parameters, and performance status, were not fully controlled. In addition, the reasons for dose delays, dose reductions, or discontinuation may have included toxicity as well as non-toxicity factors such as financial barriers, disease progression, patient preference, or logistic difficulties.

Future research should use prospective, multicenter designs with standardized toxicity grading and detailed clinical stratification. Larger studies should assess whether gender and education remain independent predictors of chemotherapy tolerance after adjusting for cancer type, stage, regimen intensity, comorbidities, nutritional status, and socioeconomic factors. Interventional studies are also needed to evaluate whether structured counseling, literacy-sensitive education, nurse-led toxicity monitoring, and patient navigation can reduce treatment interruptions among high-risk groups. Such evidence may help develop practical and locally applicable strategies to improve

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chemotherapy adherence, reduce preventable toxicity-related interruptions, and enhance overall cancer care outcomes. Overall, the study showed that chemotherapy tolerance was associated with both gender and educational status in the institutional setting. Female patients and patients with lower educational attainment experienced more treatment interruptions, while higher education was associated with better tolerance. These findings supported the importance of integrating clinical assessment with patient education, supportive counseling, and targeted follow-up to improve chemotherapy continuation and patient-centered cancer care (19,20).

CONCLUSION

This study concluded that gender and educational status were important factors associated with chemotherapy tolerance among patients with cancer. Female patients and those with lower educational attainment appeared more vulnerable to treatment interruptions, whereas better educational status was linked with improved treatment continuation and tolerance. These findings emphasize the need for patient-centered counselling, simplified treatment education, early toxicity recognition, and closer supportive care for vulnerable groups. By identifying socio-demographic factors that may affect chemotherapy tolerance, this study highlights a practical area for improving adherence, reducing avoidable treatment disruption, and strengthening cancer care in institutional settings.

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Rahimullah Khattak	Methodology, Investigation, Data Curation, Writing - Review & Editing
Qazi Muhammad Farooq	Investigation, Data Curation, Formal Analysis, Software
Dr. Bushra Malik	Software, Validation, Writing - Original Draft
Dr Muhamamr Wasim Sattar	Formal Analysis, Writing - Review & Editing
Dr. Maryam Bibi	Writing - Review & Editing, Assistance with Data Curation

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