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Recognition of cancer chemotherapy adverse effect by patients: a cross-sectional study from Palestine

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Abstract

Background It has been suggested that patient awareness of chemotherapy-induced side effects is not uniform and may vary according to communication quality between healthcare providers and patients, educational initiatives, and the type of cancer and chemotherapy regimen. This study aimed to assess real-world chemotherapy-induced adverse effects as reported by cancer patients in the West Bank of Palestine and to identify key predictors of these side effects.

Methods This cross-sectional study was conducted between January and December 2023 in various hospitals in the West Bank of Palestine. A validated questionnaire, previously developed and reviewed for face validity by a panel of experts, was administered to 266 consenting cancer patients receiving chemotherapy, and their electronic medical records were also reviewed. Descriptive statistics, chi-square/Fisher's exact tests, and multiple regression analyses were used to explore associations between sociodemographic/clinical variables and chemotherapy-induced adverse effects.

Results The median age of the 266 cancer patients was 48 [25–60] years. Overall, 91.7% of patients reported weakness, 88.0% reported hair loss, and 87.2% experienced vertigo, among other side effects. Multiple regression analyses revealed that a longer duration of chemotherapy sessions was a consistent predictor of increased adverse effects—specifically, it predicted higher frequencies of fever (Beta = 0.29, $p < 0.001$), vertigo (Beta = 0.29, $p < 0.001$), and weakness (Beta = 0.14, $p = 0.031$). Additionally, older age was associated with lower frequencies of fever (Beta = -0.28, $p < 0.001$) and skin toxicity (Beta = -0.30, $p < 0.001$), while female sex was linked to increased reports of weakness (Beta = 0.20, $p = 0.003$), hair loss (Beta = 0.25, $p = 0.001$), and edema (Beta = -0.22, $p = 0.001$).

Conclusion The findings underscore a substantial burden of chemotherapy-induced side effects among cancer patients treated in Palestinian hospitals, with treatment-related parameters—particularly the duration of chemotherapy sessions—significantly influencing the frequency of adverse effects. These results highlight the need for tailored counseling and personalized interventions that consider patient demographics and treatment characteristics to optimize care and improve quality of life.

Keywords Cancer, Chemotherapy, Adverse effects, Chemotherapy-induced side effects, Oncology

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Background

Globally, cancer is a major public health challenge. It is also the second leading cause of death in many nations, including the United States [1]. According to the World Health Organization, about 20 million new cancer cases were diagnosed and 9.7 million deaths were attributed to cancer in 2022 [2]. Approximately 1 in 5 people will develop cancer in their lifetime. In Palestine, cancer is the second leading cause of death [3, 4].

Cancer is frequently treated using various modalities, such as surgical resection, radiotherapy, hormonal therapy, immunotherapy, and chemotherapy [5]. Chemotherapy, a systemic treatment approach, employs drugs to destroy cancer cells or inhibit their growth [5]. It plays a crucial role in managing diverse malignancies, including both solid tumors and hematological cancers. However, chemotherapy is associated with a range of adverse effects that can significantly compromise patients' quality of life and treatment outcomes [6, 7].

Although chemotherapeutic agents exert their effects by targeting rapidly dividing cells, including cancer cells, these drugs can also affect normal, healthy cells in the body, leading to adverse effects [6, 7]. A thorough understanding of the mechanisms underlying chemotherapy—and the spectrum of its adverse effects—is essential for healthcare professionals to deliver optimal patient care and support [8].

The physical side effects of chemotherapy have been extensively described in the literature [9–11]. he most prevalent chemotherapy-induced side effects include bone marrow suppression, neuropathies, gastrointestinal disorders, hair loss, fatigue, and skin disorders. These well-characterized adverse effects contribute to our overall understanding of the significant challenges experienced by individuals undergoing chemotherapy.

Emerging evidence suggests that multiple patient-specific factors and treatment parameters significantly influence the profile of chemotherapy-induced adverse effects. Specifically, variations in sex and age may affect drug metabolism and toxicity, while body mass index has been associated with alterations in pharmacokinetics and differential susceptibility to side effects [12–14]. Additionally, preexisting comorbidities, past surgical history, and lifestyle factors such as smoking and sleep hours further contribute to the variability in patients' responses to chemotherapy [15–17]. Moreover, characteristics related to the cancer itself—including type and time since diagnosis—as well as treatment-related factors like the specific chemotherapy regimen, the number of chemotherapy cycles, and the duration of each chemotherapy session have been shown to modulate the incidence and severity of adverse effects [18, 19]. Understanding these interrelated factors is critical for optimizing treatment regimens and developing targeted interventions to reduce toxicity and improve the overall quality of life among cancer patients.

Patient awareness of chemotherapy side effects is not uniform and may be influenced by factors such as the quality of communication between healthcare providers and patients, educational programs, and the type of cancer and chemotherapy regimen [20–23]. Additionally, emerging evidence underscores the importance of tailoring information to meet individual patient needs and preferences [24].

Despite the growing body of literature, gaps remain in our understanding of how various factors collectively influence patient awareness and experiences of chemotherapy side effects. Understanding these interactions is essential for developing targeted interventions to improve patient education and communication strategies, ultimately enhancing the overall cancer care experience. Therefore, this study sought to assess real-world chemotherapy-induced side effects as recognized and reported by affected patients. The specific objectives of this study were as follows: (1) to assess the chemotherapy-induced side effects recognized and reported by cancer patients, (2) to determine the frequency of these side effects, and (3) to evaluate their impact on the physical, emotional, and social dimensions of patients' quality of life. A further objective was to examine the associations between patient characteristics, chemotherapy-induced side effects, and their impact on patients' quality of life.

Methods

Study design, sites, and settings

This study was a cross-sectional study conducted in adherence to the STrengthening the Reporting of OBservational studies in Epidemiology (STROBE) statement, with adherence to the checklist provided as Supplementary Table S1. The study was conducted in various hospitals in the West Bank of Palestine where cancer patients receive chemotherapy. These hospitals were selected because they are the primary cancer care centers in the region, characterized by high patient volumes, wide availability of oncology services, and broad geographic representation. Specifically, the study included An-Najah National University Hospital (Nablus) and Al-Watrani Hospital (Nablus) in the north, Jenin Governmental Hospital (Jenin) in the northern region, Al-Istishari Hospital (Ramallah) in the central West Bank, and Tulkarm Governmental Hospital (Tulkarm) in the western region. This selection ensured that the sample was representative of the diverse patient population accessing cancer care across the West Bank.

Study population and sample size

The study population consisted of cancer patients undergoing chemotherapy at the participating hospitals.

During the period of January to December 2023, approximately 1,000 patients were anticipated to attend the outpatient oncology clinics of these hospitals for treatment or consultations. Beyond these visits, cancer patients also utilized the hospitals for diagnostic procedures, chemotherapy cycles, autologous bone marrow transplants, and the management of side effects and complications. Using a 95% confidence interval, a 5% margin of error, and a response distribution of 0.5, the calculated sample size needed for this study was 278 cancer patients.

The inclusion criteria used in the study were: (1) cancer patients who were 18 years or older, (2) received cancer chemotherapy, (3) agreed to respond to a questionnaire. The study included both inpatients and outpatients diagnosed with solid cancers and hematologic malignancies. Cancer patients who did not receive chemotherapy, those admitted to intensive care or isolation units, and cancer survivors were excluded from this study.

Data collection and variables

This study was conducted with the help of a questionnaire/data collection tool. The development of this questionnaire was informed by previously validated instruments used in similar studies assessing chemotherapy-induced adverse effects. In particular, components related to the frequency and recognition of side effects were adapted from existing tools to ensure clinical relevance [15, 20, 23–25].

The patients were approached and invited to participate by the researchers. Patients undergoing chemotherapy at the participating hospitals were recruited conveniently. The questionnaire collected patient information including sex, age, weight, height, educational level, employment status, and place of residence. The patients were asked to self-rate their income as either low, middle, or high. The past medical and surgical history was obtained from the patients' medical records. The patients were asked to declare their smoking status as non-smoker, occasional smoker, or regular smoker. Patients were also asked to report their usual number of sleep hours.

The questionnaire also collected disease and treatment variables. Cancer type, time elapsed since diagnosis, type of chemotherapy, number of chemotherapy cycles, and duration of chemotherapy sessions were obtained from the patients' medical records. Patients were asked to declare the number of caregivers, their educational levels, and whether they had a family member with a healthcare background or a family member with cancer. Patients were also asked whether they had read the leaflets/drug information regarding the adverse effects of chemotherapy and whether they had been counseled by physicians, pharmacists, or nurses about these adverse effects.

The patients were also asked to report the occurrence of side effects including fever, vertigo, weakness, nausea/vomiting, constipation, diarrhea, anorexia, skin spots and keratinization, hair loss, depressed mood, unarticulated anxiety, nail degeneration, and edema. When experienced, patients were asked to report the frequency of these side effects as rarely, sometimes, or frequently.

Finally, the patients were asked to report if the side effects of chemotherapy affected the different physical, emotional, and social aspects of their lives. The questionnaire/data collection tool is provided as Supplementary Table S2.

The tool that was used in this study was previously developed and validated [15, 20, 23–25]. For this study, the questionnaire was reviewed by the research team and a panel of experts who were oncologists ($n = 3$), hematologists ($n = 2$), and internal medicine specialists ($n = 2$), to assess face validity. Furthermore, the questionnaire was pilot tested among 22 cancer patients to ensure its readability, clarity, and overall comprehensibility. The internal consistency of the tool was evaluated using Cronbach's alpha. The study tool had a Cronbach's alpha of 0.77, indicating that it was internally consistent.

Statistical analysis

The data entry and analysis for this study were conducted using the Statistical Package for Social Sciences (SPSS) version 25. Descriptive statistics, including frequencies (n), percentages (%), and the median with the interquartile range [Q1, Q3], were used to summarize the data. To capture clinically meaningful differences in the patient treatment profiles, specific cutoff points were used. For instance, patients were categorized as receiving either fewer than 4 or at least 4 chemotherapy cycles. This threshold was chosen because cumulative toxicity and the manifestation of adverse effects often become more pronounced after 3 cycles. Similarly, a cutoff of 3 h for the duration of chemotherapy sessions was selected based on standard infusion practices across the participating hospitals. Longer sessions generally indicate more intensive or complex regimens, which can be associated with a higher likelihood of adverse effects. These decisions were guided by both clinical practice and published evidence, thereby enhancing the study's ability to detect meaningful differences in outcomes and facilitate reproducibility across similar clinical settings. To explore the associations among the independent variables, side effects, and their impact on the physical, emotional, and social aspects of patients' quality of life, chi-square or Fisher's exact tests were used. To assess meaningful associations and identify the factors predicting chemotherapy-induced adverse effects experienced by the patients, multiple regression analyses were performed using the following independent variables: sex, age, body mass index, comorbidities, past surgical history, smoking status, sleep hours, cancer type, time

since cancer diagnosis, type of chemotherapy, number of chemotherapy cycles, and duration of chemotherapy sessions against each adverse effect reported by the patients. The model's goodness-of-fit was evaluated using R^2 values, and the absence of multicollinearity was confirmed by tolerance values greater than 0.2 and variance inflation factor (VIF) values less than 5. All statistical tests were two-sided, and statistical significance was defined as a p-value of less than 0.05.

Ethical considerations

This study was conducted in accordance with international and local ethical principles, including those outlined in the Declaration of Helsinki. Approval was obtained from the Institutional Review Board (IRB) of An-Najah National University (Approval reference number: Med. August. 2023/21). Permission was also obtained from the Ministry of Health for the governmental hospitals. All participants provided written informed consent.

Table 1 Sociodemographic and health characteristics of the patients ($n = 266$)

Variable	*n* (%)
Sex	
Male	157 (59.0)
Female	109 (41.0)
Age (years)	
< 50	134 (50.4)
≥ 50	132 (49.6)
Body mass index	
Normal weight	118 (44.4)
Overweight	99 (37.2)
Obese	49 (18.4)
Educational level	
School	218 (82.0)
University	48 (18.0)
Employment status	
Unemployed	203 (76.3)
Employed	63 (23.7)
Place of residence	
Village	78 (29.3)
City	120 (45.1)
Refugee camp	68 (25.6)
Self-rated income	
Low	87 (32.7)
Middle	171 (64.3)
High	8 (3.0)
Past medical history	
No	203 (76.3)
Yes	63 (23.7)
Past surgical history	
No	218 (82.0)
Yes	48 (18.0)
Smoking status	
Nonsmoker	152 (57.1)
Occasional smoker	75 (28.2)
Smoker	39 (14.7)
Number of sleep hours/day	
< 7	88 (33.1)
≥ 7	178 (66.9)

Results

Characteristics of the patients

In this study, a total of 266 cancer patients were included. The median age of the patients was 48 [25, 60] years. Of the patients, 157 (59.0%) were male; 148 (55.6%) were either overweight or obese; 48 (18.0%) had a university education; 203 (76.3%) were unemployed; 78 (29.3%) lived in villages; 68 (25.6%) lived in refugee camps; and 171 (64.3%) had a middle income. Additionally, 63 (23.7%) had a past medical history, 48 (18.0%) had a past surgical history, 114 (42.9%) were either occasional or regular smokers, and 88 (33.1%) slept less than 7 h. The characteristics of the patients are shown in Table 1.

Of the patients, 48 (18.0%) had hematological cancers, and the remaining patients had solid cancers. The details of the cancer types are shown in Table 2. Among the patients, 107 (40.2%) had been diagnosed more than 1 year ago, and 109 (41.0%) received alkylating agents. The details of chemotherapy are shown in Table 2. Additionally, 144 (54.1%) patients received four or more chemotherapy cycles, and 214 (80.5%) underwent chemotherapy sessions lasting 3 h or more. Furthermore, 65 (24.4%) patients had three or more caregivers; the caregivers of 125 (47.0%) patients had a university education; 95 (35.7%) patients had a family member with healthcare education; and 68 (25.6%) had a family member with cancer. Moreover, 172 (64.7%) patients read leaflets or drug information, 199 (74.8%) were counseled by physicians, 136 (51.1%) were counseled by pharmacists, and 166 (62.4%) were counseled by nurses about the adverse effects of chemotherapy. These details are shown in Table 2.

Frequency of adverse effects recognized by the patients

Of the patients, 244 (91.7%) reported weakness, 234 (88.0%) reported hair loss, 232 (87.2%) reported vertigo, 228 (85.7%) reported anorexia, 226 (85.0%) reported nausea/vomiting and unarticulated anxiety, 222 (83.5%) reported depressed mood, 206 (77.4%) reported constipation, 200 (75.2%) reported diarrhea, 192 (72.2%) reported nail degeneration, 191 (71.8%) reported skin spots/keratinization, 186 (69.9%) reported fever, and 173 (65.0%) reported edema. The frequency of these adverse effects is shown in Table 3. In addition, the frequencies of adverse effects categorized by cancer type are shown in Supplementary Table S3.

Table 2 Cancer type, caregiving, chemotherapy, and knowledge about the adverse effects of chemotherapy

Variable	*n* (%)
Cancer type	
Hematological (Leukemia/lymphoma)	48 (18.0)
Breast	34 (12.8)
Colon/colorectal	33 (12.4)
Prostate	25 (9.4)
Lung	23 (8.6)
Lymph nodes	21 (7.9)
Gastric	21 (7.9)
Pancreas	15 (5.6)
Bone	13 (4.9)
Liver	12 (4.5)
Ovarian/uterine	10 (3.8)
Head/neck	7 (2.6)
Thymic carcinoma	4 (1.5)
Time since diagnosis with cancer (years)	
≤ 1	159 (59.8)
> 1	107 (40.2)
Chemotherapy	
Alkylating agents	109 (41.0)
Vinca alkaloids	48 (18.0)
Antimetabolites	40 (15.0)
Taxanes	31 (11.7)
Altretamine	28 (10.5)
Topoisomerase inhibitors	6 (2.3)
Platinum-based agents	4 (1.5)
Number of chemotherapy cycles	
< 4	122 (45.9)
≥ 4	144 (54.1)
Duration of chemotherapy session (hours)	
< 3	52 (19.5)
≥ 3	214 (80.5)
Number of caregivers	
1	128 (48.1)
2	73 (27.4)
3 or more	65 (24.4)
Educational level of the caregivers	
School	141 (53.0)
University	125 (47.0)
A family member with healthcare education	
No	171 (64.3)
Yes	95 (35.7)
A family member with cancer	
No	198 (74.4)
Yes	68 (25.6)
Read leaflets/drug information about the adverse effects of chemotherapy	
No	94 (35.3)
Yes	172 (64.7)
Was counseled by physicians about the adverse effects of chemotherapy	
No	67 (25.2)
Yes	199 (74.8)
Was counseled by pharmacists about the adverse effects of chemotherapy	
No	130 (48.9)
Yes	136 (51.1)
Was counseled by nurses about the adverse effects of chemotherapy	
No	100 (37.6)
Yes	166 (62.4)

Associations between the variables of the patients with chemotherapy adverse effects

Univariate analysis showed that chemotherapy adverse effects, including fever, vertigo, weakness, nausea/vomiting, constipation, diarrhea, anorexia, skin spots/keratinization, hair loss, depressed mood, unarticulated anxiety, nail degeneration, and edema were associated with different demographic and treatment related variables. The factors associated with fever, vertigo, weakness, nausea/vomiting, constipation, diarrhea, anorexia, skin spots/keratinization, hair loss, depressed mood, unarticulated anxiety, nail degeneration, and edema are shown in Supplementary Tables S4-S16. Regression models were used to identify the factors predicting chemotherapy adverse effects experienced by the patients. As shown in Table 4, older age was associated with a lower frequency of fever (Beta = −0.28, $p < 0.001$), while a longer duration of the chemotherapy session was linked to a higher frequency of fever (Beta = 0.29, $p < 0.001$). A past surgical history was associated with vertigo (Beta = 0.17, $p = 0.017$) and a lower number of chemotherapy cycles were associated with a greater frequency (Beta = −0.16, $p = 0.017$) of vertigo. Additionally, a longer duration of the chemotherapy session also predicted higher vertigo (Beta = 0.29, $p < 0.001$). For weakness, being female (Beta = 0.20, $p = 0.003$), having a higher body mass index (Beta = 0.13, $p = 0.025$), and having a past surgical history (Beta = 0.25, $p < 0.001$) were associated with a greater frequency. Interestingly, a longer time since cancer diagnosis (Beta = −0.12, $p = 0.038$) and a higher number of chemotherapy cycles (Beta = 0.11, $p = 0.047$) were associated with a lower frequency, while a longer chemotherapy session (Beta = 0.14, $p = 0.031$) predicted higher reports of weakness. For nausea/vomiting, a higher body mass index (Beta = 0.14, $p = 0.033$) and a longer duration of the chemotherapy session (Beta = 0.25, $p < 0.001$) were significant positive predictors. For constipation, older age (Beta = −0.14, $p = 0.052$, approaching significance) and more sleep hours (Beta = −0.12, $p = 0.038$) tended to be associated with a lower frequency, while a longer chemotherapy session (Beta = 0.27, $p < 0.001$) was associated with a higher frequency. Diarrhea was significantly predicted by a longer duration of the chemotherapy session (Beta = 0.30, $p < 0.001$), with longer sessions associated with more

Table 3 Frequency of the adverse effects as recognized by the patients

Adverse effects	Never	Rarely	Sometimes	Frequently
	n (%)	*n* (%)	*n* (%)	*n* (%)
Fever	80 (30.1)	88 (33.1)	74 (27.8)	24 (9.0)
Vertigo	34 (12.8)	59 (22.2)	131 (49.2)	42 (15.8)
Weakness	22 (8.3)	54 (20.3)	108 (40.6)	82 (30.8)
Nausea/vomiting	40 (15.0)	66 (24.8)	87 (32.7)	73 (27.4)
Constipation	60 (22.6)	58 (21.8)	91 (34.2)	57 (21.4)
Diarrhea	66 (24.8)	62 (23.3)	81 (30.5)	57 (21.4)
Anorexia	38 (14.3)	46 (17.3)	118 (44.4)	64 (24.1)
Skin spots/keratinization	75 (28.2)	56 (21.1)	85 (32.0)	50 (18.8)
Hair loss	32 (12.0)	51 (19.2)	92 (34.6)	91 (34.2)
Depressed mood	44 (16.5)	71 (26.7)	93 (35.0)	58 (21.8)
Unarticulated anxiety	40 (15.0)	74 (27.8)	90 (33.8)	62 (23.3)
Nail degeneration	74 (27.8)	45 (16.9)	86 (32.3)	61 (22.9)
Edema	93 (35.0)	55 (20.7)	78 (29.3)	40 (15.0)

frequent reports. Skin spots and keratinization were less frequent in older patients (Beta = −0.30, $p < 0.001$) and more frequent with longer chemotherapy sessions (Beta = 0.18, $p = 0.006$). For anorexia, having comorbidities (Beta = 0.15, $p = 0.033$) and a longer chemotherapy session (Beta = 0.22, $p = 0.001$) were significant predictors of a higher occurrence. Hair loss was more frequent in females (Beta = 0.25, $p = 0.001$), in those with a higher body mass index (Beta = 0.12, $p = 0.051$, approaching significance), and in those with comorbidities (Beta = 0.14, $p = 0.028$); it also increased with a higher number of chemotherapy cycles (Beta = 0.14, $p = 0.016$) and a longer duration of the chemotherapy session (Beta = 0.23, $p < 0.001$). A longer time since cancer diagnosis (Beta = −0.10, $p = 0.054$, approaching significance) was associated with less hair loss. Regarding depressed mood, a longer time since cancer diagnosis (Beta = −0.14, $p = 0.018$) was associated with a lower frequency, while a longer chemotherapy session (Beta = 0.23, $p = 0.001$) predicted a higher frequency. Similarly, for unarticulated anxiety, a longer time since cancer diagnosis (Beta = −0.16, $p = 0.008$) was associated with a lower frequency, and a longer chemotherapy session (Beta = 0.20, $p = 0.003$) was associated with a higher frequency. Finally, nail degeneration was less frequent in older patients (Beta = −0.17, $p = 0.019$) and more frequent with longer chemotherapy sessions (Beta = 0.22, $p = 0.001$). Edema was less frequent in females (Beta = −0.22, $p = 0.001$) and older patients (Beta = −0.24, $p < 0.001$), but more frequent with a longer duration of the chemotherapy session (Beta = 0.20, $p = 0.001$). Details of the regression models are shown in Supplementary Table S17.

The impact of the chemotherapy on the physical, emotional, and social aspects of the lives of the patients

The adverse effects of chemotherapy affected the ability of 108 (40.6%) patients to accomplish daily activities, 106 (39.8%) to go out without help, and 118 (44.4%) to take a half-hour walk. On the other hand, 113 (42.5%) experienced difficulty walking even a short distance, 92 (34.6%) were unable to walk up and down the stairs, 83 (31.2%) were unable to take a bath, 142 (53.4%) lost weight, 97 (36.5%) did not sleep well, and 130 (48.9%) experienced vomiting. Of the patients, 122 (45.9%) did not feel well, 140 (52.6%) did not have a good appetite, 115 (43.2%) did not enjoy meals, 98 (36.8%) were unable to deal with stress, 133 (50.0%) were unable to concentrate, and 157 (59.0%) were worried about their disease. Of the patients, 77 (28.9%) did not receive any encouragement, 85 (32.0%) had problems interacting with people outside their family, 110 (41.4%) were troubled by the treatment, and 133 (50.0%) were worried about their future social life. These details are shown in Table 5.

Discussion

Chemotherapy is a main stay in the treatment of different solid and hematological cancers [5, 6, 9]. Chemotherapy can be associated with significant side effects that can impact the physical, emotional, and social aspects of the lives of affected patients. It has been argued that patients experience treatment-related adverse effects differently [11, 24–26]. For the first time in Palestine, chemotherapy-induced side effects as recognized and reported by cancer patients were assessed. Moreover, the impact of these side effects on the physical, emotional, and social well-being of patients was evaluated for the first time in Palestine. The findings from this study warrant consideration by oncologists and other healthcare providers caring for patients with cancer. These findings might be used to improve the experiences and outcomes of cancer patients undergoing chemotherapy in Palestinian hospitals.

The finding of this study showed a high prevalence of chemotherapy-induced side effects among the cancer

Table 4 Predicting factors of chemotherapy adverse effects experienced by the patients

Variable	Unstandardized coefficients		Standardized coefficients			Collinearity statistics	
	B	SE	Beta	t	*p*-value	Tolerance	VIF
Fever							
Age	−0.01	0.00	−0.28	−3.99	< 0.001	0.64	1.57
Duration of chemotherapy session	0.32	0.07	0.29	4.43	< 0.001	0.77	1.30
Vertigo							
Past surgical history	0.40	0.17	0.17	2.40	0.017	0.66	1.52
Number of chemotherapy cycles	−0.05	0.02	−0.16	−2.39	0.017	0.78	1.28
Duration of chemotherapy session	0.30	0.07	0.29	4.44	< 0.001	0.77	1.30
Weakness							
Sex	0.38	0.13	0.20	2.95	0.003	0.62	1.61
Body mass index	0.03	0.01	0.13	2.25	0.025	0.87	1.15
Past surgical history	0.59	0.16	0.25	3.66	< 0.001	0.66	1.52
Cancer	−0.03	0.01	−0.12	−2.08	0.038	0.96	1.04
Chemotherapy	0.05	0.02	0.11	2.00	0.047	0.94	1.07
Duration of chemotherapy session	0.14	0.07	0.14	2.16	0.031	0.77	1.30
Nausea/vomiting							
Body mass index	0.03	0.01	0.14	2.14	0.033	0.87	1.15
Cancer	−0.03	0.02	−0.12	−1.94	0.054	0.96	1.04
Duration of chemotherapy session	0.30	0.08	0.25	3.69	< 0.001	0.77	1.30
Constipation							
Age	−0.01	0.00	−0.14	−1.95	0.052	0.64	1.57
Sleep hours	−0.09	0.04	−0.12	−2.08	0.038	0.93	1.07
Duration of chemotherapy session	0.34	0.08	0.27	4.20	< 0.001	0.77	1.30
Diarrhea							
Duration of chemotherapy session	0.38	0.08	0.30	4.48	< 0.001	0.77	1.30
Skin spots and keratinization							
Age	−0.02	0.00	−0.30	−4.26	< 0.001	0.64	1.57
Duration of chemotherapy session	0.23	0.08	0.18	2.77	0.006	0.77	1.30
Anorexia							
Comorbidities	0.33	0.16	0.15	2.15	0.033	0.77	1.30
Duration of chemotherapy session	0.25	0.08	0.22	3.25	0.001	0.77	1.30
Hair loss							
Sex	0.50	0.14	0.25	3.48	0.001	0.62	1.61
Body mass index	0.03	0.01	0.12	1.96	0.051	0.87	1.15
Comorbidities	0.33	0.15	0.14	2.22	0.028	0.77	1.30
Chemotherapy	0.07	0.03	0.14	2.43	0.016	0.94	1.07
Duration of chemotherapy session	0.27	0.07	0.23	3.67	< 0.001	0.77	1.30
Depressed mood							
Cancer	−0.04	0.02	−0.14	−2.39	0.018	0.96	1.04
Duration of chemotherapy session	0.27	0.08	0.23	3.38	0.001	0.77	1.30
Unarticulated anxiety							
Cancer	−0.05	0.02	−0.16	−2.67	0.008	0.96	1.04
Duration of chemotherapy session	0.23	0.08	0.20	2.96	0.003	0.77	1.30
Nail degeneration							
Age	−0.01	0.00	−0.17	−2.36	0.019	0.64	1.57
Duration of chemotherapy session	0.29	0.09	0.22	3.31	0.001	0.77	1.30
Edema							
Sex	−0.50	0.15	−0.22	−3.24	0.001	0.62	1.61
Age	−0.01	0.00	−0.24	−3.55	< 0.001	0.64	1.57
Duration of chemotherapy session	0.25	0.08	0.20	3.24	0.001	0.77	1.30

SE Standard error, *t* t-statistics, *VIF* Variance inflation factor

Table 5 The impact of chemotherapy on the physical, emotional, and social aspects of the lives of the patients

Physical aspects	No	Yes
	n (%)	*n* (%)
Able to accomplish daily activity	108 (40.6)	158 (59.4)
Able to go out without help	106 (39.8)	160 (60.2)
Able to take a half hour walk	118 (44.4)	148 (55.6)
Feel difficulty walking even a short distance	153 (57.5)	113 (42.5)
Walk up and down the stairs	92 (34.6)	174 (65.4)
Able to take a bath	83 (31.2)	183 (68.8)
Lose any weight	124 (46.6)	142 (53.4)
Sleep well	97 (36.5)	169 (63.5)
Experience any vomiting	136 (51.1)	130 (48.9)
Emotional aspects		
Feel well	122 (45.9)	144 (54.1)
Have a good appetite	140 (52.6)	126 (47.4)
Enjoy meal	115 (43.2)	151 (56.8)
Able to deal with stress	98 (36.8)	168 (63.2)
Unable to concentrate	133 (50.0)	133 (50.0)
Worry about disease	109 (41.0)	157 (59.0)
Social aspects		
Get any encouragement	77 (28.9)	189 (71.1)
Have problems dealing with people outside the family	181 (68.0)	85 (32.0)
The family was troubled by the treatment	156 (58.6)	110 (41.4)
Worry about future social life	133 (50.0)	133 (50.0)

patients who received chemotherapy in the Palestinian hospitals in the West Bank. Among the most commonly reported symptoms were weakness, hair loss, and vertigo. These findings were consistent with those reported in previous studies among cancer patients who received chemotherapy in different healthcare systems [5, 6, 9, 11, 15, 24, 25]. It is well-established that cancer patients receiving chemotherapy suffer a significant burden as a result of the chemotherapy-induced adverse effects. These chemotherapy-induced adverse effects are known to deteriorate the quality of life of the affected patients. Documenting real-world experiences of cancer patients undergoing chemotherapy captures the comprehensive spectrum of side effects in clinical practice. These insights can inform targeted education and counseling for patients receiving or scheduled to receive chemotherapy, thereby potentially improving their experiences and outcomes in Palestinian clinical practice.

The findings of this study showed a significant impact of the chemotherapy-induced side effects on the physical, emotional, and social aspects of the quality of life of the patients. Certain physical symptoms—such as weakness, nausea/vomiting, and anorexia—can impair daily functioning and compromise functional independence [27, 28]. These findings indicate the oncologists and other healthcare providers should routinely screen for chemotherapy-induced adverse effects and evaluate the extent to which they limit patients' ability to lead a normal life. Furthermore, providing counseling and education regarding these adverse effects, along with guidance on effective coping strategies, may help mitigate their impact on quality of life. Moreover, psychological distress—including depressed mood and unarticulated anxiety—highlights the emotional burden of chemotherapy on patient wellbeing, while social limitations, such as difficulties interacting with others and concerns about future social life, further underscore this burden. In summary, integrating systematic screening and supportive interventions into clinical practice is essential to reduce the adverse impact of chemotherapy on patients' overall quality of life [9, 29]. In addition, social limitations including difficulties in interacting with others and concerns about future social life indicate a heavy burden of chemotherapy on the wellbeing of the patients. These findings indicate that oncologists and other healthcare providers should consider screening for the chemotherapy-induced side effects. In addition, healthcare providers should consider ways to reduce the burden of these side effects on the quality of life of the affected patients.

The study identified several sociodemographic and clinical factors that may influence chemotherapy-induced side effects, including age, sex, socioeconomic status, and past medical history. Collectively, these factors suggest a complex interplay between patient characteristics and treatment-related side effects [9, 11, 24, 25, 27]. Consequently, healthcare providers should consider these factors when screening for chemotherapy-induced side

effects and design tailored, patient-specific counseling and educational sessions.

Our regression analyses further revealed that treatment-related parameters, especially the duration of chemotherapy sessions, are critical predictors of adverse effects. Specifically, longer chemotherapy sessions were consistently associated with a higher frequency of side effects such as fever, vertigo, and weakness. These findings corroborate observations reported in previous studies [9, 15, 18, 25], thereby extending their applicability to a Palestinian patient cohort. Additionally, our study found that older age was linked to a reduced frequency of certain adverse effects—such as fever and skin toxicity—suggesting potential protective factors attributable to age-dependent variations in drug metabolism. Although the inclusion of stratified analyses (e.g., interaction terms or subgroup-specific regression) might have provided deeper insights into these variabilities, our findings still yield important clinical indicators. The increased frequency of adverse effects among female patients aligns with previous studies and supports the implementation of gender-sensitive approaches in chemotherapy management, potentially reflecting hormonal or pharmacokinetic differences. Together, these observations underscore the need for treatment protocols that account for patient-specific factors as well as treatment parameters, thereby paving the way for personalized patient counseling and management strategies. Future research incorporating detailed stratified analyses is warranted to further refine these recommendations and guide clinical practice.

The results of this study have significant implications for oncological clinical practice in Palestine. Understanding the prevalence, patterns, and factors associated with chemotherapy-induced side effects can help oncologists and other healthcare providers design personalized counseling sessions and treatment strategies for individual patients. Moreover, these findings highlight the importance of promoting effective communication among patients, their caregivers, and healthcare providers, as such communication may optimize patient outcomes and enhance the overall care experience.

Strengths of the study

This study possesses several notable strengths. First, it is the first investigation of its kind in Palestine, providing valuable baseline data on chemotherapy-induced side effects within the local population. Second, the use of a structured, validated questionnaire—refined through expert review by a panel of oncologists, hematologists, and internal medicine specialists, and pilot tested among 22 cancer patients—ensured clarity, comprehensibility, and strong face validity. Third, the study combined self-reported data with information extracted from electronic medical records, allowing for a comprehensive analysis of both subjective experiences and objective clinical variables. Additionally, the application of robust statistical methods, including multiple regression analysis, facilitated the identification of significant predictors of adverse effects, thereby offering insights into the complex interplay of treatment parameters and patient characteristics. Collectively, these strengths enhance the study's internal validity and underscore its potential to inform personalized patient care and guide future research in the Palestinian clinical setting.

Limitations of the study

This study has several limitations. First, its cross-sectional design precludes establishing causal relationships between the independent variables and the outcomes. On the other hand, the use of a cross-sectional design was well suited to our objective of assessing patient recognition of chemotherapy-induced adverse effects in a real-world setting. Confidence in the study's reproducibility was ensured through several methodological approaches. We strictly adhered to the STROBE checklist while reporting our findings and recruited patients from the five major hospitals providing cancer care in Palestine. In addition, standardized protocols for patient recruitment, data collection, and extraction of clinical records were implemented, and data were collected using a validated, pilot-tested questionnaire. These comprehensive procedures facilitate a high degree of reproducibility and enable other researchers to replicate our study under similar clinical settings. Second, the reliance on a questionnaire that, despite demonstrating acceptable internal consistency and being face validated by experts, has not been subjected to comprehensive construct or content validation. Although the questionnaire was developed based on previously validated tools and tailored to capture the specificities of chemotherapy-induced adverse effects in our setting [15, 20, 23–25], the absence of formal construct validation may limit the instrument's robustness and the generalizability of our findings. Third, recall bias was also a major concern, as patients were required to retrospectively report the occurrence and frequency of chemotherapy-induced adverse effects, which may affect the accuracy of the findings. Fourth, the study's relatively small sample size and the use of self-reported data may limit the generalizability of the results. However, despite these limitations, the inclusion of 266 patients provides valuable insights given the pioneering nature of this study in the Palestinian context, and it establishes an important baseline for future research. In addition, a post hoc power analysis indicated that sufficient power was maintained for the primary analyses. Specifically, under a two-tailed significance level of 0.05 and using effect sizes consistent with those observed in

our regression models, the sample size provided approximately 80% power to detect medium effects ($f^2 \approx 0.10$) as calculated using G*Power. It is, however, important to acknowledge that subgroup analyses—where the sample was further subdivided—may have suffered from reduced power, potentially limiting the detection of smaller or more nuanced effects. Future research with larger cohorts is recommended to enhance statistical power for such detailed subgroup evaluations. Other limitations include the potential for incomplete or inconsistent data in the electronic medical records, the absence of long-term follow-up, and the possibility of unmeasured confounders and selection bias influencing the outcomes.

Conclusion

The findings of this study indicate that chemotherapy-induced side effects impose a heavy burden on cancer patients treated in Palestinian hospitals. These side effects negatively impacted the physical, emotional, and social dimensions of patients' quality of life. The prevalence and frequency of these side effects were influenced by various sociodemographic and clinical factors. Oncologists and healthcare providers should consider offering tailored counseling and educational sessions that provide personalized information to individual patients.

Supplementary Information

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Supplementary Material 1.

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Authors' contributions
Riad Amer, Sultan Mosleh, and Ramzi Shawahna were involved in the conception and design of the work, analysis and interpretation of data, and drafting and final approval of the manuscript. Ayah Maqdasawi, Rawan Ghanayiem, and Marwa Khalaf were involved in the data acquisition, analysis, drafting of the work and final approval of the version to be published. All authors approved the final manuscript.

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Data availability
All data analyzed in this study were included in the manuscript. The datasets used in the analysis or entered into statistical software can be obtained from the corresponding author upon making a reasonable request.

Declarations

Ethics approval and consent to participate
This study was conducted in accordance with international and local ethical principles, including those outlined in the Declaration of Helsinki. Approval was obtained from the Institutional Review Board (IRB) of An-Najah National University (Approval reference number: Med. August. 2023/21). Permission was also obtained from the Ministry of Health for the governmental hospitals. All participants provided written informed consent.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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