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The Relationship between Patients' Chemotherapy-Induced Peripheral Neuropathy and their Demographic and Clinical Characteristics

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ABSTRACT

Objective(s): To find out the relationship between patients' chemotherapy-induced peripheral neuropathy (CIPN) and their demographic and clinical characteristics.

Methods: The study utilized a descriptive cross-sectional design conducted at two oncology centers. A purposive sampling method was used to collect data from 102 breast or lung cancer patients receiving neurotoxic chemotherapy from December 2022 to May 2023. A 20-item EORTC QLQ-CIPN20 scale was used to evaluate CIPN symptoms. The content validity was evaluated by 12 expert, The Cronbach alpha reliability coefficient was 0.8, indicating that the instrument is reliable. Descriptive and inferential analyses approaches was used for the data analysis.

Results: The study showed significant statistical differences between patients' chemotherapy-induced peripheral neuropathy with their age group, chemotherapy, and tumor stage at $P < 0.05$. Moreover, the results showed a significant statistical positive correlation between patients' chemotherapy-induced peripheral neuropathy with their number of chemotherapy cycles and cumulative dose at $P < 0.05$.

Conclusion: Participants age, cancer stage, type of chemotherapeutic agents, number of chemotherapy cycles, and cumulative dose were all correlated with the development of CIPN.

Recommendation: Conducting future research with a larger sample size would be beneficial and allowing for differentiation the results among participants with different cancer types and varying chemotherapy agents.

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العلاقة بين مرضى الاعتلال العصبي المحيطي الناجم عن العلاج الكيميائي وخصائصهم الديموغرافية والسريرية

المستخلص

الهدف: معرفة العلاقة بين الاعتلال العصبي المحيطي الناجم عن العلاج الكيميائي للمرضى وخصائصهم الديموغرافية والبيانات السريرية.

المنهجية: استخدمت الدراسة تصميم مقطعي وصفي وأجريت في مركزين للأورام. تم استخدام طريقة أخذ العينات هادفة لجمع البيانات من 102 مريض بسرطان الثدي أو الرئة يتلقون العلاج الكيميائي السام للأعصاب من ديسمبر 2022 إلى مايو 2023.تم استخدام استبيان EORTC QLQ-CIPN-20 لتقييم الاعتلال العصبي المحيطي للمرضى الناجم عن العلاج الكيميائي. تقييم صدق المحتوى من قبل 12 خبيراً، وبلغ معامل ثبات ألفا كرونباخ 0.8 مما يدل على موثوقية الأداة. وتم استخدام منهج التحليل الوصفي والاستنتاجي لتحليل البيانات.

النتائج: أظهرت الدراسة فروق ذات دلالة إحصائية بين الاعتلال العصبي المحيطي الناجم عن العلاج الكيميائي للمرضى مع فئتهم العمرية ونوع العلاج الكيميائي ومرحلة الورم عند P <0.05. علاوة على ذلك ، أظهرت النتائج وجود علاقة ذات دلالة إحصائية موجبة بين الاعتلال العصبي المحيطي الناجم عن العلاج الكيميائي للمرضى مع عدد دورات العلاج الكيميائي والجرعة التراكمية عند P <0.05.

التوصيات: إن إجراء بحث مستقبلي بحجم عينة أكبر سيكون ذي نتائج مفيدة ويسمح بتمييز النتائج بين المشاركين الذين لديهم أنواع مختلفة من السرطان وعوامل علاج كيميائي مختلفة.

الكلمات المفتاحية: الاعتلال العصبي المحيطي الناجم عن العلاج الكيميائي ، المرضى ، الخصائص الديموغرافية ، الخصائص السريري

Introduction

Globally, cancer is the second cause of death and one of the main public health problem[1]. Cancer imposes a significant burdens on societies, particularly on developing countries, contributing to a considerable societal impact[2].

Over the past ten years, cancer rates have increased among people in the Middle East, especially in Iraq[3].

The World Health Organization has presented Iraq's cancer statistics for new cases in 2020, revealing that lung cancer is the most common cancer among males (15.2%), while breast cancer holds the highest prevalence among females (37.9%)[4].

The increasing prevalence of cancer can be attributed to the simultaneous growth of the population and the aging demographic, coupled with the escalation of risk factors associated with the adoption of a western lifestyle, including sedentary behavior, tobacco use, and obesity [1,3,5].

Chemotherapy is one of the primary interventions in managing the malignant tumors, and it can be administered as the primary therapy or in combination with other treatments such as radiation therapy or surgical resection. It may also be given before or after the primary treatment. Although antineoplastic agents are initially designed and intended to selectively target malignant cells, they also have detrimental effects on healthy host cells, as evident from the occurrence of systemic adverse reactions[5].

CIPN is one of the most common dose-limiting and long-standing side effect caused by several chemotherapeutic agents[6]. The neurotoxic antineoplastic drugs lead to nerve fibers damage, degeneration, and inflammation[7]. Oncology nurses frequently report this treatment-related

adverse effect when caring for patients with cancer. CIPN has been documented to manifest in a varying percentage, ranging from 10% to 100%, among patients receiving platinum, taxane, and plant alkaloid therapies[8].

A tendency to develop CIPN is generally observed in nerves that were previously affected by inherited neuropathy, diabetes mellitus, alcohol use, and thyroid dysfunction[9].

The CIPN can result in sensory loss, hypersensitivity, and functional deficits such as tingling, numbness, and discomfort[10]. While some patients experience severe neuropathic pain, others may experience sensory loss without pain[11]. The impairment of both gross and fine motor skills can occur, along with loss of proprioception and numbness in the hands and feet, leading to an increased risk of falls and injuries[12].

In addition to the physical manifestations and functional decline, CIPN can also induce psychological symptoms that have the potential to disrupt daily functioning[13].

Many studies found that CIPN was associated with increased healthcare costs, decreased work productivity, higher rates of disability and early retirement. In addition to direct healthcare costs, such as increased medication and hospitalization expenses, CIPN can also lead to indirect costs, such as lost wages and reduced quality of life[14].

The rising incidence and prevalence of cancer, coupled with the absence of proven preventative or treatment options for CIPN, means that more patients are facing the consequences of this condition. Consequently, CIPN is expected to emerge as a significant concern, carrying substantial social and economic implications for society[15].

The nurses plays a crucial role in educating patients about their treatment objectives, the possible adverse effects, how to manage them effectively, self-care practices, and emotional well-being[16]. As a result, the nursing team responsible for caring for cancer patients must continuously assess and manage any adverse events that may occur with chemotherapy[16].

The present study aims to find out the relationship between patients' CIPN and their demographic characteristics and clinical data.

Methods

Study Design and Setting

The study utilized a descriptive cross-sectional design conducted across two specialized centers in Babylon Province: the Babylon Oncology Center situated in Marjan Medical City at the heart of Hilla city, operational since 2015; and the Oncology and Radiotherapy Center located within Imam Al-Sadiq Hospital in central Hilla, established in 2018. These centers were selected due to their exclusive focus on oncologic diseases within the province, serving as primary destinations for cancer patients referred from clinics, primary health centers, and hospitals.

Study Sample and Sampling

A non-probability (purposive) sampling method was used. The study sample was selected from patients with breast and lung cancer receiving neurotoxic chemotherapy agents. According to the statistics from the Babylon Health Directorate, the breast and lung cancer cases in Babylon City were 414 at 2020, (111) patients agreed to participate in this study. Nine patients withdrew during the data collection process because they felt tired or developed nausea and vomiting as a result of chemotherapy administration. A total of 102 patients were included in the data collection from the period of December 2022 to May 2023. The participants were provided

with written consent to participate in the study.

Data Collection and the Study Instruments

The study tool involves a 20-item EORTC QLQ-CIPN20 scale to evaluate CIPN symptoms. The EORTC QLQ-CIPN20 scale is a valuable tool for assessing CIPN-related quality of life issues in cancer patients[13]. Its specificity, comprehensiveness, sensitivity to change, and validation make it an important instrument for both clinical practice and research in the field of oncology.

A permission was obtained from the copyright owner EORTC by Email, according to Brisling`s back translation model[15], the EORTC QLQ–CIPN-20 was translated into Arabic by two bilingual physicians who work in the Imam Al-Sadiq Hospital/Oncology and Radiotherapy Center. A proficient native speaker of Arabic language was responsible for conducting the back-translation of the instrument, and after comparing the two translations with the original, the final translations were determined.

The Instruments Validity and Reliability

The content validity was evaluated by 12 experts using the content validity index, The content validity of this tool was checked by (7) expert from College of Nursing / University of Baghdad from the faculty members, (one) expert from College of Nursing/ University of Kerbala from the faculty members, (2) expert from Babylon Oncology, (2) expert from Oncology and Radiotherapy Center in Imam Al-Sadiq Hospital. In order to evaluate expert opinion, the Content Validity Index (CVI) was adopted. The adequacy of each questionnaire item was evaluated by the experts on a scale of 1 to 4: 1: not suitable, 2: suitable, 3: well suitable and 4: very suitable. The formula for CVI involves dividing the number of experts who find an item relevant by the total number of experts. This yields a proportion indicating the content validity of that item. Higher CVI values suggest stronger content validity. The mean of CVI for Arabic version of EORTC QLQ–CIPN-20 tool equal to 0.952.

A pilot study with 11 patients was conducted to assess the reliability of the Arabic version of the EORTC QLQ-CIPN20. The Cronbach alpha reliability coefficient was 0.8, indicating that the instrument is reliable for measuring the study phenomenon in the future. The EORTC QLQ-CIPN20 scale comprises 20 items that patients use to rate their symptoms over the previous week. The ratings for the CIPN20 scale range from 1 to 4, with 1 representing "not at all" and 4 representing "very much." To calculate the sum score, the scores from items 1 to 19 are added together, resulting in a range of 19 to 76 or 20 to 80. Furthermore, the CIPN20 items are divided into three subscales: sensory (items 1, 2, 3, 4, 5, 6, 9, 10, and 18), motor (items 7, 8, 11, 12, 13, 14, 15, and 19), and autonomic (items 16, 17, and 20)[13]. Participants use a 4-point Likert scale (1 = "not at all," 2 = "a little," 3 = "quite a bit," and 4 = "very much") to indicate the extent of their sensory, motor, and autonomic symptoms experienced during the past week. Sensory raw scores range from 9 to 36, motor raw scores range from 8 to 32, and autonomic raw scores range from 3 to 12 for men and 2 to 8 for women (excluding the erectile function item). All scale scores are then linearly converted to a 0-100 scale, with higher scores indicating a greater burden of symptoms item)[13]. The demographic data consisted of (five) items including age, gender, occupation, BMI, and smoking. While the clinical data which consists of (five) items including site of cancer, stage of cancer, chemotherapeutic agent, number of chemotherapy cycles, and a cumulative dose. Chemotherapy cycles are planned sequences of treatment sessions designed to combat cancer by maximizing treatment benefits while minimizing side effects. The cycles consist of an active treatment phase, where

patients receive chemotherapy drugs either through intravenous drips or oral tablets, followed by a rest period to allow the body to recover. The duration and frequency of cycles vary based on the specific drugs used, with some lasting a few hours and others extending to several days[7]. A series of cycles written in patient's file. The Statistical Package for Social Sciences (SPSS) version 26 software to manage and analyze the study data, conducting both descriptive and inferential analyses on the sample data.

Data Analysis

A descriptive data analysis involved assessing frequency and percentage, as well as calculating the mean scores and standard deviation. In the realm of inferential data analysis, various statistical tests were employed to determine the acceptance or rejection of specific hypotheses. These tests included the Pearson correlation test, two-sample independent t-test, and analysis of variance (ANOVA), aimed at examining correlations and differences between variables. For the sake of comparative significance (C.S.), the following abbreviations were employed: Non-significant when the probability value exceeded 0.05, as per Serdar et al. (2021), and significant when the probability value equaled or was less than 0.05, following the same reference.

Results

Table 1. Distribution of the Patients According to their Demographic Characteristics

Demographic Characteristics	Subgroup	f.	%
Age Group	30- 40 years	8	7.8
	41- 50 years	18	17.7
	51- 60 years	42	41.2
	60 years and above	34	33.3
	Mean ± SD 56.90 ± 9.973 Min- Max 31-75 years		
Gender	Male	18	17.6
	Female	84	82.4
Occupation	Student	0	0
	Employer	8	7.9
	Earner	0	0
	Retired	18	17.6
	Homemaker	76	74.5
Body Mass Index	Underweight	0	0
	healthy weight	20	19.6
	Overweight	40	39.2
	Obesity class I	34	33.3
	Obesity class II	8	7.9
	Obesity class III	0	0
Smoking	No	76	74.5
	Yes	26	25.5

f= frequencies**, %=** Percentages**, M=** Mean of score**, SD=** Standard Deviation**, Min=** minimum**, Max=** maximum.

This table reveals that 41.2% of the patients fell within the age range of 51-60 years, with a mean age of 56.90 years. The predominant demographic comprised females, accounting for 82.4% of the total, and a significant proportion (74.5%) identified as homemakers. Additionally, a majority of patients (74.5%) reported a non-smoking status, and notably, 39.2% of patients with cancer exhibited an overweight BMI.

Table 2. Distribution of the Patients According to their Clinical Characteristics

Clinical data characteristics	**Subgroup**	**f.**	**%**
Site of Cancer	Breast	74	72.5
	Lung	28	27.5
Tumor Stage	First	20	19.6
	Second	32	31.4
	Third	20	19.6
	Fourth	30	29.4
Chemotherapy Drug	Cisplatin	14	13.8
	Paclitaxel	80	78.4
	Docetaxel	8	7.8
The Number of Chemotherapy Cycles	Mean ± SD 3.55 ± 2.272 Min- Max 1-12 cycles		
Cumulative Dose	Mean ± SD 934.33 ± 945.457 Min- Max 220- 6288 mg/m²		

f= frequencies, **%**=Percentages, **M**= Mean of score, **SD**= Standard Deviation, **Min**= minimum, **Max**= maximum.

In Table 2, it is evident that 72.5% of the patients in the study were diagnosed with breast cancer, with a notable proportion (31.4%) presenting at the second stage of disease progression. The majority of these patients (78.4%) underwent Paclitaxel chemotherapy. Examining the number of chemotherapy cycles, the data ranged from a minimum of 1 to a maximum of 12 cycles, with an average of 3.55 cycles. Furthermore, the cumulative dose, ranging from a minimum of 220 mg/m^2 to a maximum of 6288 mg/m^2, had an average value of 934.33 mg/m^2.

Table 3. The Chemotherapy-Induced Peripheral Neuropathy for Patients with Cancer Receiving Neurotoxic Anticancer Drugs

DOMAINS		**PATIENTS' SCORES**			
		Range	**T**	**Raw Score**	**Transformed Score**
					0-100
Sensory	(9 items)	9-36	19.33	2.14	38.27
Motor	(8 items)	8-32	15.12	1.89	29.66
Autonomic	(3 items)	3-12	5.47	1.82	27.45
	Female (2 items)	2-8	4.84	2.42	47.39
Total	(20 items)	20-80	39.92	1.99	33.20
	Female (19 items)	19- 76	39.29	2.06	35.60

T= Total summation, Higher scores represent more complaints.

Table (3) shows that the chemotherapy-induced peripheral neuropathy for patients with cancer receiving neurotoxic anticancer drugs was more complaints in female than male (transformed score

35.6), In terms of the subscale, there were more sensory complaints than motor complaints, with a transformed score of 38.27. Additionally, when it comes to the autonomic aspect, males had fewer complaints compared to females, with a transformed score of 47.39.

Table 4. The Relationship between Patients' Chemotherapy-Induced Peripheral Neuropathy and their Demographic Characteristics and Clinical Data

DEMOGRAPHIC CHARACTERISTICS AND CLINICAL DATA	**SUBGROUP**	**CIPN**			
		M	**SD**	**Analysis**	**P.value**
Age	30- 40 years	20.42	16.153	F= 3.646	.015
	41- 50 years	38.89	28.901		
	51- 60 years	27.46	17.766		
	60 years and Above	40.29	21.806		
Gender	Male	36.67	25.321	t=.729	.468
	Female	32.46	21.532		
Occupation	Student	.	.	F= .731	.484
	Employer	33.33	24.785		
	Earner	.	.		
	Retired	38.89	23.750		
	homemaker	31.84	21.612		
Body Mass Index	Underweight	.	.	F= 1.012	.391
	healthy weight	28.67	24.754		
	Overweight	34.08	17.242		
	Obesity class I	36.86	25.245		
	Obesity class II	24.58	23.549		
	Obesity class III	.	.		
Smoking	No	30.88	21.461	t= -1.832-	.070
	Yes	40.00	23.228		
Site of Cancer	Breast	31.35	21.325	t= -1.377-	.172
	Lung	38.10	23.976		
Tumor Stage	First	15.50	16.738	F= 6.101	.001
	Second	37.50	20.063		
	Third	36.83	17.942		
	Fourth	38.00	24.854		
Chemotherapy Drug	Cisplatin	36.90	18.127	F= 2.711	.046
	Paclitaxel	31.04	22.132		
	Docetaxel	48.33	24.721		
The Number of Cycles		3.55	2.272	r. =.330**	.001
Cumulative Dose		934.33	945.457	r. =.397	.042

Significant at P > 0.05, **S**: Significant at P < 0.05, **HS**: Highly Significant at P < 0.01. **r** = Correlation coefficient, **F**= Fisher Test (ANOVA), **t**= t-test, **P**=probability value, **NS**: Non- Significant at P > 0.05, **S**: Significant at P < 0.05, **HS**: Highly Significant at P < 0.01. **r** = Correlation

Table 4, the findings demonstrated statistically significant differences between patients' CIPN with their age group, type of chemotherapy drug and tumor stage at P < 0.05. The results also showed that there was a significant statistical positive correlation between patients' chemotherapy-induced peripheral neuropathy with their number of chemotherapy cycles and cumulative dose at P < 0.05.

Discussion

The study found that more than one third of study participants fell within the age range between 51-60 years, with a mean age of 56.9 years. This suggests that the study population was predominantly middle-aged.

This finding is consistent with study conducted in Virginia in United States which aimed to explore the prevalence, pattern, and impact of CIPN on the quality of life of women undergoing treatment for breast cancer within a community oncology practice.

The study sample had a mean age of 56.6 years [16], The researcher attributes this finding to the well-established fact that the risk of cancer increase with age. It is estimated that approximately 80% of all cancer cases are diagnosed in individuals aged 50 years or older[17]. This study reports that 82.4% of participants were female, and 17.6 % were male. This finding similar to a study conducted on African American cancer survivors, to identify non-genetic risk factors and comorbidities associated with CIPN. The study indicated that 76.1% were female and 23.9 % male[18].

The results show that approximately three-quarters of patients were homemaker, this result is supported by Hung et al. (2021) which conducted a study to assess CIPN and general quality of life level. The study found that the majority of participants (71%) unemployed[19], The reason behind this finding to the fact that the participants were predominantly female, and female breast cancer patients in Iraq often do not have access to higher education, resulting in limited employment opportunities[20]. The results of the present study revealed that more than one-third of patients fell into the overweight category based on body mass index classification, similar findings were reported in a longitudinal study involving women diagnosed with invasive breast cancer, where 65.6% of study participants were found to be overweight[21].

The current study shows that 74.5% of participants were nonsmokers, which is consistent with the findings of study conducted on CIPN evaluation after initiating chemotherapy administration, and reported that 78% of their participants were non-smokers[19].

The majority of participants 72.5% had breast cancer, while a smaller percentage 27.5% had lung cancer. The researcher justifies the reason for the emergence of these results to the higher prevalence of breast cancer globally and locally compared to other types of cancer[22].

Most patients 31.4% were at second stage of the disease. This result aligned with a previous study that investigated the predictors of incident claims related to CIPN among a cohort of 11,149 women aged 66 years or older, diagnosed with stage II to IV breast cancer according to the American Joint Commission on Cancer (AJCC) staging. According to the findings of the study, the distribution of participants across tumor stages revealed that the majority 47% of the study sample were at the second stage[23].

The results regarding chemotherapeutic agents showed the majority 78.4% of participants were use paclitaxel, this finding similar to several studies in related literature. The results showed the mean of number of chemotherapy cycles was 3.55, this result is algin with previous prospective observational study, their results show the mean of number of chemotherapy cycles was 2.59[24].

The results also showed that the mean cumulative dose was 934.33 mg/m^2, this finding aligns with a study that aimed to evaluate the development of neuropathy resulting from weekly paclitaxel treatment and assess the effects of dose reduction on post-treatment neuropathy outcomes. The study reported a similar outcome, with a mean cumulative dose of 848.9 mg/m^2 [25].

Regarding the spectrum of CIPN manifestations, the present study has shown that sensory peripheral neuropathy is the most commonly reported type of peripheral neuropathy among participants with a mean transformed score of 38.27. This finding is consistent with two previous studies[13,19].

Regarding autonomic symptoms, the current study shows that females report more complaints than males, with a mean transformed score of 47.39. This finding is bolstered by a multicounty/multiregional study conducted across Hong Kong, Singapore, and Manchester in the UK found that females are more likely to experience autonomic symptoms related to CIPN than male patients [22].

According to the researchers' understanding, the main issue causing sensory symptoms in CIPN appears to be the degeneration of axons in unmyelinated nerve endings located at the far end of the nerves. Despite this, it is believed that nerve conduction is not entirely compromised, particularly in the case of large, myelinated nerve fibers responsible for transmitting information about body positioning and movement to muscles. These fibers may be less impacted by the condition[26].

According to the study findings, there are significant statistical differences observed between patients' CIPN and their age (p: 0.015). This finding is consistent with finding of a retrospective chart review conducted in Korea of 1629 breast cancer patients receiving taxane, the main objectives of this study were to evaluate the incidence, risk factors, and prescribing pattern of taxane-induced peripheral neuropathy (TIPN) in real-world clinical practice, where the results showed a significant difference between CIPN and age groups (p=0.001), The exact reasons for this association are not fully understood, but it is thought that age-related changes in nerve function, decreased ability to repair damaged nerves, and increased vulnerability to oxidative stress may contribute to the increased risk of CIPN in older patients[26].

The current study found no significant differences in CIPN incidence between genders (p=0.468). This is also consistent with the findings of Korea study[27].

The current study also showed that there were no significant statistical differences between the incidence of CIPN and patient occupation (p=0.484). A systematic review to evaluate 25 previous studies found that referred that the relationship between occupation and CIPN is unclear and inconsistent across studies[28].

Regarding BMI, the current study showed no significant differences in the incidence of chemotherapy-induced peripheral neuropathy and BMI (p=0.391). This finding is aligning with prospective cohort study conducted across 9 medical centers in China from 2019 to 2021. The results of this study showed no significant differences in CIPN incidence and BMI (p=0.59)[29].

In term of smoking it is noticed that no significant differences in CIPN incidence and smoking (p=0.468). This result aligns with the findings of multicounty/multiregional study conducted across Hong Kong, Singapore, and Manchester in the UK, The study revealed no statistically significant differences between the incidence of CIPN and smoking (p=0.13)[30]. The study results indicated no significant statistical differences between the incidence of CIPN and the site of cancer (p=0.172). A previous systematic review found that the association between the site of cancer and the development of CIPN is inconsistent across studies[31]. The current study has demonstrated that there are significant statistical differences between chemotherapy-induced peripheral neuropathy and cancer stage (p=0.001), which is consistent with the findings of study conducted on 11,149 women who were 66 years or older and diagnosed with stage II to IV breast Based on the AJCC classification of cancer, the study findings revealed that the AJCC stage (hazard ratio [HR] for stage II, 1.34; 95% confidence interval [CI], 1.06-1.69; HR for stage III, 1.56; 95% CI, 1.23-1.98) emerged as a significant predictor of higher incidence of CIPN (p=0.001)[32]. The study found significant differences in CIPN incidence based on chemotherapy type. Docetaxel had a higher association with CIPN, consistent with previous research. Patients on docetaxel reported an average of 4.8 neuropathic symptoms, compared to 4.3 for paclitaxel, indicating greater risk with docetaxel[32]. The current study found a

significant positive correlation between CIPN and the number of chemotherapy cycles. This aligns with a study conducted to examined CIPN in cancer patients receiving taxane- and platinum-based chemotherapy, their findings indicated that an increased number of chemotherapy cycles was a significant risk factor for CIPN[33]. Lastly, the study found a significant positive correlation between CIPN and the cumulative dose of chemotherapy received by patients. This finding aligns with a study conducted at the Oncology Department of the Clinical Emergency Hospital of Constanța, Romania, involving 163 eligible patients receiving neurotoxic chemotherapy, the findings of this study demonstrated similar relationship between CIPN and cumulative dose in cancer patients. They also reported specific median cumulative doses for paclitaxel, cisplatin, and docetaxel[34].

Conclusions

The study concluded that age, cancer stage, type of chemotherapeutic agents, number of chemotherapy cycles, and cumulative dose were all correlated with the development of CIPN.

Recommendations

Conducting future research with a larger sample size would be beneficial findings and allowing for differentiation of the results among participants with different cancer types and varying chemotherapy agents.

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