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Evaluating Epidemiological and Physical Risk Factors in the Development of Chemotherapy-induced Peripheral Neuropathy (CIPN): An In-depth Systematic Review and Meta-analysis

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Abstract

Background of study: *Chemotherapy-induced peripheral neuropathy (CIPN) encompasses a range of adverse effects caused by various cytotoxic medications and stands as a primary source of pain among individuals who have survived cancer. In instances of pronounced and sudden CIPN, it might become necessary to diminish chemotherapy dosages or discontinue their application. Currently, no efficacious strategy exists for proactively preventing CIPN, managing established chronic CIPN is constrained, and the risk factors associated with CIPN are also transient and elusive.* ***Objectives of the study:*** *The aim is to identify the epidemiological and physiological risk elements associated with chemotherapy-induced peripheral neuropathy in adults.* ***Research methodology:*** *A systematic review was conducted to locate research articles detailing the risk factors associated with chemotherapy-induced peripheral neuropathy (CIPN). The exploration involved searching through various databases, including Delnet, RemoteXS (PGIMER), Ebsco, Wiley online library, Medline, PubMed, and Web of Knowledge, to find relevant sources. A random-effects meta-regression approach was employed. The quality of the studies was evaluated using the CONSORT and STROBE guidelines, along with adherence to PRISMA guidance.* ***Conclusion and results****: This systematic review encompassed 133 research studies, incorporating data from a total of 12,378 patients for the purpose of meta-analysis. A qualitative synthesis was performed to outline factors that were found to influence the risk of chemotherapy-induced peripheral neuropathy (CIPN). Among the 133 studies, 68 of them elucidated distinct risk elements contributing to CIPN. In terms of epidemiological factors, 19 studies highlighted aspects such as age (with a focus on older adults), gender (with females displaying a greater susceptibility to CIPN development), and BMI (with obesity and overweight status being implicated). Physical factors, identified in 17 studies out of the total 133, encompassed characteristics like general weakness, fatigue, elevated distress scores, reduced participation in moderate to vigorous physical activity (MVPA), sleep disturbances, shorter stature, increased body weight, impact on health-related quality of life (HRQOL), and a history of smoking.*

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INTRODUCTION

Neuropathy is a frequent complication linked to both cancer and the therapies used to treat it. “Peripheral or supplementary neuropathy is a concern expressed by individuals with cancer, arising due to additional malfunctioning of axons. This occurs when these axons are harmed or destroyed, leading to a disruption in their proper

functioning". Chemotherapy-induced peripheral neuropathy (CIPN) is an unwanted consequence associated with multiple cytotoxic drugs, causing considerable discomfort in individuals with cancer. CIPN, a prevalent distinct neurological condition arising from cancer treatment, gives rise to severe symptoms, profoundly affecting the lives of cancer patients. This often leads to restlessness and enduring neuropathic pain. Since the 1970s, the number of cancer survivors has grown threefold, with over 28 million individuals now worldwide. There is an increasing awareness and understanding of the enduring issues and the impact on the quality of life that cancer survivors experience after completing their treatment [1–5].

CHEMOTHERAPY-INDUCED PERIPHERAL NEUROPATHY (CIPN)

Chemotherapeutic Agents and Mechanisms of Neuropathy

The genesis of neuropathy arises from impairment to peripheral or supplementary axons. In the peripheral nervous system, motor axons, characterized by their largeness and myelination, play a significant role. Conversely, sensory and autonomic axons are smaller and either unmyelinated or thinly myelinated. The particular form of neuropathic symptom experienced is contingent upon the specific type of axonal region that is impacted, as detailed below [6–8]:

- Sensitive axons influence sensory perception, potentially giving rise to painful paresthesia, altered sensation, cold sensitivity, tingling, numbness, changes in vibration and proprioception, or shifts in reflexes.
- Motor axons play a role in affecting muscle function and mobility, leading to manifestations like muscle weakness.
- Autonomic axons have an impact on the operation of internal organs, which can result in outcomes like orthostatic hypotension, constipation, urinary retention, irregular heartbeat, and sexual dysfunction.

Chemotherapeutic drugs disperse throughout the entire body, and specific categories of cytotoxic medications have the potential to harm distinct axonal regions. The occurrence and severity of CIPN can be influenced by factors such as the selection of medication, the duration of its usage, the complete or partial administration of the prescribed dosage, and the presence of any pre-existing supplementary medical conditions (Table 1).

Table 1. Division of chemotherapeutic medicines.

Chemo medicine class	Chemo medicine name
Platinum derivative medicines	Cisplatin, Carboplatin, and Oxaliplatin
Taxanes	Paclitaxel, Docetaxel, and Cabazitaxel
Epothiolones	Iixabepilone
Plant alkaloids	Vinblastine, Vincristine, Vinorelbine, and Etoposide
Protease Inhibitors	Bortezomib, and Carfilzomib
Immunomodulatory/ Antiangiogenic agents	Thalidomide, Lenalidomide, and Pomalidomide

Symptoms of CIPN

The National Cancer Institute's Cancer Dictionary defines peripheral or supplementary neuropathy as a condition involving axonal issues that result in sensations of pain, numbness, tingling, swelling, or muscle weakness across different body regions. This condition typically initiates from the extremities, both upper and lower, and worsens progressively over time. Peripheral neuropathy is defined by sensory symptoms that include abnormal or heightened reactions to both painful and non-painful stimuli [9]. Motor symptoms impact the musculoskeletal system, leading to peripheral neuropathy, and can be categorized as either causing discomfort (such as joint pain) or being painless (like muscle weakness). Chemotherapy medications disseminate throughout the entire body, and specific types of chemotherapy can cause damage to various nerves. Symptoms tend to emerge initially in the distant parts of the body and gradually progress closer over time. Generally, patients initially detect signs of chemotherapy-

induced peripheral neuropathy (CIPN) in their lower limbs, which are subsequently followed by symptoms in the upper limbs. These indications might commence in the toes and then extend to the ankles and legs. Similarly, symptoms can manifest from the fingertips and then extend to the hands and arms. CIPN often exhibits a similar pattern on both sides of the body. If both upper and lower extremities are equally affected, this distribution is referred to as a "stocking-glove distribution" [10–15]. CIPN can emerge at any point after treatment and typically intensifies as treatments continue (Table 2).

Table 2. Classification of CIPN associated symptoms identified by American Cancer Society, 2008.

S.N.	Symptoms
1.	Pain of any type
2.	Burning sensation upper and lower limbs
3.	Tingling (Pins and needles feeling)
4.	Loss of feeling (which may be numbness or just less ability to sense pressure, touch, heat or cold)
5.	Balance problems (troubles with tripping or stumbling while walking)
6.	Generalized Muscle weakness

Pathogenesis of Chemotherapeutic Drugs

CIPN may develop as a result of axonal disturbances at various anatomic regions of the nerve depending on the specific medicines (Table 3). The myelin is a superficial layer of nerves that preserves nerves from damage and ensures their function properly. Chemotherapy-induced peripheral neuropathy (CIPN) occurs as a result of the breakdown of the myelin sheath in nerves due to the generation of free radicals induced by medications. Nerves with compromised myelin are unable to efficiently transmit signals. This phenomenon is thought to manifest when nerves deviate from their normal function, causing disruptions in signal transmission. Misfiring may occur when erroneous signals are sent, and pain is experienced when unprotected nerves become overloaded with information [16, 17].

Table 3. Common sites of involvement by neurotoxin medicines division.

Agent	Areas of peripheral/supplemental axonal damage
Cisplatin	Rearward root ganglion
Oxaliplatin	Rearward root ganglion; ion channels
Paclitaxel	Rearward root ganglion; microtubules; axonal end
Docetaxel	Rearward root ganglion; microtubules; mitochondria; axonal end
Epithilones	Rearward root ganglion; microtubules; axonal end
Bortezomib	Microtubules; mitochondrial and endoplasmic reticulum; dysregulation of neurotrophins
Thalidomide	Rearward root ganglion; axonal blood circulation; dysregulation of neurotrophins
Lenalidomide	Rearward root ganglion; axonal blood circulation; dysregulation of neurotrophins
Pomalodomide	Rearward root ganglion; axonal blood circulation; dysregulation of neurotrophins
Vincristine	Rearward root ganglion; microtubules; axonal end

Threat Factors of CIPN

The primary risk factor for the development of CIPN is the administration of anti-cancer medications that impact the nervous system. Various risk factors contribute to chemotherapy-induced peripheral neuropathy (CIPN), such as the cumulative dosage administered, duration of treatment, a history of neuro-pathological conditions, concurrent treatments, and genetic alterations in cellular structure. CIPNs are most common in cancer patients with prevalence of around 38% (conceivably over to 90% of cases treated with oxaliplatin). The risk of CIPN increases with higher cumulative doses of chemotherapy. Individuals receiving multiple neurotoxic chemotherapy drugs are at greater risk compared to those with preexisting

neuropathy. In addition to chemotherapy, supplementary neuropathy can be induced by various other factors, including [18]:

- Any other cancer treatments, like surgical intervention or radiotherapy remedies, and
- Nerve compressing excrescences.
- Infections that attack on the nerve fibers.
- Spinal cord injuries.
- Diabetes and Alcohol abuse.
- High Serum Creatinine lab values.
- Shingles (post herpetic neuralgia).
- Decreased vitamin B levels.
- Some autoimmune disorders.
- HIV (human immunodeficiency virus/contagion) infection Kidney, liver or thyroid disorders.
- Exposure to toxic materials, such as heavy ores, gold composites, lead, arsenic, mercury, and organophosphate insecticides.
- Poor blood flow conditions (peripheral vascular disturbances).
- The cancerous condition itself a reason (for instance, multiple myeloma can beget supplemental neuropathy including multiple body pains).

The duration of CIPN can vary, with the potential for either a brief or prolonged existence, contingent on factors such as the patient's age and the presence of other medical conditions that induce neuropathy [19].

- Drugs taken by patients under prescription.
- Any significant family history of neuropathy.
- Various combinations of chemo-medicines used (including those used previously).
- The medication dose (some medicines only beget CIPN at high boluses).
- Frequency of medicines given.
- The total recommended dose of chemo given over time.

So, it is veritably important to know the reasons for supplemental neuropathy and the right treatment can be started timely. Factors responsible for CIPN are any former neuropathy convinced conditions like diabetes mellitus; alcohol, inherited neuropathies and related illnesses may contribute more severe neuropathy. Advanced age axonal loss may also increase severe symptoms from CIPN. The pre-chemotherapy cycles also increase pre-existent supplemental neuropathy cases that will lead them in advance threat for CIPN. This clinical assessment should include a medical history focusing on symptoms and functional capabilities, along with a physical examination that objectively evaluates the patient's strength, sensation, reflexes, and gait.

Prevalence of neuropathic pain (NeP) related to threat factors: NeP influences 8% of the population. It is fairly common in people with certain conditions. For example, 20–40% of people with diabetes experience NeP (painful diabetic neuropathy). 25–50% of patients aged over 50 years with herpes zoster infection develop post-herpetic neuralgia 3 months after the rash recovery. 30% of people with cancer reported NeP. 20% of women feel neuropathic pain after mastectomy surgery. During the literature review, the researcher will aim to identify differences in studies using meta-analysis and systematic reviews. The objective of this study is to identify the consistently reported epidemiological and physical risk factors [20–24].

OBJECTIVES OF THE STUDY

- To pinpoint the predictors and risk elements for CIPN in adult cancer patients.
- To gather the epidemiological and physical risk factors that contribute to CIPN in adult cancer patients.

SIGNIFICANCE OF THE STUDY

This review work aims to compile and outline the range of characteristics associated with chemotherapy-induced peripheral neuropathy (CIPN) to emphasize areas for future research in this field. Existing information indicates that the predictors and risk factors of CIPN are still elusive.

Background

1. The current study involves a comprehensive systematic review and meta-analysis. The researcher conducted an extensive search and systematic review of literature relevant to the study, employing search strategies that encompass both offline and online sources. This effort has provided a thorough understanding of the subject matter and research methodology.
2. Online Coffers: Delnet, RemoteX, =Spgimer, Ebsco, Willey online library.
3. Offline Coffers: Dr. Tulsi Das Library PGIMER, Chandigarh, National Library Bangalore.

REVIEW OF LITERATURE

The literature for the current study has been gathered, structured, and presented under the title: "Evaluating epidemiological and physical risk factors in the development of Chemotherapy-Induced Peripheral Neuropathy (CIPN): An In-Depth Systematic Review and Meta-Analysis" (Table 4).

Table 4. Overview of included studies.

S.N.	Year	Study type
1	2010	Observational descriptive study
2	2010	Review
3	2010	Review
4	2010	Cohort study
5	2010	Cross-sectional cohort
6	2011	RCT
7	2011	RCT
8	2011	Review
9	2012	Prospective cohort study
10	2012	Prospective cohort study
11	2012	Prospective cohort study
12	2012	NM*
13	2012	Descriptive study
14	2012	Prospective study
15	2013	Prospective cohort study
16	2013	Phase III RCT
17	2013	Cohort study
18	2013	Assessment study
19	2014	Mini review
20	2014	NM*
21	2014	Population-based sample study
22	2014	NM*
23	2014	Population-based profile registry
24	2014	Interview based survey
25	2014	Questionnaire survey
26	2014	NM*
27	2014	Patient records study
28	2014	Cancer clinic chart review
29	2014	Comprehensive survey
30	2014	Systematic review and meta-analysis
31	2014	Review
32	2016	Evaluative study
33	2015	Population survey

34	2015	Prospective cohort study
35	2015	Literature review
36	2015	Review
37	2015	Cross-sectional survey design
38	2015	Questionnaire survey
39	2015	Cohort study
40	2015	Evaluative study
41	2015	Evaluative study
42	2015	Pathway study
43	2016	Cross-sectional analyses
44	2016	NM*
45	2016	Phase II and III trials
46	2016	Population-based profile registry
47	2016	RCT
48	2016	Prospective study
49	2016	Quantitative assessment
50	2016	Descriptive study
51	2016	Trial study
52	2016	Prospective study
53	2017	Cross-sectional study design
54	2017	Comprehensive literature review
55	2017	Systematic review
56	2017	Comparative study
57	2017	RCT
58	2017	The pathways study
59	2017	Evaluative study
60	2017	Critical review
61	2017	Clinical details
62	2017	Prospective study
63	2017	Prospective cohort study
64	2017	NM*
65	2017	Prospective observational study
66	2017	Monocentric observational study
67	2017	Prospective study
68	2017	Review

NM: Not Mentioned in the study.*

Study Characteristics

Among the 133 studies incorporated, 17 were prospective cohort studies, 12 were randomized controlled trials (RCTs), and 14 were cross-sectional cohort studies. Among the 12 RCTs, 82% reported some form of investigator bias. Confused evaluation of outcomes was noted in 3 out of 14 prospective cohort studies. All studies that reported CIPN risk factors outlined the methods used to identify these predictors and risk factors. A total of 68 studies on risk factors were included; among them, 19 focused on epidemiological risk factors, and 17 on physical factors are included in this study [25–27].

MATERIAL AND METHODS

1. *Research design:* The present study has non-experimental quantitative (casual-relative exploration design).
2. *Area of study:* This research employs a dual-pronged approach to gather data, which is categorized into the following sources:
   i. *Online resources:* Delnet, RemoteXSpgimer, Ebsco, Willey online library.
   ii. *Offline resources:* Dr. Tulsi Das Library PGIMER, Chandigarh, National Library Bangalore. The selection of the hunt strategies was done on the base of feasibility of conducting the study and vacuity of studies in particular coffers.

3. *Population:* The population of the present study includes all the research studies related to adult patients receiving any type of chemotherapy from the year 2010 to 2017. The samples of the present study include adult cancer patients receiving any type of chemotherapy. Total figure of adult cancer patients from 133 studies is 12,378.

The sampling method used in this study was purposive/intentional nonprobability sampling technique grounded on inclusive criteria.

Criteria For the Selection of Studies

1. *Addition criteria:* prospective experimental studies including:
   i. Clinically controlled studies;
   ii. Randomized controlled trials;
   iii. Methodical reviews of prospective studies;
   iv. Any other type of study supposed fit while doing review of literature; and
   v. Adult cancer cases getting any type of chemotherapy.
2. *Rejection criteria:* The present study will ban:
   i. Retrospective studies;
   ii. Case reports;
   iii. Non-systematic reviews;
   iv. Studies including pediatric population;
   v. Best models of chemotherapy-induced peripheral neuropathy.
   vi. Studies probing other causes of neuropathy in cancer cases (pre-existing neuropathy, diabetic);
   vii. Studies grounded on data cases getting chemotherapy and radiotherapy contemporaneously; and
   viii. Any other type of study not supposed fit while doing literature review.
3. *Data particulars:* Description of data particulars is given as below:
   i. *Demographic data of subjects:*
      - Age,
      - Gender,
      - Type of cancer,
      - Chemotherapy type,
      - Medicine's given dose, and
      - Number of chemotherapy cycles.
   ii. Time frame over which CIPN symptoms were assessed in each study.
   iii. Styles used to identify threat factors for chemotherapy convinced peripheral neuropathy.
   iv. *Study characteristics:*
      - Author,
      - Design,
      - Publication year,
      - Sample size,
      - Type of chemotherapeutic medicine and its given dose,
      - Duration of study,
      - Predictors threat factors related to chemotherapy induced peripheral neuropathy, and
      - Styles used to calculate data analysis (incidence and frequency rates).

ANALYSIS AND ESTIMATION

The present study will include systematic/methodical review and meta-analysis system of data analysis and data estimation. Meta-analysis can be done in following ways:

1. Expression of Problem.
2. Search of Literature.
3. Selection of studies based on inclusion criteria.

4. Decide which dependent variables or summary measures are allowed.
5. Differences (separate data).
6. Means (continual data).
7. Selection of meta-retrogression statistical model.

This study includes selection of meta-retrogression statistical model grounded on Simple retrogression, and Random result meta-retrogression.

Testing Hypothesis

This study testing hypothesis may show significant difference between the tested parameters of chemotherapy induced peripheral neuropathy (CIPN) grounded on methodical/systematic review and meta-analysis.

RESULTS

The researcher initially identified 4,047 studies that could potentially be relevant, and after reviewing the full text of 326 studies, a total of 133 studies (encompassing 12,378 patients) were found to meet the inclusion criteria. Among these, 68 studies were evaluated as risk factor studies, with 19 of them focusing on epidemiological risk factors, and 17 addressing physical risk factors.

CIPN Predictors and Risk Factors

Out of the studies that were included, 68 of them examined risk factors associated with CIPN. 19 of these studies focused on epidemiological factors. It was observed that pre-chemotherapy screening also played a role in the development of CIPN. Among the epidemiological factor studies, age (over 50 years), gender (females), high BMI (obesity), and being of African-American ethnicity were identified as factors that increased the likelihood of developing CIPN. Physical/General factors include smoking history, exposure to cold, shorter and heavier patients, life style (low QOL), nutritional deficiency (lack of vitamin B1, B6, D), MVPA (LOW moderate-to-vigorous physical activity).

This study exclusively focuses on epidemiological and physical risk factors associated with chemotherapy-induced peripheral neuropathy (CIPN), as detailed in Table 5.

Regarding the threat factors present to CIPN under study apparent that maturity of clinical factors has significant part but epidemiological threat factors (19.8) threat factors (17.7) also contributes major part in CIPN circumstance (Table 6 and Figure 1).

Hence it has been concluded that epidemiological factors and physical factors were also responsible for CIPN circumstance than other factors [25–29].

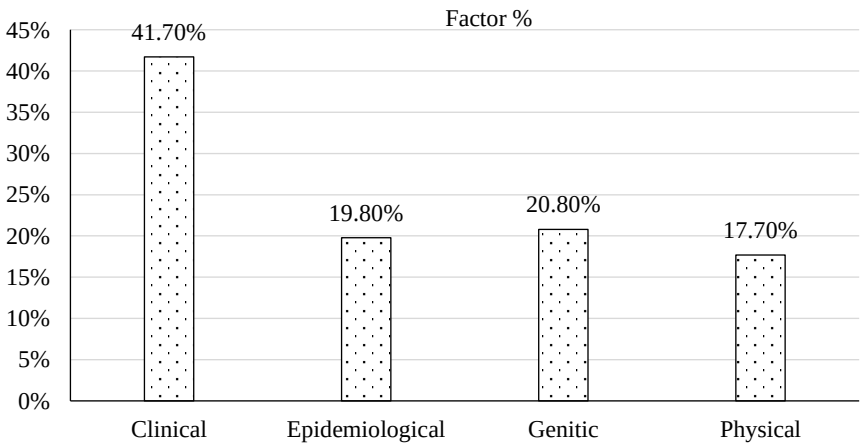

Figure 1. Aggregate distributions of risk/threat factors contributing CIPN.

Table 5. CIPN risk/threat factors.

S.N.	Category of risk factor reported	Data source of study	Sample size of study	Predictors and risk factor details
1	Epidemiological	Cross-sectional study	210	Age, disease duration
2	Epidemiological	Cross-sectional analyses	296	Obesity (high BMI)
3	Genetical and Epidemiological	Comprehensive literature review	NM*	Old age people, several Illnesses, cumulative dose, treatment duration, history of neuropathy, combination of therapies and genetic polymorphisms
4	Clinical and Physical	Review	NM*	Dose per cycle, cumulative dose, duration of infusion, exposure to cold
5	Clinical and Racial	Cancer clinic chart review	123	African American patients, diabetic patients, and patients using Paclitaxel
6	Epidemiological and Clinical	Comprehensive survey	NM*	Dose per cycle, cumulative dose, treatment schedule, duration of infusion, administration of other chemotherapy drugs, other related illnesses
7	Physical	Observational descriptive study	171	Short height and fatty patients
8	Epidemiological	Review	NM*	Old age people
9	Epidemiological and Clinical	Patient records study	41	Age (up to 65 years), drug dose, concomitant use of aprepitant
10	Dietary and Physical	Systematic Review	22 articles	Life-style related factors (dietary supplements and physical exercise)
11	Epidemiological	Comparative study	NM*	Obesity, age and months since treatment
12	Epidemiological	RCT	22	Old age people
13	Social	Cross-sectional survey design	130	Psychosocial distress
14	General	Interview based survey	706	Weak mental health status, sleep quality, depression
15	General	Systematic review	1643	Lower QOL
16	General	Cross-sectional descriptive study	90	Insomnia, HRQOL (Health related quality of life)
17	Epidemiological and Clinical	Population survey	142	High distress score, depression, anxiety, chemo and radio therapy both
18	Epidemiological	Pathway-based study	400	Epidemiologic threat factors (count of chemo cycles, type of concurrent chemotherapy).
19	Physical	The pathways study	1237	BMI (obesity), MVPA (LOW moderate-to-vigorous physical activity)
20	Epidemiological and Clinical	Quantitative assessment	50	Cumulative dose, Age, Height
21	Epidemiological and Clinical	Clinical details	NM*	Age, Gender, negative effects of medications and other related illnesses
22	Nutritional	Evaluative study	NM*	Lack of vit. B1, B6 and D (25OH derivative of vit D) and Fat molecules
23	Epidemiological	Evaluative study	131	Age, continuous muscle and joint pain, stomatitis and tiredness
24	Physical	Prospective cohort	186	Obesity and increased weight

25	Epidemiological	Comparative study	58	Age, prior treatment with VCR, no. of VCR and BTZ cycles, LDH lacatate dehydrogenase, neurological monitoring
26	Epidemiological	Prospective study	2102	Age, self-reported comorbidities, Female more prone to CIPN
27	General	Population-based profile regisrty study	191	Attitude towards sickness, financial situation
28	Epidemiological	Prospective study	80	Age

NM: Not Mentioned in the study.*

Table 6. Frequency and aggregate distribution of risk/threat factors contributing CIPN.

Factors	Mean	N	Std. deviation	% of total sum	% of total N
Clinical	40.00	1	.	41.7%	25.0%
Epidemiological	19.00	1	.	19.8%	25.0%
Inheritable	20.00	1	.	20.8%	25.0%
Physical	17.00	1	.	17.7%	25.0%
Total	24.00	4	10.739	100.0%	100.0%

CONCLUSION

This systematic review and meta-analysis offers an interpretive overview of reported factors posing a risk of chemotherapy-induced peripheral neuropathy (CIPN), encompassing 68 studies on risk factors. Among these 68 studies, 19 focused on epidemiological risk factors, constituting 19.8% of epidemiological factors contributing to CIPN occurrence. 17 studies investigated physical risk factors, representing 17.7% of general or physical factors contributing to the context of CIPN. A comprehensive examination of the literature yielded conclusions about the elements contributing to CIPN, which encompass older age, multiple coexisting health conditions, the potential impact of certain treatments, treatment duration, genetic polymorphisms linked to neuropathy, the combined use of platinum-based drugs, interventions involving proteasome/angiogenesis inhibitors, and the administration of taxanes or vinca alkaloids. The prevalence of CIPN ranged from 38 (overall) to 90% (in cases involving oxaliplatin). A prospective study involving 2,102 adult cancer patients that focused on predictors and risk factors of supplementary neuropathy underscored the significance of general and epidemiological factors similar to those mentioned previously, such as age, reported comorbidities, and gender (with women being more susceptible to CIPN). An evaluative study, encompassing 131 adult cancer patients, elucidated epidemiological and physical health risk factors contributing to CIPN. These factors included age, patient-reported muscle and joint pain, stomatitis, fatigue, and general weakness.

Benefaction of This Study

Distinct chemotherapy drugs were linked to varying rates of CIPN occurrences. Several studies indicated that severe acute cases of CIPN might necessitate a reduction in chemotherapy dosages or the discontinuation of treatment. Unfortunately, there is a lack of effective strategies to prevent CIPN. Moreover, the management of established chronic CIPN is constrained, and the risk factors associated with CIPN remain elusive. This study brings forth the following contributions:

- It emphasizes the need for nursing practice to enhance awareness regarding the connection between chemotherapy and CIPN within oncology settings. It also underscores the significance of comprehending and considering epidemiological and physical risk factors.
- The findings can aid nursing staff in evaluating the epidemiological and physical risk factors prior to chemotherapy initiation and in managing subsequent CIPN cases.
- This study provides valuable insights for healthcare providers involved in the clinical management of CIPN. By understanding the responsible risk factors, healthcare professionals can better address the occurrence of CIPN.

- The study serves as a resource for the entire oncology clinical community, fostering a more comprehensive consideration of predictors and risk factors that contribute to CIPN. This encompasses a wide range of factors, encompassing not just clinical elements but also genetic, epidemiological, and physical risk factors.

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