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Symptom clusters in breast cancer patients, post-chemotherapy: Prevalence, severity, and network analysis approaches

Brotobor D[1ID], Nwozichi CU[1ID], Brotobor O[2ID]

[1]*Department of Nursing Science, Babcock University, Ogun State, Nigeria*
[2]*Department of Surgery, Federal Medical Centre, Delta State, Nigeria*

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Abstract

Background: Breast cancer patients undergoing chemotherapy experience multiple symptoms that cluster together, exacerbating their overall distress and impacting their quality of life. Understanding the structure and interactions of these symptom clusters can guide more effective supportive care interventions.

Materials and Methods: A descriptive cross-sectional design was employed. This study employed network analysis to investigate the composition and structure of symptom clusters among breast cancer patients undergoing chemotherapy in selected hospitals in Delta State, Nigeria. 139 participants who had undergone chemotherapy within the past 12 weeks. Data on symptom prevalence and severity were collected using the Memorial Symptom Assessment Scale (MSAS). Symptom clustering was analysed using Principal Component Analysis (PCA), and network analysis was conducted in R (version 4.3.1) to identify key symptom interactions, using EBICglasso for network estimation.

Results: The findings showed that pain was the most prevalent symptom (80%). Lack of energy (69.5%), difficulty sleeping (63.8%), and pain (62.2%) were the most severe symptoms. Among others, difficulty swallowing (8.7%) and vomiting (6.2%) were the least severe. A symptom network analysis identified three clusters: constitutional, gastrointestinal-epithelial, and psychological. Lack of energy emerged as the most central symptom, strongly connected to drowsiness, pain, difficulty sleeping, nausea, and difficulty concentrating.

Conclusion: The study highlights fatigue as a key driver of symptom co-severity, emphasising the need for multidimensional symptom management strategies. Interventions targeting fatigue, cognitive impairments, and psychological distress may help improve patient outcomes and quality of life. Further longitudinal studies are recommended to explore symptom progression over time.

Key words: Breast cancer, Chemotherapy, Fatigue, Network analysis, Symptom clusters

Plain English Summary

Breast cancer is a significant global public health issue and the most frequently diagnosed cancer among women. Statistics indicate that 1 in 8 women is likely to develop invasive breast cancer during their lifetime. Breast cancer is considered the most common cancer globally. The widespread use of breast cancer screening programs has led to a substantial increase in the detection of cases annually. While advancements in treatment remain a key focus, healthcare providers must prioritise interventions that address poor treatment outcomes and work to improve the quality of life for persons with breast cancer

Correspondence:
Brotobor Deliverance
Department of Nursing Science
Babcock University
Ogun State, Nigeria
+2349055468987, brotobor0469@pg.babcock.edu.ng

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Background

Breast cancer is one of the leading causes of cancer-related deaths worldwide, significantly impacting patients' quality of life (QoL). In the United States alone, approximately 240,000 women and 2,100 men are diagnosed annually, with 42,000 women and 500 men dying from the disease (1). While chemotherapy remains a crucial treatment for halting cancer progression, it frequently leads to severe side effects that manifest in clusters. These symptom clusters complicate symptom management, increase distress, and reduce treatment adherence, ultimately affecting clinical outcomes (2). Common symptoms include fatigue, anxiety, sleep disturbances, cognitive impairments, nausea, and depression (3, 4, 5, 6). However, research on post-chemotherapy symptom clusters remains limited, making it challenging to develop standardised intervention strategies.

Fatigue, also referred to as lack of energy, is one of the most frequently reported and debilitating symptoms following chemotherapy, often coexisting with sleep disturbances, anxiety, and cognitive impairments (7, 8, 9). Psychological symptoms such as anxiety and depression are also common, with socio-demographic factors influencing symptom severity (10). Patients with higher education levels generally report fewer symptoms, possibly due to improved coping mechanisms, while financial challenges contribute to heightened psychological distress (11, 12, 13). The financial burden of cancer treatment, especially in countries like Nigeria, where out-of-pocket expenses are high, exacerbates anxiety and depression among patients. Studies indicate that fatigue and sleep disorders worsen with successive chemotherapy cycles (14). Without effective symptom management, these clusters can severely impact patients' daily functioning and overall well-being (15). Given the interplay between symptoms, focusing on clusters rather than individual symptoms provides a more comprehensive understanding of patient experiences and improves management strategies.

Symptom clusters are dynamic, evolving based on treatment stages, individual physiology, and external factors (16, 17). Cytokine activity in breast cancer patients has been linked to symptoms such as depression, pain, and fatigue (18). Research by Sullivan et al. identified eight major symptom clusters, including psychological, hormonal, gastrointestinal, and epithelial clusters (17). Some clusters, such as sickness behaviour and weight changes, varied over time, while neuropathy clusters emerged primarily after chemotherapy. Fatigue, sleep disturbances, and pain were consistently reported across studies as dominant symptoms affecting patient well-being. A study by Duran-Gomez et al. classified post-chemotherapy symptoms into two primary clusters: psychological symptoms (depression, cognitive impairments, fatigue, insomnia, and pain) and upper gastrointestinal symptoms (19). However, De Rooji et al. found no significant clustering of gastrointestinal symptoms in breast cancer patients, suggesting that treatment type influences symptom presentation (20). Patients undergoing chemotherapy tend to experience more symptom clusters compared to those receiving surgery or hormonal therapy (21). Moreover, research shows that after two chemotherapy cycles, physical and psychological symptoms become more interconnected, particularly fatigue and cognitive impairments (22, 23, 24, 25). Continuous assessment is necessary to track symptom progression and adjust treatment plans accordingly.

Symptom severity typically peaks after the first chemotherapy cycle, gradually declining over time, although certain symptoms persist or worsen. Anxiety, depression, and sleep disturbances can last through multiple cycles, while fatigue, cognitive impairments, and drowsiness emerge early and continue throughout treatment. Other symptoms, such as appetite loss, nausea, and taste changes, are more commonly observed after the second cycle (24). Variability in symptom experiences highlights the influence of distress levels on overall well-being (25). For about 19% of patients, symptom severity becomes so overwhelming that they discontinue chemotherapy prematurely, negatively impacting treatment outcomes (26, 27). A patient's subjective perception of symptoms, emotional resilience, and social support play a crucial role in determining QoL (28, 29, 30, 31, 32). Traditional methods for analysing symptom clusters include factor analysis, predefined symptom grouping, and cluster analysis based on individual symptom profiles (4). While these approaches identify prominent symptoms such as pain, fatigue, depression, and sleep disturbances, they often fail to capture the full complexity of symptom interactions. The National Comprehensive Cancer Network recommends managing symptom clusters holistically rather than addressing individual symptoms, as clusters tend to co-occur and amplify one another, significantly affecting QoL (33, 34). Network analysis offers a more sophisticated approach to understanding symptom relationships by constructing visual maps

that illustrate complex symptom interactions (35). This method helps researchers and clinicians identify key symptoms central to a cluster, allowing for targeted interventions. By focusing on the most interconnected symptoms, healthcare providers can implement strategic management plans that alleviate not only the primary symptom but also its associated symptoms.

More so, Rha et al. applied network analysis to examine symptom interactions across chemotherapy cycles, revealing how symptoms evolve (36). In another study, Rha and Lee investigated the relationships among 12 common symptoms in breast cancer patients and identified strong associations between anxiety and depression, fatigue and drowsiness, and appetite loss and taste changes (24). Fatigue was found to be the most interconnected symptom, particularly after the second chemotherapy cycle, reinforcing its central role in symptom networks. These findings demonstrate the effectiveness of network analysis in uncovering hidden symptom relationships that may not be evident through traditional analytical methods. The application of network analysis extends beyond breast cancer to other malignancies, where it has consistently revealed interconnected symptom networks (20, 37, 38). These studies confirm that some symptoms serve as key influencers within symptom clusters, emphasising the need for targeted interventions. Addressing central symptoms such as fatigue, which influences multiple related symptoms, can lead to broader improvements in patient outcomes. Given the dynamic nature of symptom clusters, continuous monitoring and flexible management strategies are essential., Network analysis provides a framework for tracking symptom evolution, allowing healthcare providers to adjust treatment plans in real time. By integrating dietary changes, pharmacological interventions, and psychological support, clinicians can develop comprehensive care strategies tailored to individual patients' needs (39).

This study investigates the central symptoms experienced by breast cancer patients undergoing chemotherapy in Delta State tertiary hospitals. Findings will contribute to the development of targeted interventions that enhance patient outcomes and align with international cancer care guidelines (40). As network analysis continues to evolve, its applications in oncology hold great promise for improving personalised symptom management, ensuring more effective and responsive care for breast cancer patients (41). This study examines the prevalence and severity of symptom clusters in breast cancer patients post-chemotherapy in Delta State tertiary hospitals, using network analysis to explore symptom relationships and guide intervention strategies.

Materials and Methods

This study applied a quantitative research method with a descriptive cross-sectional design to analyse network analysis of the composition and structure of symptom clusters in breast cancer patients after chemotherapy in selected Delta State hospitals. The study included 139 participants who had undergone chemotherapy within the past 12 weeks. Purposive sampling ensured the selection of eligible patients using the selection criteria and peculiarity of the study participants. The study focuses on breast cancer patients aged 18+ who have undergone chemotherapy in the past 12 weeks and have experienced symptoms. Exclusions apply to those with cognitive impairments, language limitations, severe health conditions, participation in other trials, ongoing alternative treatments, or a diagnosis of another cancer type.

A structured instrument was developed to collect both categorical and continuous data, divided into two sections. Section A captured demographic details including age, gender, education, occupation, marital status, duration since diagnosis, cancer stage, and chemotherapy timeline. Section B measured symptom prevalence and severity using the Memorial Symptom Assessment Scale (MSAS), a tool assessing 32 symptoms over the past week on a 0–4 scale, with symptom burden classified from no burden to very severe burden. The MSAS instrument demonstrated high reliability of Cronbach's alpha. .782–.94 (42). The validity of the instruments was confirmed through expert evaluation (face validity), alignment with study objectives (content validity), and statistical correlation with other validated measures (construct validity).

Data Analysis

Categorical variables were analysed using frequency and percentage distributions, while continuous variables following a normal distribution were summarised using frequency, percentage, and ranking order. Principal Component Analysis (PCA) in R (version 4.3.1) was used to identify symptom clusters based on severity, with data suitability assessed through the Kaiser-Meyer-Olkin test and Bartlett's Test of Sphericity. Symptom clusters were determined using varimax rotation, considering only factors with eigenvalues above 1.0 and loadings exceeding 0.4. Symptoms

occurring in more than 20% of cases were included for variability.

To explore relationships between symptoms, network analysis (NA) was conducted using the "qgraph and bootnet package" in R (version 4.3.1). A weighted, undirected network was built, where symptoms were nodes and edges represented correlations. The “EBICglasso” method (tuning=0.5) was applied to refine the network, and the Fruchterman-Reingold algorithm visualised the structure, with edge width indicating correlation strength and colour denoting direction. Key symptoms were identified using centrality measures (strength, closeness, betweenness), and network stability was tested using bootstrap methods. Research questions were addressed through descriptive statistics, symptom categorisation, and network modelling.

Participants were assured they could withdraw without repercussions. Data confidentiality was strictly maintained, with no identifying information recorded. The study posed no harm to participants, whether physical, social, or psychological. No compensation was offered to participants.

Results

The study included 139 participants, as shown in Table 1 below, predominantly female (98.56%), with only 1.43% male. Most were between the ages of 41 and 60, accounting for 61.14% of the sample. Educationally, nearly half (49.64%) had tertiary education, while 35.97% had secondary and 14.38% had primary education. In terms of occupation, 32.37% were civil servants, 28.77% were unemployed or housewives, and 25.17% were private employees. The majority were married (64.74%), while 17.26% were widowed. Regarding time since diagnosis, 28.77% had been diagnosed within the past year, the same percentage for those diagnosed 3–5 years ago. Most participants were at Stage II (32.37%) or Stage III (35.97%) of cancer, indicating a substantial number were in advanced stages of the disease. This demographic profile highlights a predominantly middle-aged, educated, married female population with varied durations of cancer diagnosis, mostly in moderate to advanced stages.

Table1: Demographic characteristics of Participants n = 139

	Variables	%	Frequency
Age	21-30	5	3.59
	31-40	15	10.79
	41-50	45	32.37
	51-60	40	28.77
	61 and above	34	24.46
Gender	Male	2	1.43
	Female	137	98.56
Education	Primary	20	14.38
	Secondary	50	35.97
	Tertiary	69	49.64
Occupation	Housewife/unemployed	40	28.77
	Private employee	35	25.17
	Civil Servant	45	32.37
	Retired	19	13.66
Marital Status	Single	15	10.79
	Married	90	64.74
	Divorced	10	7.19
	Widowed	24	17.26
Duration since Diagnosis	< 1 year	40	28.77
	1-2years	35	25.17
	3-5years	40	28.77
	>5years	24	17.26
Cancer Stage	Stage I	20	14.38
	Stage II	45	32.37
	Stage III	50	35.97
	Stage IV	24	17.26

Figure 1 below shows the severity of the symptoms experienced by breast cancer patients. Across all of the patients, lack of energy was the most severe symptom (69.5%), followed by difficulty sleeping (63.8%), pain (62.2 %), drowsiness (52.8%), worry (50.3%), difficulty concentrating (49.1%), numbness/tingling in hands and feet (48.6%), sadness (43.2%), irritability (39.5%), nervousness (35.1%), dry mouth (30.6 %), constipation, (29.3%), sweat (29.1%), sexual issues (29.0%) hair loss, (28.9%). The least severe symptoms were urinary symptoms (11.8%), problem swallowing (8.7%) and vomiting (6.2%).

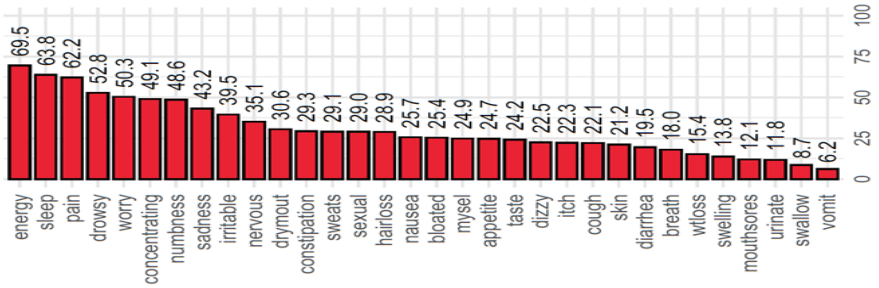


Figure 1: Severity of the symptoms experienced by breast cancer patients

The compositions of symptom clusters experienced by breast cancer patients

Symptoms rarely occur in isolation; instead, they interact within symptom networks. This perspective aligns with the Network Theory of Symptoms, which conceptualises symptoms as interdependent rather than as mere outcomes of a single underlying disease process. A regularised GGM network model was constructed using the symptom severity scores for the entire sample of 139 participants. Permutation-based statistical tests verified the accuracy and stability of the network edge weights. The symptom organisation in the network was assessed for the presence of physical and psychological clusters or dimensions that explained the symptom experience. According to Figure 2 (a) below, three distinct symptom clusters were identified and labelled as constitutional, gastrointestinal-epithelial, and psychological.

The network structure of symptom clusters experienced by breast cancer patients

Figures 2, 3, 4 and 5 depict the estimated symptom network comprising 31 nodes for patients after chemotherapy. The thickness of the edge represents the strength of interaction between two symptom nodes. Analysing the network connections of these symptoms nodes as shown in figure 2 below, the symptoms in the network most strongly connected to (and likely activated by) lack of energy include the constitutional symptoms of feeling drowsy, pain, and difficulty sleeping; the gastrointestinal-epithelial symptoms of nausea/vomiting and lack of appetite; and the psychological symptom of difficulty concentrating. The symptoms most strongly connected to feeling that “I don't look like myself” include the constitutional symptoms of feeling bloated and swelling of arms/legs; the gastrointestinal-epithelial symptoms of changes in skin and hair loss; and the psychological symptoms of feeling sad, worrying, and decreased sexual interest. The symptoms most strongly connected to difficulty concentrating include the constitutional symptoms of lack of energy, difficulty sleeping, sweats, and feeling drowsy; and the psychological symptoms of feeling sad, feeling nervous, and feeling irritable.

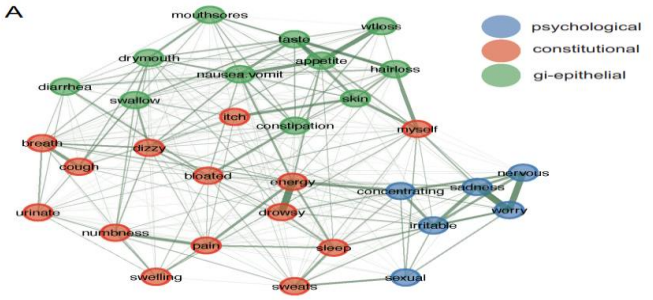


Figure 2: Symptom network clusters

From Figure 3 above, psychological Cluster (Blue) symptoms like nervousness, sadness, worry, and irritability show very high stability (all around 0.99), indicating strong, consistent grouping across resampling. Concentration also appears here with a slightly lower but still high value (0.87), suggesting it's a borderline symptom bridging psychological and constitutional domains.

Constitutional Cluster (Red): This cluster includes pain (0.86), energy (0.83), drowsiness (0.83), numbness (0.8), swelling (0.83)—all showing moderately high stability. However, other symptoms like dizziness (0.37), itch (0.3), breath (0.24), and cough (0.23) exhibit low stability, indicating inconsistency in their cluster membership across permutations. This explains why the constitutional cluster is labelled "not stable" overall—while some core symptoms are consistently present, others are variable.

GI-Epithelial Cluster (Green): Includes symptoms like mouth sores, taste, constipation, dry mouth, swallow, skin, appetite, etc. All these symptoms show very high stability (close to or exactly 1.00), confirming the robustness and cohesiveness of this cluster.

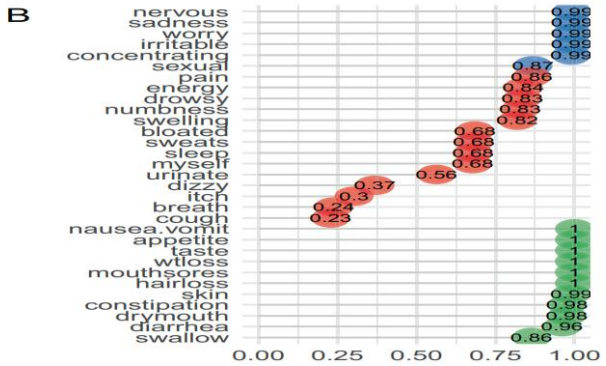


Figure 3: Stability of the symptom clusters

According to the data in Figure 4 below, lack of energy had the highest strength, closeness, and betweenness centrality scores of all symptoms in the network. This finding suggests that a lack of energy substantially contributes to the severity of other symptoms and may drive many of the co-severity relationships in the network. Other symptoms that had high values across all centrality measures (*z*-score > 0 in all three measures) included: change in the way food tastes, nausea/vomiting, lack of appetite, difficulty concentrating, feeling that "I don't look like myself," and hair loss. Next, the researcher assessed which symptoms may provide activation links between the three symptom clusters and may precede or exacerbate the severity of multiple symptoms by calculating bridge centralities and verifying their stability with permutation-based statistical tests.

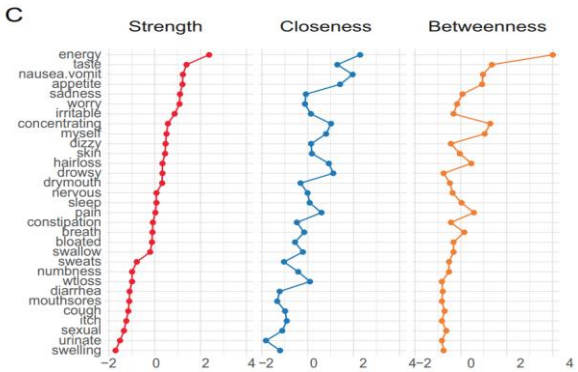


Figure 4: Strength, closeness and betweenness of the symptoms

Figure 5 below shows the symptoms lack of energy, feeling that "I don't look like myself," and difficulty concentrating exhibited the highest values in bridge strength, bridge closeness, and bridge betweenness, indicating their critical role in linking different symptom clusters within the symptom

network. Bridge strength reflects how strongly a symptom is connected to symptoms in other clusters. High bridge strength suggests that these symptoms serve as key conduits through which distress spreads between otherwise distinct domains (e.g., physical and psychological symptoms). Bridge closeness measures how efficiently a symptom can reach other symptoms across clusters. High closeness means that a symptom can quickly influence or be influenced by others, facilitating rapid propagation of symptom burden. Bridge betweenness indicates how often a symptom lies on the shortest paths connecting symptoms from different clusters. A high value suggests that the symptom acts as a critical "broker" or mediator between clusters.

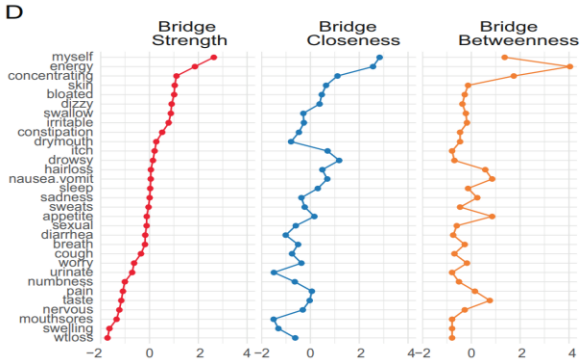


Figure 5: Bridge strength, bridge closeness and bridge betweenness of the symptoms

Discussion

Chemotherapy remains a primary treatment for breast cancer; however, its adverse effects significantly impact patients' quality of life. This study, conducted among breast cancer patients in Delta State, Nigeria, explores the prevalence and severity of symptom clusters following chemotherapy. By analysing symptom interactions and their interdependencies, this research provides valuable insights into patient distress and offers recommendations for improved supportive care. Among the 139 participants (see Table 2), the most commonly reported symptoms included pain (80%), hair loss (75%), nausea (70%), fatigue (65%), excessive worrying (65%), and difficulty sleeping (60%). These symptoms frequently co-occur, forming distinct symptom clusters that exacerbate overall distress. Research attributes this clustering to shared physiological mechanisms, such as systemic inflammation and metabolic disruptions (43).

Pain was the most frequently reported symptom, affecting 80% of participants. This aligns with global research, where chemotherapy-induced peripheral neuropathy (CIPN) is a major contributor to pain in breast cancer patients. Taxane-based chemotherapy, such as paclitaxel, is particularly associated with CIPN, causing persistent numbness, tingling, and sharp pain (44). Unmanaged pain significantly impairs mobility, increases emotional distress, and reduces overall quality of life (45). These findings underscore the urgent need for comprehensive pain management strategies, including pharmacologic treatments (e.g., neuropathic pain medications) and non-pharmacologic interventions (e.g., acupuncture, physical therapy) to reduce long-term disability.

Hair loss, reported by 75% of participants, was another highly distressing symptom. Beyond its cosmetic impact, chemotherapy-induced alopecia contributes to psychological distress, diminished self-esteem, and identity loss (46). The visible nature of hair loss serves as a constant reminder of illness, exacerbating vulnerability and emotional distress. Emerging treatments, such as low-dose oral minoxidil, offer potential solutions; however, psychosocial support remains critical. Counselling, peer support groups, and scalp cooling systems have been effective in helping patients manage this distressing side effect. Nausea, experienced by 70% of participants, remains a significant challenge despite advancements in antiemetic therapies. This symptom is physically exhausting and disrupts nutritional intake, potentially prolonging recovery. While antiemetic medications are the primary treatment, complementary approaches, including acupuncture, dietary modifications, and ginger supplementation, have demonstrated effectiveness in nausea management (47).

Fatigue, reported by 65% of participants, was identified as one of the most debilitating symptoms. Unlike regular tiredness, chemotherapy-induced fatigue is chronic and deeply affects daily life. Its causes are multifactorial, involving systemic inflammation, metabolic imbalances, disrupted sleep, and psychological stress (48). Effective

management strategies include tailored exercise programs, self-acupressure, and nutritional interventions targeting anaemia and metabolic dysregulation (49). Addressing fatigue may also mitigate other related symptoms, leading to improved overall well-being. Psychological distress was another key finding, with excessive worrying (65%) and difficulty sleeping (60%) being highly prevalent. Sleep disturbances create a negative feedback loop where poor rest exacerbates fatigue and cognitive impairments, further diminishing well-being (42). Cognitive-behavioural therapy (CBT), mindfulness, and relaxation techniques have demonstrated effectiveness in improving sleep quality, offering a holistic approach for symptom management (50). Integrating mental health services into cancer treatment is essential to address the interconnected nature of physical and psychological distress and ensure a more holistic recovery.

A network analysis of symptom interactions revealed a complex web of interconnections among chemotherapy-related symptoms. Fatigue emerged as the most central symptom, exhibiting the highest strength, closeness, and betweenness centrality scores. This suggests that fatigue plays a pivotal role in driving co-severity relationships among symptoms. Research has long established that cancer-related fatigue affects up to 80% of chemotherapy patients, significantly influencing well-being and treatment adherence (7, 43, 51). Fatigue was strongly connected to constitutional symptoms such as drowsiness, pain, and difficulty sleeping, as well as gastrointestinal issues like nausea and appetite loss. Additionally, psychological distress, particularly difficulty concentrating, was closely linked to fatigue, consistent with studies indicating that cognitive impairments and reduced mental clarity often accompany cancer-related fatigue (52, 53, 54, 55). Another critical symptom within the network was the perception of “not looking like myself”, which was highly connected to bloating, limb swelling, skin changes, and hair loss. These findings highlight the significant psychosocial impact of chemotherapy-induced physical changes, as alterations in appearance contribute to emotional distress, self-esteem issues, and depressive symptoms (45, 56). The strong association between body image concerns and psychological symptoms such as worrying, sadness, and decreased sexual interest reinforces the need for psychological interventions that address self-identity disruptions in cancer survivors (46, 57). Difficulty concentrating also emerged as a highly central node, showing strong associations with lack of energy, difficulty sleeping, sweats, and drowsiness. Additionally, it was closely linked to psychological symptoms such as sadness, nervousness, and irritability, reinforcing research suggesting that cognitive impairments in cancer patients may be mediated by fatigue and emotional distress (58, 59). Studies on “chemo brain” have documented similar patterns, with difficulties in cognitive processing linked to fatigue, sleep disturbances, and heightened anxiety (60, 61). These findings emphasise the need for integrated supportive care interventions to alleviate interconnected symptoms and enhance patient well-being.

Cluster analysis revealed that gastrointestinal-epithelial and psychological symptom clusters were highly stable, with over 85% of individual symptoms consistently grouped across multiple permutations. These clusters were replicated in 87% and 86% of permutations, respectively, indicating that they represent distinct, persistent symptom experiences among breast cancer patients undergoing chemotherapy (62, 63). The gastrointestinal-epithelial cluster included changes in skin, nausea/vomiting, taste alterations, and appetite loss. These symptoms remain a consistent feature across studies examining chemotherapy-related toxicities, often associated with metabolic dysregulation and inflammatory responses (64). Persistent gastrointestinal symptoms significantly affect nutritional status and overall quality of life (65). Similarly, the psychological symptom cluster, encompassing worrying, sadness, nervousness, and irritability, has been widely recognised as a major determinant of cancer patients’ quality of life. Research from the National Cancer Institute highlights that depression and anxiety are significant concerns among chemotherapy patients, often correlating with pain, fatigue, and gastrointestinal symptoms (66, 67). Conversely, the constitutional symptom cluster was less stable, with significant variations in symptom groupings across different permutations. This suggests systemic symptoms like fatigue and generalised pain fluctuate based on treatment stage, comorbidities, and individual differences (48, 68). The instability of the constitutional cluster highlights the need for adaptive, patient-centred management, while the identity-related bridge symptom serves as a strategic target for breaking the link between physical and emotional symptom burdens. Recognising and addressing such bridge symptoms can enhance symptom control and improve patients’ wellbeing across multiple domains.

Conclusion

This study provides valuable insights into the symptom clusters experienced by breast cancer patients, post-chemotherapy, using network analysis to map their interconnections. The findings reveal that fatigue, difficulty concentrating, and body image concerns play a central role in symptom severity, influencing both physical and psychological distress. The study also identifies stable gastrointestinal-epithelial and psychological clusters, suggesting targeted interventions for these domains. However, the constitutional symptom cluster was less stable, indicating a need for further longitudinal studies to examine its variability. From a clinical perspective, addressing fatigue may alleviate other related symptoms, improving overall well-being. Multimodal interventions, including physical activity, nutritional support, cognitive therapy, and psychosocial counselling, should be integrated into chemotherapy care plans. Additionally, early symptom detection and personalised treatment strategies may enhance symptom management and reduce long-term distress.

Given the study's cross-sectional design, future research should employ longitudinal approaches to track symptom evolution over time. Further exploration of patient-specific factors, such as treatment stage, co-morbidities, and genetic predispositions, could refine symptom management strategies. This study used a small sample from two tertiary hospitals. It is recommended that more hospitals across different states and regions in Nigeria be used to increase sample size and provide better opportunities for a probability sampling, better population representation and evidence for generalizability in the Nigerian setting. Ultimately, a holistic, patient-centred approach is essential for improving the quality of life in breast cancer patients after treatment.

Lists of Abbreviations

MSAS: Memorial Symptoms Assessment Scale
PCA: Principal Component Analysis
QOL: Quality of Life
NA: Network analysis
CIPN: Chemotherapy-induced Peripheral Neuropathy
CBT: Cognitive-behavioural Therapy

Declaration

Ethical approval and consent to participate.

Approval was obtained from the Health Research and Ethics Committee in both Centres (HREC/PAN.2024/056.0663 and FMC/ASB/A81 VOL. XII/454), entry into the outpatient clinic was authorised by the ethical committees of the data collection centres, and eligible participants were approached during clinic visits. Informed consent was obtained voluntarily, with clear explanations of the study's objectives, risks, and benefits.

Consent for publication

All the authors gave their approval for this publication.

Availability of data and materials

The data will be available upon request from the corresponding author.

Completing Interests

None was declared.

Funding

No fund was generated from any external organisation for this study.

Author contribution

BD and NCU did the conceptualisation and design of the study. The Study was supervised by NCU. BO was actively involved in data collection and analysis. All authors were involved in the reviewing and editing of the final draft.

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