AUCTORES
Globalize your Research

International Journal of Clinical Case Reports and Reviews

Prathepa Jagdish *

Open Access

Research Article

Effectiveness of Yoga on Patients with Chemotherapy Induced Cognitive Impairment (CICI) In Lung Cancer at Tertiary Care Center, Mumbai- A Pilot Study.

Prathepa Jagdish [1*], Jimli Daimari [1], Vanita Noronha [2], Minit Shah [2], Nandini Menon [2], Kumar Prabash [2]

[1] College of Nursing, Tata Memorial Hospital, Mumbai, Maharashtra, India.

[2] Department of Medical Oncolog , Tata Memorial Hospital, HBNI, Mumbai, Maharashtra, India.

***Corresponding Author:** Prathepa Jagdish, College of Nursing, Tata Memorial Hospital, Mumbai, Maharashtra, India.

Received Date: November 24, 2025 | **Accepted Date:** December 15, 2025 | **Published Date:** December 22, 2025

Citation: Prathepa Jagdish, Jimli Daimari, Vanita Noronha, Minit Shah, Nandini Menon, et al., (2025), Effectiveness of Yoga on Patients with Chemotherapy Induced Cognitive Impairment (CICI) In Lung Cancer at Tertiary Care Center, Mumbai- A Pilot Study, *International Journal of Clinical Case Reports and Reviews*, 33(2); **DOI:10.31579/2690-4861/1008**

Abstract:

Introduction: Lung cancer is the most prevalent cancer globally. It is the most prevalent cancer among males and the second most prevalent cancer among women. In 2022, there were 2,480,675 new cases of lung cancer globally. In 2022, India was placed 4th with a total of 81,748 cases. Chemotherapy-induced cognitive impairment (CICI), commonly known as "chemo brain" or "chemo fog," is an adverse effect that manifests during and after chemotherapy, characterized by difficulties in memory, attention, concentration, processing speed, and executive functions. NSCLC patients exhibit cognitive deficits in attention, memory, fluency, language and visuospatial domain which affects quality of life. Yoga has been an effective, economical and feasible intervention in improving cognition. Exercises such as super brain yoga, bhastrika, kapalabhati, bhramari and siddha walk increases blood flow to the brain improving oxygenation thus stimulating and boosting cognitive clarity. These are independent nursing action which focuses on improving cognitive function as well as self-esteem of participants.

Problem Statement: "Effectiveness of yoga on patients with chemotherapy induced cognitive impairment (CICI) in lung cancer at tertiary care center, Mumbai-A pilot study".

Objectives

1.To assess the effect of yoga on patients with chemotherapy induced cognitive impairment in lung cancer receiving third or fourth cycle of chemotherapy.

2.To identify the degree of cognitive impairment and to see the trend of changes in cognition measured by ACE III among patients with lung cancer at tertiary care center.

3.To compare the association between the cognitive function and the clinical data of patients with lung cancer at tertiary care center.

Methodology: The study enrolled 30 lung cancer patients receiving third or fourth cycle of chemotherapy by using non-probability convenient sampling technique and design as quasi-experimental one group pre-post design out of which 29 patients have completed intervention of 30 days. Intervention consisted of yoga containing 5 exercises such as super brain yoga, bhastrika, kapalabhati, bhramari and siddha walk which were demonstrated. These exercises were performed 3 times a day and total duration of 5 exercises was 20-25 minutes for a period of 30 days. Regular follow up was done log book was maintained for compliance. On day 21 and day 30, patients were assessed for effectiveness of yoga using ACE III tool. The statistical evaluation for primary objective was done by Friedman Test and the secondary objective evaluation was done by using Chi Square Test to identify the degree of cognitive impairment and Wilcoxon Signed rank Test to see the trend of changes in score from day 0 to day 21, from day 21 to day 30 and from day 0 to day 30.

Results of The Study: In this study, 30 participants received intervention and 29 participants have completed the intervention and follow up.

The result showed maximum of 13 (44.8%) participants were in the age group 51-60 years, 10 (34.5%) participants were in the age group 41-50 years, 4 (13.8 %) participants were in the age group of 31-40 years and a minimum of 2 (6.9%) participants were in the age group of 18-30 years. The group consisted of 21 (72.4%) males and 8 (27.6%) females. It showed that 14 (48.3%) participants were under the category of monthly income of Rs. 11000-20000, 6 (20.7%) participants under the category of monthly income of Rs. 21000-30000, 4 (13.8%) participants under monthly income of Rs. > 40000 whereas 4 (13.8%) participants were under monthly income of Rs. ≤ 10000 and 1 (3.4%) participant were under monthly income of Rs. 31000-40000. Here, 21 (72.4%) participants were receiving 3rd cycle of chemotherapy, 8 (27.6%) participants were receiving 4th cycle of chemotherapy and 1 (3.4%) participant had received immunotherapy along with chemotherapy.

On day 0, the mean attention score was 13.76 and SD 2.63, the mean memory score 11.07 and SD 3.38, the mean fluency score 7.72 and SD 1.91, the mean language score 16.66 and SD 2.47 and mean visuospatial score 9.45 and SD 2.67.

On day 21, the mean attention score was 14.72 and SD 2.02, mean memory score was 13.86 and SD 3.47, mean fluency score was 9.76 and SD 1.38, mean language score was 17.69 and SD 2.88 and mean visuospatial score 10.97 and SD 2.51.

On day 30, the mean attention score was 14.90 and SD 2.04, mean memory score was 14.69 and SD 3.16, mean fluency score was 10.48 and SD 1.27, mean language score was 17.97 and SD 2.96 and mean visuospatial score was 11.45 and SD 2.44. And the total mean on day 0 was 58.69 and SD 8.63, on day 21 mean was 66.93 and SD 8.28, on day 30 mean was 69.41 and SD 8.26.

The p-value for attention, memory, fluency, language and visuospatial score were found statistically highly significant ($p<0.001$).

Conclusions: The result of the study suggests that yoga is effective in improving attention, memory, fluency, language and visuospatial domains of cognition which can improve quality of life of patient and in executive functions in daily life.

Key words: effectiveness; yoga; chemotherapy; chemotherapy induced cognitive impairment (CICI); lung cancer

Introduction

Chemotherapy induced cognitive impairment (CICI) which is also referred to as “chemobrain” or “chemo fog” is an adverse reaction occurring during and after chemotherapy characterized by difficulty in memorizing visual-verbal activity, attention, concentration, processing speed and executive functions. It affects upto75% of patients during the period of chemotherapy and about 35% patients suffer for several months post chemotherapy1. The manifestations can be seen in varying degrees with varying onset and durations affecting quality of life of patients2. Chemotherapy induced cognitive impairment can result due to effects associated with neuronal damage, abnormality in repair and brain remodelling3.

As per GLOBOCAN 2020, lung cancer (11.4%) is leading after breast cancer (11.7%) with an estimation of 1.8 million deaths (18%)4. Study revealed that patients with small cell lung cancer developed cognitive impairment mostly with visuospatial disabilities and verbal influency after chemotherapy treatment with lowered grey matter and white matter integrity in bilateral paralimbic regions and white matter tract5.Chemotherapy negatively affects brain glucose metabolism and cognition by reducing blood flow. Chemotherapeutic agents, such as methotrexate with its antiangiogenic effect mediates vascular toxicity6. Doxorubicin used in breast cancer develops brain mitochondrial dysfunction, structural deformity and cognitive impairment by increasing peripheral (reactive oxygen species) ROS production in both clinical and preclinical settings7.

Studies showed both doxorubicin and cyclophosphamide caused behavioral defects, though Cyclophosphamide was associated with microglia induced inflammation. Hippocampal-dependent memory deficiency in rats was caused by activated microglial cells in hippocampus. Immuno fluorescence techniques showed that almost 90% decline in neuro genesis caused by both the drugs8.

Platinum-based agents (cisplatin, oxaliplatin, carboplatin etc.) are neuro toxic to neural progenitor cell (NPC) and oligodendrocytes through excitotoxic alterations and apoptotic pathway that inhibit protein synthesis by cross-linking susceptible mitochondrial DNA, leading to irreversible mutations rather than affecting nuclear DNA9,10

Studies showed that taxanes (Paclitaxel, docetaxel) caused mitochondrial damage in a neuropathic rodent model and also caused structural compromise in vital areas of the cerebral cortex and peripheral neurons11.

Triple chemotherapeutic drugs including cyclophosphamide, methotrexate and 5-fluorouracil causes neuro inflammation and neuro degeneration in the prefrontal cortex and hippocampus of breast cancer patients. Severe cognitive impairment and dementia are seen when there is loss of neurons in the major centres for learning and memory12.

Study showed that Immune Check point inhibitor (ICI) mono therapy can lead to cognitive decline and can deteriorate as the treatment progresses in lung cancer.13

Lung cancer metastasizes to brain within 2 years after the primary tumor diagnosis. In SCLC, 10% of patients with small cell lung cancer have metastasized to central nervous system (CNS) at the time of primary tumor diagnosis14.

Studies also showed that yoga as a promising non pharmacological intervention that improved cognition and cardiac issues in patients with CICI in breast cancer which improved their quality of life15.

Study showed that Non-Small Cell Lung Cancer patients Cognitive impairment at baseline, before to treatment, particularly in verbal memory, accompanied by extensive reductions in white matter. One-month post-treatment, Small Cell Lung Cancer patients had notable cognitive abnormalities, particularly in visuo-spatial ability and verbal fluency, and structural alterations in grey and white matter within bilateral regions associated with the paralimbic system16.

In view of fulfilling the gap, with reference to evidences from several studies, nurses encounter various cognitive issues that are subjectively and objectively gathered during nursing service. There are studies done on chemotherapy induced cognitive impairment in breast cancer. There is a gap existing of patients with lung cancer. Hence it is felt as necessary topic to be chosen as a study to assess the level of cognitive impairment and to provide intervention of yoga that may improve their cognition to be able to execute functional activities to prevent them from declining in social activities.

Primary objective was to assess the effect of yoga on patients with chemotherapy induced cognitive impairment in lung cancer patients receiving third or fourth cycle of chemotherapy. Secondary objective was to identify the degree of cognitive impairment and to see the trend of changes in cognition measured by ACE III scale among patients with lung cancer at tertiary care center and to compare the association between the cognitive function and the clinical data of patients with lung cancer at tertiary care center

Materials and Methods

The study approach used in this study was quantitative. The study consists of single arm experimental design. A single cohort of research participants undergoes pretesting, followed by the implementation of treatments or alteration of the independent variable, and concludes with post-testing. A total of 30 participants were selected based on the selection criteria using convenient sampling technique. The study was executed in outpatient medical oncology thoracic department, General and Private Daycare after approval from IEC and CTRI registration at Tata Memorial Hospital in Mumbai, India. Participants enrolled in the study were diagnosed with lung cancer undergoing 3rd or 4th cycle of chemotherapy. An informed consent was taken from the participants meeting inclusion criteria and those willing to participate. Pre intervention assessment was done using standardized ACEIII tool for cognitive impairment and the intervention was provided with five exercises such as Super Brain Yoga, Bhastrika, Kapalabhati, Bhramari and Siddha Walk.

CTRI number is CTRI/2024/07/071133

Inclusion criteria

• Patient's histologically proven with lung cancer with /without metastasis.

• Age18-60years.

• Receiving chemotherapy (cisplatin, carboplatin, paclitaxel, docetaxel, bleomycin, gemcitabine, etoposide, pemetrexed) alone/with immunotherapy (nivolumab, pembrolizumab, durvalumab) /targeted therapy (bevacizumab, Osimertinib and crizotinib).

• Patients who were able to implement the planned interventional exercises.

Exclusion criteria

• Patients receiving only immunotherapy/targeted therapy

• Preexisting cognitive impairment such as dementia, Alzheimer's, epilepsy, Parkinson's, traumatic brain injury, cerebrovascular accident-related cognitive dysfunction.

• Complications such as neutropenia, febrile neutropenia, pneumothorax, pain, thrombocytopenia, peripheral neuropathy.

Data Collection Tool

The initial Addenbrooke's Cognitive Examination (ACE) was created in the late 1990s at the Medical Research Council Cognition and Brain Sciences Unit in Cambridge as a straightforward bedside test battery intended to identify mild dementia and distinguish Alzheimer's disease from frontotemporal dementia17.

•The ACE-III is a concise, paper-and-pencil assessment of overall cognitive performance. It encompasses five cognitive domains. Each cognitive domain assesses distinct cognitive abilities, contributing to the aggregate score. The scale consists of 100 points. Each domain possesses distinct point locations, as detailed

below: 18 points are assigned to the attention and orientation domain,26 points to the memory domain,14 points to the verbal fluency domain, 26 points to the language domain, and 16 points to the visuospatial domain. A superior score is indicative of enhanced cognitive ability18,19.

The domains were-

- Attention: 18 points
- Memory: 26 points
- Verbal fluency: 14points
- Language: 26points
- Visuospatial abilities: 16points Total score = 100 points

The optimal cut-off score of 71 (sensitivity=76.13%, specificity=78.42%; AUC :0.849) effectively distinguishes mild cognitive impairment (MCI) from healthy controls (HC). And the optimal cut- off for diagnosing cases with major neuro cognitive is order (MNCD)was determined to be 6220

Intervention

•Participants were assessed for cognitive impairment using ACE III tool and scored. Those who has major or mild cognitive dysfunction were taught about the exercises.

•Informed them about the importance of yoga on cognition and its benefits. Demonstrated 5 exercises: Super Brain Yoga, Bhastrika, Kapalabhati, Bhramari and Siddha Walk.

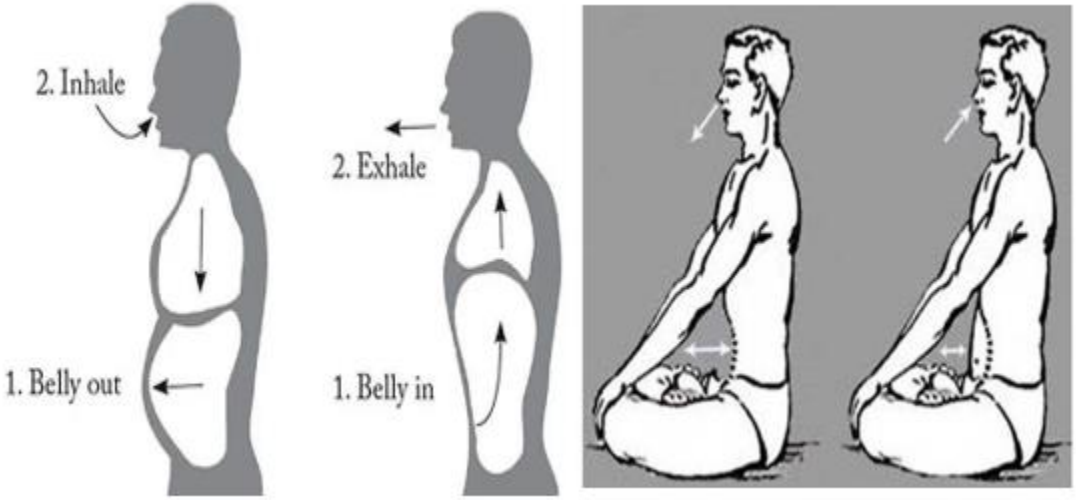
•Return demonstration from the participants on the same day was also taken to confirm they have learnt it properly. A validated video recording of all the exercises was also provided them to refer.

1. Super brain yoga

Super brain yoga is a type of yoga in which acupuncture points are the energy centres**.**

2 Bhastrika: Bhastrika means a bellows used in a furnace. Here the air is forcibly drawn in and out as in a blacksmith's bellows. Hence the name.

3 Kapalabhati: Kapalabhati Pranayama is a breathing technique that involves forceful exhalations and passive inhalations. The word "Kapal" means forehead, and "Bhati" means shining, hence the name "Skull Shining Breath.".



1 Bhramari: Bhramari Pranayama is a form of breathing exercise that is particularly beneficial to the brain. Bhramari is a Sanskrit term derived from the black Indian bumblebee, Bhramar. It refers to the distinctive humming sound made when exhaling.

2 Siddha Walk: The Siddha walk comes from the ancient scripture of Agastya Nadi. According to him, Maharishi Agastya was one of the learned sages, who adopted this.

Sr. No.	Intervention	Steps	Frequency	Duration	Benefits
1.	Super brain yoga	• Stand straight and open the legs as wide as the shoulders and the tongue should touch the hard palate. • Touch the acupressure points (earlobes)with the thumb and index finger of opposite hands • The hands are to be crossed in front of the chest. • The index finger points in ward and the thumb should point outward. • Perform 30 squats, inhaling while sitting down and exhaling while standing up or can sit on the chair and perform.	3 times a day with 30 squats each time: before breakfast, before lunch, before dinner.	5 minutes	Super brain Yoga is a type of yoga which stimulates the acupressure points in the earlobes. This sends electrical signals to the brain, thus stimulating it and boosting cognitive clarity. By pressing the earlobes, the left and right hemispheres of the brain are activated. The squatting action in the practice is meant to transmute the energy that is trapped in the lower chakra to the upper chakras (i.e the squatting action causing rhythmic contraction and relaxation of the muscles of lower limbs compresses veins increasing venous return to the heart, which subsequently increases sroke volume and boosts cardiac output, thus increasing systemic arterial blood pressure improving circulation to the brain)[21,22].
2.	Bhastrika	• Sit with crossed legs. • Take a fast, vigorous breath and exhale fast and forcefully. One inhalation and one exhalation completes a cycle of Bhastrika. The sound made resembles air rushing through bellows. • Complete10-12cycles. • If the sound of the air lessens, and the vigour diminishes, then reduce the number of cycles to 8. • After completion lied own in savasana (supine).	10-12 cycles per time**.** Repeat 3 times a day	5 minutes	Bhastrika activates and invigorates the liver, spleen, pancreas and abdominal muscles. Improves digestion, sinuses are drained, eyes feel cool and has a great sense of exhilaration. It helps to clear the mind and enhance mental clarity by increasing the oxygen supply to the brain, also improve cognitive function and memory retention.
3.	Kapalabhati	• Sit in a comfortable position with spine erect and hands on abdomen. • Take a deep breath in and exhale forcefully through nose, contracting abdominal muscles. • While exhaling, imagine pushing the air out of lungs, and abdomen to move inward. • Take a passive inhale through nose, allowing abdomen to expand. • Repeat the process.	3times a day.	5 minutes	Kapalabhati Pranayama is believed to stimulate the parasympathetic nervous system, which can cause a decrease in heart rate and blood pressure, and increase blood flow to the brain improving oxygenation, reduce stress, and enhance cognitive function[23]

4.	Bhramari	• Relax the body and sit in any comfortable position with a straight spine and a calm mind. • Throughout the exercise, to keep eyes closed. Place index fingers of both hands on the forehead, middle fingers on the eyes, ring fingers on the nose, and little fingers on the top lips, close the ears with thumbs. • Slowly and deeply inhale via both nostrils. The sound of the breath is being listened to. • Exhale should be done slowly, generating a pleasant, slow-pitch humming sound like a Bumblebee or "Om". To feel the vibrations throughout the entire body and mind. It lifts one's spirits by creating positive energy and genuine joy.	3 times a day	5 minutes	Om chanting is said to help with the development of mental abilities and strength, as well as the reduction of stress and the development of a higher level of consciousness. Improves parasympathetic nervous system (vagal tone) dominance[24,25]
5.	Siddha walk	• Walk on an Eight ("8″) shaped pattern on the floor with 6 feet width and 10 feet in length. • Follow the "8" pattern as per the arrow marking • When walking, observe breath and walk at a constant pace –not too fast or too slow. • One complete round to be counted while coming back to start position "1". • Walk from south to north direction in clockwise for 10 rounds and then anticlockwise for 10 rounds.	3 times a day	5 minutes	Walk in South-North direction i.e towards and against the earth's magnetic field, the body gets energized and activates chakras and all internal organs for normal functioning. Due to 8 shaped walking style, all the body parts like legs, ankles, knees, abdomen, hips, hands, shoulders, neck, head etc moves in a twist and turn pattern. So it gives a very good physical movement to all parts of the body when compared to regular walking. It improves consciousness and alertness (the bilateral movement helps to activate both the hemispheres and releases serotonin, dopamine, endorphin reducing anxiety and stress. The acupressure points enhances blood circulation to the brain)[26].

Results

Analysis and Interpretation of Data

Demographic Variables	Number of Patients	Percentage
Age Group(yrs)		
18 –30	2	6.9
31 –40	4	13.8
41 –50	10	34.5
51 –60	13	44.8
Total	29	100.0
Gender		
Female	8	27.6
Male	21	72.4
Monthly Family Income (Rs)		
≤10000	4	13.8
11000– 20000	14	48.3
21000– 30000	6	20.7
31000– 40000	1	3.4
>40000	4	13.8
Age (Mean ±SD)	48.10±9.00	

Table I: Demo graphic data, N=29.

Table I represents the distribution of participants as per age, gender and monthly income. Showed that a maximum of 13 (44.8%) participants were in the age group 51-60 years, 10 (34.5 %) participants were in the age group 41-50 years, 4 (13.8 %) participants were in the age group of 31-40 years and a minimum of 2(6.9%) participants were in18-30years of age group. Distribution of participants as per gender where 21(72.4%) participants were male and 8(27.6%) participants were female. 14 (48.3%) participants were under the category of monthly income of Rs.11000- 20000, 6 (20.7%) participants under the category of monthly income of Rs. 21000-30000, 4 (13.8%) participants under monthly income of Rs. > 40000 whereas 4 (13.8%) participants were under monthly income of Rs.≤10000 and 1(3.4%) participant was under monthly income of Rs. 31000- 40000.

Clinical Data	**Number of Patients**	**Percentage**
Diagnosis		
Ca Lung	29	100.0
Chemo Cycle		
3	21	72.4
4	8	27.6
Immunotherapy		
Received	1	3.4
Not Received	28	96.6
Targeted therapy		
Received	0	0.0
Not Received	29	100.0

Table II: Clinical data of patients, N=29.

Table II represents the distribution of participants as per diagnosis, chemotherapy cycle, immunotherapy and targeted therapy. Here, 21 (72.4%) participants were receiving 3rd cycle of chemotherapy, 8 (27.6%) participants were receiving 4th cycle of chemotherapy and 1 (3.4%) participant had received immunotherapy along with chemotherapy.

Assessment		Day0		Day21		Day30		Friedman Test	P-Value	Sig. at 5% level
Domain wise	N	Mean	Std dev	Mean	Std dev	Mean	Std dev			
Attention Score	29	13.76	2.63	14.72	2.02	14.90	2.04	22.656**	P<0.001	Yes
Memory Score	29	11.07	3.38	13.86	3.47	14.69	3.16	37.232**	P<0.001	Yes
Fluency Score	29	7.72	1.91	9.76	1.38	10.48	1.27	47.319**	P<0.001	Yes
Language Score	29	16.66	2.47	17.69	2.88	17.97	2.96	19.283**	P<0.001	Yes
Visuo spatial Score	29	9.45	2.67	10.97	2.51	11.45	2.44	32.066**	P<0.001	Yes
Total Score	29	58.69	8.63	66.93	8.28	69.41	8.26	45.243**	P<0.001	Yes

Table III: Effect of yoga on chemotherapy induced cognitive impairment (day wise), N=29.

***Statistically Significant at 5% level i.e., P< 0.05.**
****Statistically Highly Significant at 0.1% level i.e., P<0.001.**

Degree of cognitive impairment (Score)	Day0		Day21		Day30		Total	Chi Square Test	P-Value	Sig. at 5% level
	f	%	f	%	f	%				
Normal (≥71)	0	0.0	12	41.4	14	48.3	26	24.562**	P<0.001	Yes
Mild (62-70)	12	41.4	9	31.0	12	41.4	33			
Major (<62)	17	58.6	8	27.6	3	10.3	28			
Total	**29**	100.0	**29**	100.0	**29**	100.0	87			

Table IV: Degree of cognitive impairment, N=29.

****Statistically highly Significant at 0.1% level i.e., P<0.001**

Assess the effect	Day0			Day21			Application	
Domain wise	N	Mean	Std dev	N	Mean	Std dev	Wilcoxon Signed rank Test	P-value
Attention Score								
Day 0 Vs Day 21	29	13.76	2.63	29	14.72	2.02	3.573**	0.000
Memory Score								
Day 0 Vs Day 21	29	11.07	3.38	29	13.86	3.47	4.367**	0.000

Fluency Score								
Day 0 Vs Day 21	29	7.72	1.91	29	9.76	1.38	4.4542**	0.000
Language Score								
Day 0 Vs Day 21	29	16.66	2.47	29	17.69	2.88	3.086*	0.002
Visuospatial Score								
Day 0 Vs Day 21	29	9.45	2.67	29	10.97	2.51	3.755**	0.000
Total Score								
Day 0 Vs Day 21	29	58.69	8.63	29	66.93	8.28	4.714**	0.000

Table V: Trend of changes in cognition (day0 vs day21), N=29.

***Statistically Significant at 5% level i.e., P<0.05.**

****Statistically Highly Significant at 0.1% level i.e., P<0.001.**

The above Table V reveals that the mean value of attention score on day 0 was 13.76 and 14.72on day 21. The p-value was found statistically highly significant (0.000). The mean value of memory score was 11.07 on day 0 and 13.86 on day 21. The p-value was found statistically highly significant (0.000). The mean score of fluency score on day 0 was 7.72 and 9.76 on day 21. The p-value was found statistically highly significant (0.000). The mean value of language score was

16.66 on day 0 and 17.69 on day 21. The p-value was found statistically significant (0.002). The mean value for visuospatial score was 9.45 on day 0 and 10.97 on day 21. The p-value was found statistically highly significant (0.000).

Assess the effect	Day 21			Day 30			Application	
Domain wise	N	Mean	Std dev	N	Mean	Std dev	Wilcox on Signed rank Test	P-value
Attention Score								
Day 21 Vs Day 30	29	14.72	2.02	29	14.90	2.04	1.249	0.212
Memory Score								
Day 21 Vs Day 30	29	13.86	3.47	29	14.69	3.16	3.203*	0.001
Fluency Score								
Day 21 Vs Day 30	29	9.76	1.38	29	10.48	1.27	3.337*	0.001
Language Score								
Day 21 Vs Day 30	29	17.69	2.88	29	17.97	2.96	1.628	0.103
Visuospatial Score								
Day 21 Vs Day 30	29	10.97	2.51	29	11.45	2.44	2.636*	0.008
Total Score								
Day 21 Vs Day 30	29	66.93	8.28	29	69.41	8.26	3.241*	0.001

Table VI: Trend of changes in cognition (day 21 vs day 30), N=29.

***Statistically Significant at 5% level i.e., P< 0.05**

****Statistically Highly Significant at 0.1% level i.e., P<0.001.**

The above table VI reveals that the mean value of attention score on day 21 was 14.72 and 14.90 on day 30. The p-value was statistically not significant (0.212). The mean value of memory score was 13.86 on day 21 and 14.69on day 30. The p-value was found statistically significant (0.001).

The mean score of fluency score was 9.76 on day 21 and 10. 48 on day 30. The p-value was found statistically significant (0.001). The mean value of language score was 17.69 on day 21 and 17.97 on day 30. The p-value was found statistically not significant (0.103). The mean value for visuospatial score was 10.97 on day 21 and 11.45 on day 30. The p-value was found statistically significant (0.001).

Assess the effect	Day0			Day30			Application	
Domain wise	N	Mean	Std dev	N	Mean	Std dev	Wilcoxon Signed rank Test	P-value
Attention Score								
Day 0 Vs Day 30	29	13.76	2.63	29	14.90	2.04	3.127*	0.002
Memory Score								

Day 0 Vs Day 30	29	11.07	3.38	29	14.69	3.16	4.411**	0.000
Fluency Score								
Day 0 Vs Day 30	29	7.72	1.91	29	10.48	1.27	4.490**	0.000
Language Score								
Day 0 Vs Day 30	29	16.66	2.47	29	17.97	2.96	3.095**	0.000
Visuospatial Score								
Day 0 Vs Day 30	29	9.45	2.67	29	11.45	2.44	3.947**	0.000
Total Score								
Day 0 Vs Day 30	29	58.69	8.63	29	69.41	8.26	4.566**	0.000

Table VII: Trend of changes in cognition (day 0 vs day 30), N=29.

***Statistically Significant at 5% level i.e., P<0.05**
****Statistically Highly Significant at 0.1% level i.e., P<0.001**

The Table VII reveals that the mean value of attention score was 13.76 on day 0 and 14.90 on day 30. The p-value was statistically significant (0.002). The mean value of memory score was 11.07 on day 0 and 14.69 on day 30. The p-value was found statistically highly significant (0.000). The mean score of fluency score was 7.72 on day 0 and 10.48 on day 30. The p-value was found statistically highly significant (0.000). The mean value of language score was 16.66 on day 0 and 17.97 on day 30. The p-value was found statistically highly significant (0.000). The mean value for visuospatial score was 9.45 on day 0 and 11.45 on day 30. The p-value was found statistically highly significant (0.000).

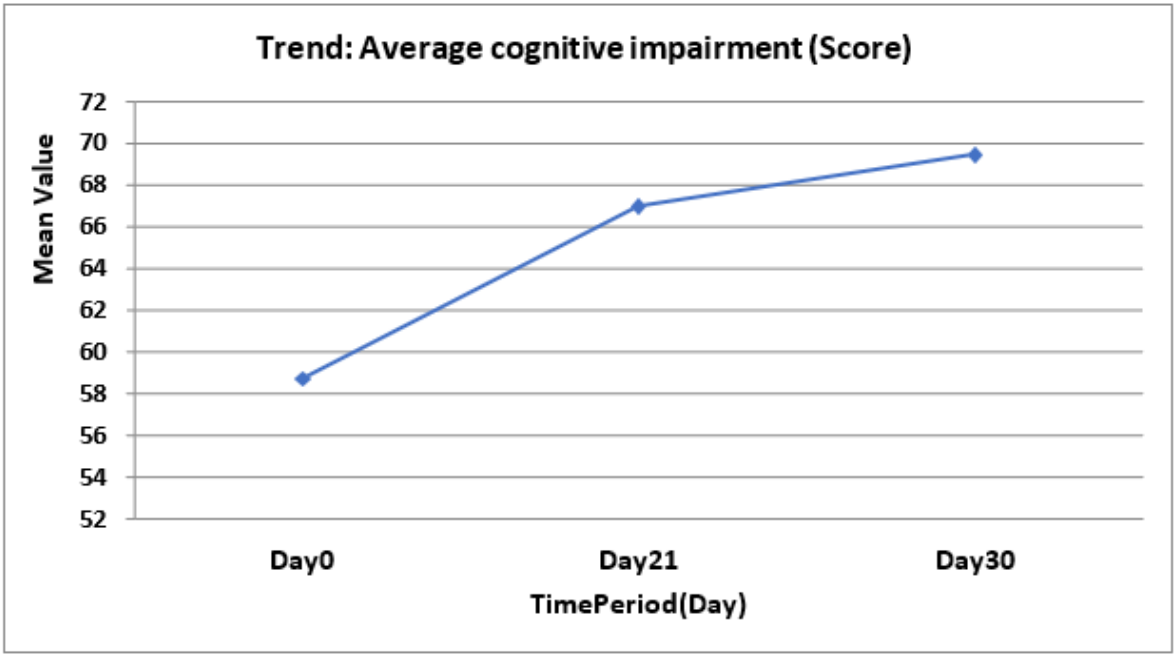


Figure I: Trend of changes in cognition, N=29.

The above line chart displays the data over time period of 30 days which shows the increasing trend of mean values of cognitive domains from day 0 to day 21 and from day 21 to day 30.

Table VIII: Association between cognitive function and clinical data, N=29.

The above table VIII depicts that there is no association between cognitive function and clinical data i.e., either 3rd or 4th cycle of chemotherapy. It does not show any significant difference in mean values of cognitive domains on day 0.

Discussion:

Cognitive impairment following third cycle of chemotherapy in lung cancer emerged as a notable adverse effect that impacts activities of daily living and self-care.

This quasi-experimental study aimed at assessing the effectiveness of yoga on patients with chemotherapy induced cognitive impairment in lung cancer. 29 participants have followed and completed 30 days of intervention without any complication. They found super brain yoga and siddha walk more interesting as compared to other three breathing exercises- bhastrika, kapalabhati and bhramari.

In this study, the interventions included 5 exercises such as super brain yoga, bhastrika, kapalabhati, bhramari and siddha walk for 20-25 minutes 3 times a day before food for a period of 30 days. Assessment of cognitive impairment was done by using ACEIII tool on day0, day21and day 30. A significant increase in the scores of cognitive domains such as attention, memory, fluency, language and visuospatial were noted and their interest towards continuing these exercises which indicates a positive effect of yoga on cognition.

Janelsins MC et al. in his study done on prevalence, mechanism and possible interventions for CICI on breast cancer patients found that 30%ofpatients manifested CICI before chemotherapy, 75% throughout treatment and 35%had even manifested after years of treatment (Janelsins MCet al 2014)36. In our study among 29 participants, 17 (58.6%) participants had major neuro cognitive disorder (MNCD, score <62) and 12 (41.4%) participants had mild cognitive impairment (MCI, score62-71) on day 0 receiving 3rd or 4th cycle of chemotherapy.

Simo M et al in their study indicated that individuals with Non-Small Cell Lung Cancer demonstrated cognitive impairment at baseline, before to therapy, particularly in verbal memory, accompanied by extensive reductions in white matter. One-month post-treatment, patients with Small Cell Lung Cancer exhibited notable cognitive impairments, particularly in visuo-spatial skills and verbal fluency16. In this study, participants diagnosed with NSCLC and SCLC both had demonstrated mild (41.4% of participants) as well as major (58.6% of participants) cognitive impairment at baseline undergoing 3rd or 4th cycle of chemotherapy.

Von Ah D, et al. in their study, the cumulative impact of chemotherapy on cognition in breast cancer patients, involving 60 individuals, indicated that cognitive deterioration typically manifests after the initial chemotherapy cycle and exacerbates with increased chemotherapy exposure13. In this study, it is found that there is no association between chemotherapy cycle and cognitive function. The participants receiving either 3rd or 4th cycle of chemotherapy exhibited cognitive impairment and there is no significant difference in scores. It can be the gap between the 2 cycles was only 21 days and the investigator has not followed up throughout the cycles after 4th cycle of chemotherapy.

Babakhani M in his study, super brain yoga for a period of one month has shown effective for haemo dialysis patient. The mean scores for cognitive function, urea, Creatinine, and dialysis adequacy at baseline were 26.07±3.72, 133.83±34.19, 9.37±2.55, and 1.22±0.24 in the control group, and 28.97 ± 1.62, 174.17 ± 52.8, 13.38 ± 4.16, and 1.26 ± 0.22 in the intervention group, respectively. At baseline, a significant difference existed between the two groups regarding cognitive function, urea, and creatinine (p-value = 0.001), although no significant difference was observed in dialysis adequacy (p-value=0.974)27. In our study, super brain yoga along with other four exercises were taught to perform for a period of 1 month and it showed statistically highly significant (p<0.001). On day 0, the mean attention score was 13.76 and SD 2.63, the mean memory score 11.07 and SD 3.38, the mean fluency score 7.72 and SD 1.91, the mean language score 16.66 and SD 2.47 and mean visuospatial score 9.45 and SD 2.67.On day 21, the mean attention score was 14.72 and SD 2.02,mean memory score was 13.86 and SD 3.47, mean fluency score was 9.76 and SD 1.38, mean language score was 17.69 and SD 2.88 and mean visuospatial score 10.97 and SD 2.51.On day 30, the mean attention score was 14.90 and SD 2.04, mean memory score was 14.69 and SD 3.16, mean fluency score was 10.48 and SD 1.27, meanl anguage score was 17.97 and SD 2.96 and mean visuospatial score was 11.45 and SD 2.44. And the total mean on day 0 was 58.69 and SD 8.63, on day 21 mean was 66.93 and SD 8.28, on day 30 mean was 69.41 and SD 8.26.The p-value for attention, memory, fluency, language and visuospatial score were found statistically highly significant (p<0.001).

Dhanawat A. et al in their study among elderly Indian individuals with brain metastasis did not show higher occurrence of cognitive impairment than those without metastasis28. In our study, participants diagnosed with NSCLC with or without metastasis undergoing 3rd or 4th cycle of chemotherapy demonstrated cognitive impairment.

Limitations

The study was a single arm study. Convenient sampling technique was used for small sample size with 30 participants with time constraints and lack of previous research studies on the topic.

Recommendations

Good Clinical Practice Guidelines can be prepared to pertain care of cognitive domains in lung cancer patients receiving chemotherapy. Establishing a standard protocol for the management of cognitive impairment by performing super brain yoga, bhastrika, kapalabhati, bhramari and siddha walk on patients with chemotherapy induced cognitive impairment in lung cancer receiving chemotherapy. All five exercises should be added to routine care. Publishing the booklet to improve knowledge and skill among nurses.

Conclusion

This study was undertaken to assess the effectiveness of yoga on patients with chemotherapy induced cognitive impairment in lung cancer. Majority of the patients with lung cancer receives chemotherapy of multiple cycles and are more prone to develop cognitive impairment irrespective of age and gender. The study showed that yoga for a short period can improve cognition with proper adherence and follow up. The five exercises- super brain yoga, bhastrika, kapalabhati, bhramari and siddha walk are simple techniques of increasing oxygenation and stimulating brain cells and it is cost effective. These nursing interventions can improve patients' quality of life by making them independent to take part in decision making in the family and feeling of emotional well-being.

References

1. Das A, Ranadive N, Kinra M, Nampoothiri M, Arora D, Mudgal J. An Overview on Chemotherapy-inducedCognitiveImpairmentandPotentialRoleofAntidepressants.Curr Neuro pharmacol. 2020;18(9):838-51. doi: 10.2174/1570159X18666200221113842. PMID: 32091339; PMCID: PMC7569321.
2. Mounier NM, Abdel-Maged AE, Wahdan SA, Gad AM, Azab SS. Chemotherapy-induced cognitive impairment (CICI): An overview of etiology and pathogenesis. Life Sci. 2020; 258:118071. doi: 10.1016/j.lfs.2020.118071.
3. StaatK, Segatore M. The phenomenon of chemobrain. Clin J Oncol Nurs. 2005;9(6):713- 21. doi:10.1188/05.CJON.713-721.
4. Global Cancer Statistics 2020 GLOBOCAN Estimates of Incidence and Mortality Worldwide.
5. Simó M, Root JC, Vaquero L, Ripollés P, Jové J, Ahles T, et al. Cognitive and brain structural changes in a lung cancer

population. J Thorac Oncol. 2015;10(1):38-45. doi: 10.1097/JTO.0000000000000345.

6. Seigers R, Timmermans J, van der Horn HJ, de Vries EF, Dierckx RA, Visser L, et al. Metho trexate reduces hippo campal blood vessel density and activates microgliainrats but does not elevate central cytokine release. Behav Brain Res. 2010;207(2):265-72. doi: 10.1016/j.bbr.2009.10.009.
7. Keeney JTR, Ren X, Warrier G, Noel T, Powell DK, Brelsfoard JM, et al. Doxorubicin- induced elevated oxidative stress and neuro chemical alterations in brain and cognitive decline: protection by MESNA and insights into mechanisms of chemotherapy-induced cognitive impairment ("chemo brain"). Onco target. 2018;9(54):30324-39. doi: 10.18632/oncotarget.25718.
8. Kitamura Y, Hattori S, Yoneda S, Watanabe S, Kanemoto E, Sugimoto M, et al. Doxorubicin and cyclophosphamide treatment produces anxiety-like behavior and spatial cognition impairment in rats: Possible involvement of hippo campal neurogenesis via brain- derive dneurotrophic factor and cyclin D1 regulation. Behav Brain Res.2015; 292:184-93. doi: 10.1016/j.bbr.2015.06.007.
9. Chovanec M, Vasilkova L, Setteyova L, Obertova J, PalackaP, Rejlekova K, et al. Long- term cognitive functioning in testicular germ-cell tumor survivors. Oncologist. 2018; 23(5):617-23. doi: 10.1634/theoncologist.2017-0457.
10. John T, Lomeli N, Bota DA. Systemic cisplatin exposure during infancy and adolescence causes impaired cognitive function in adulthood. Behav Brain Res. 2017; 319:200-6. doi: 10.1016/j.bbr.2016.11.013.
11. Lacourt TE, Heijnen CJ. Mechanisms of neurotoxic symptoms as a result of breast cancer and its treatment: considerations on the contribution of stress, inflammation, and cellular bioenergetics. Curr Breast Cancer Rep. 2017;9(2):70-81. doi: 10.1007/s12609-017-0245- 8.
12. Zhou W, Kavelaars A, Heijnen CJ. Metformin prevents cisplatin-induced cognitive impairment and brain damage in mice. PLoS One. 2016;11(3) doi: 10.1371/journal.pone.0151890.
13. Kwan AC, Zhang JQ, Truong AD, Shulman R, Shahriar S, Crowley N, et al. Machine learning and clinical decision support systems in hospitalized patients with COVID-19: a decision curve analysis. EClinicalMedicine. 2023; 59:101987. doi: 10.1016/j.eclinm.2023.101987.
14. Castrucci W, Knisely J. An update on the treatment of CNS metastases in small cell lung cancer. Cancer J. 2008;14(2):138–146.
15. Inbaraj G, Sathyaprabha TN, Udupa K, et al. Impact of integrated yoga therapy on cognitive impairment and cardiac dysfunction in relation to quality of life in breast cancer patients undergoing chemotherapy: Study protocol for a two-arm randomized controlled trial. Front Oncol. 2022; 12:955184. doi: 10.3389/fonc.2022.955184.
16. Simó M, Root JC,VaqueroL,et al.Cognitive and brain structural changes in along cancer population. J Thorac Oncol. 2015;10(1):38–45. doi: 10.1097/JTO.0000000000000345.
17. Mathuranath PS, Nestor PJ, Berrios GE, Rakowicz W, Hodges JR. A brief cognitive test battery to differentiate Alzheimer's disease and frontotemporal dementia. Neurology. 2000; 55:1613–1620.
18. Porrselvi AP, Shankar V. Status of cognitive testing of adults in India. Ann Indian Acad Neurol. 2017;20(4):334. doi:10.4103/aian.AIAN_107_17.
19. Kan KC, Subramaniam P, Shahrizaila N, Kamaruzzaman SB, Razali R, Ghazali SE. Validation of the Malay version of Addenbrooke's Cognitive Examination III in detecting mild cognitive impairment and dementia. Dement Geriatr Cogn Dis Extra. 2019;9(1):66– 76. doi:10.1159/000495107.
20. Bajpai S, Upadhyay A, Sati H, Pandey RM, Chaterjee P, Dey AB. Hindi version of Addenbrooke's Cognitive Examination III: Distinguishing cognitive impairment among older Indians at the lower cut-offs. Clin Interv Aging. 2020; 15:329-339. doi:10.2147/CIA.S244707.
21. Jois SN, D'Souza L, Moulya R. Beneficial effects of Super brain yoga on short-term memory and selective attention of students. Indian J Tradit Know l. 2017; 16: 35-39.
22. VermaS,Kumar K.Evidence based study on super brain yoga and its application on alpha EEG in adolescence. Int J Sci Consciousness. 2016;2: 40-46.
23. The Bodhi Yoga. Kapalbhati Pranayama: Benefits and Effects on Brain. Available from: https://www.thebodhiyoga.com/kapalbhati-pranayama-benefits-and-effects-on-brain/#:~:text=While%20there%20is%20no%20direct,stress%2C%20and%20enhanced%20cognitive%20function.
24. Hari harananda A.Patanjal YogaDarshanam. Motilal Banarsidas; 1980. Sadhanapad, 2/52- 53.pp. 282-283.
25. Swami M. Hathyoga Pradipika: Light on Hatha Yoga. Yoga Publication Trust; 2006. Shatkarma and pranayama, 2/68. pp. 260
26. Raghavendra K. "8" shaped walk maintain good health. Available from: IJCRT https://ijcrt.org/papers/IJCRT1133156.pdf
27. Babakhani M, Rahzani K, Hekmat pou D, Sheykh V. The effect of super brain yoga on the cognitive function of hemo dialysis patients. Heliyon. 2024; 10(16) doi:10.1016/j.heliyon.2024.e36384.
28. Dhanawat A, Noronha V, Ramaswamy A, et al. The prevalence of cognitive impairment in older Indian persons with cancer and brain metastases. E cancer medical science. 2022; 16:1372. doi: 10.3332/ecancer.2022.1372.

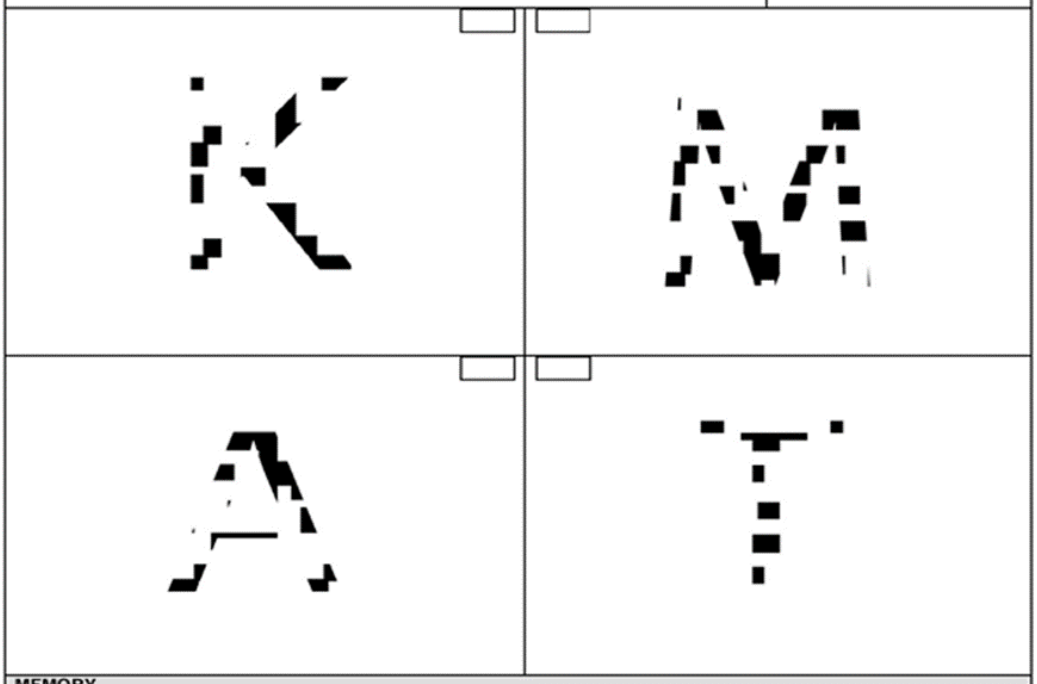
Other References

1. Winocur G, Berman H, Nguyen M, Binns MA, Henkelman M, van Eede M, et al. (2018). Neurobiological mechanisms of chemotherapy-induced cognitive impairment in a transgenic model of breast cancer. Neuroscience.;369: 51-65.
2. Siegel RL, Miller KD, Jemal A.(2018). Cancer statistics, 2018. CA Cancer J Clin.; 68(1):7- 29.
3. Ahles TA, Saykin AJ, No ll WW, Furstenberg CT, GuerinS, Cole B, et al., (2003). The relationship of APOE genotypetoneuropsychologicalperformanceinlong-termcancersurvivors treated with standard dose chemotherapy. Psychooncology.;12(6):612-619.
4. Yang M, Kim J-S, Kim J, Jang S, Kim S-H, Kim J-C, et al., (2012). Acute treatment with methotrexate induces hippocampal dysfunction in a mouse model of breast cancer. Brain Res Bull.;89(1-2):50-6.
5. ElBeltagy M, Mustafa S, Umka J, Lyons L, Salman A, Chur-yoe GT, et al. (2010). Fluoxetine improves the memory deficits caused by the chemotherapy agent 5-fluorouracil. Behav Brain Res.;208(1):112-117.
6. Lyons L, ElBeltagy M, Bennett G, Wigmore P. (2012). Fluoxetine counteracts the cognitive and cellular effects of 5-fluorouracil in the rat hippocampus by a mechanism of prevention rather than recovery. PLoS One.;7(1)
7. Lange M, Giffard B, Noal S, Rigal O, Kurtz JE, Heutte N, et al., (2014). Baseline cognitive functions among elderly patients with localized breast cancer. J Psychosom Res.;76(6):503-509.
8. Ahles TA, Saykin AJ, McDonald BC, Furstenberg CT, Cole BF, Hanscom BS, et al. (2010). Cognitive function in breast cancer patients prior to adjuvant treatment. J Clin Oncol.;28(8):1294-301
9. Whitney KA, Lysaker PH, Steiner AR, Hook JN, Estes DD, Hanna NH. (2008). Is "chemo brain" a transient state? A prospective pilot study among persons with non-small cell lung cancer. J Support Oncol.;6(7):313–321.
10. Mandelblatt JS, Hurria A, Mc Donald BC, et al. (2013). Cognitive effects of cancer and its treatments at the intersection of aging: what do we know; what do we need to know? Sem in Oncol.;40(6):709–25.
11. Sørensen J, Hansen H, Hansen M, Dombernowsky P. (1988). Brain metastases in adenocarcinoma of the lung: frequency, risk groups, and prognosis. J Clin Oncol.;6(9):1474–1480.
12. Bray VJ, Dhillon HM, Bell ML, et al. (2017). Evaluation of a web-based cognitive rehabilitation program in cancer survivors reporting cognitive symptoms after chemotherapy. J Clin Oncol.;35(2):217–225.
13. Cicerone KD, Dahlberg C, Malec JF, et al. (2005). Evidence-based cognitive rehabilitation: updated review of the literature from 1998 through 2002. Arch Phys Med Rehabil.;86(8):1681–1692.
14. Dhanawat A, Noronha V, Ramaswamy A, et al. (2022). The prevalence of cognitive impairment in older Indian persons with cancer and brain metastases. E cancer medical science.; 16:1372.
15. Derayat A, Beydokhti TB, Mottaghy MR, Kakhki SK, Sadeghmoghadam L. (2021). The effect of Super brain Yoga exercises on cognitive functions of the older adult. Research Square [Preprint].
16. Kumari N, Gupta ID, Jeph D, Yadav A, Yadav K, Garg N, Goothy SS, Choudhary A. (2023). Effect of yoga practice on cognitive functions among the patients of depression. Asian J Med Sci [Internet]. Feb 1 [cited 2024 Sep 30];14(2):208-213.
17. Jagadeesan T, RA, RK, Jain T, Allu AR, Selvi GT, Maveeran M, Kuppusamy M. (2022). Effect of Bhramari Pranayama intervention on stress, anxiety, depression and sleep quality among COVID-19 patients in home isolation. J Ayurveda Integr Med.;13(3):100596.
18. Tritsch JM. (1998). Application of King's theory of goal attainment and the Carondelet St. Mary's case management model. Nurs Sci Q. Summer;11(2):69-73.
19. Hampton DC. (1994). King's theory of goal attainment as a framework for managed care implementation in a hospital setting. Nurs Sci Q. Winter;7(4):170-173.
20. Alligood M, Tomey A. Nursing theorists and their work. Maryland Heights: Mosby- Elsevier; 2010. p. 7.
21. Bray F, Laversanne M, Sung H, et al. (2024). Global cancer statistics 2022: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA Cancer J Clin.;74(3):229-263.
22. Li C, Lei S, Ding L, Xu Y, Wu X, Wang H, et al., (2023). Global burden and trends of lung cancer incidence and mortality. Chin Med J.;136(13):1583-1590.
23. Jani C, et al., (2022). Temporal trends of lung cancer burden in India in comparison to global burden from 1990 to 2019: An observational analysis. JCO.;40
24. Thandra KC, Barsouk A, Saginala K, Aluru JS, Barsouk A. (2021). Epidemiology of lung cancer. Contemp Oncol (Pozn).;25(1):45-52.
25. Nair CK, Mathew AP, George PS. (2017). Lung cancer: Presentation and pattern of care in a cancer center in South India. Indian J Cancer.;54(1):164-168.
26. Murali AN, etal., (2017). Outcomes in lung cancer: 9-year experience from a tertiary cancer center in India. JGO.;3:459-68.
27. Noronha V, Pinninti R, Patil VM, Joshi A, Prabhash K. (2016). Lung cancer in the Indian subcontinent. South Asian J Cancer.;5(3):95-103.
28. Malik PS, Malik A, Deo SV, Mohan A, Mohanti BK, Raina V. (2014). Underutilization of curative treatment among patients with non-small cell lung cancer: Experience from a tertiary care centre in India. Asian Pac J Cancer Prev;15(6):2875-2878.
29. Amani O, Mazaheri MA, Moghani MM, Zarani F, Choolabi RH. (2024). Chemotherapy-induced cognitive impairment in breast cancer survivors: A systematic review of studies from 2000 to 2021. Cancer Rep.;7(2).
30. Whittaker AL, George RP, O'Malley L. (2022). Prevalence of cognitive impairment following chemotherapy treatment for breast cancer: a systematic review and meta-analysis. Sci. Rep.; 12:2135.
31. van der Weijst L, Lievens Y, Surmont V, Schrauwen W. (2022). Neurocognitive functioning following lung cancer treatment: The PRO-Long Study. Tech Innov Patient Support Radiat. Oncol.;21:36-40.

32. Mounier NM, Abdel-Maged AE, Wahdan SA, Gad AM, Azab SS. (2020). Chemotherapy-induced cognitive impairment (CICI): An overview of etiology and pathogenesis. Life Sci.; 258:118071.
33. Matsos A, Johnston IN. (2019). Chemotherapy-induced cognitive impairments: A systematic review of the animal literature. Neurosci Biobehav Rev.; 102:382-99.
34. Rodríguez Martín B, Fernández Rodríguez EJ, Rihuete Galve MI, Cruz Hernández JJ. (2020). Study of chemotherapy-induced cognitive impairment in women with breast cancer. Int J Environ Res Public Health.;17(23):8896.
35. Lange M, Joly F, Vardy J, Ahles T, Dubois M, Tron L, Winocur G, DeRuiter MB, Castel H. (2019). Cancer-related cognitive impairment: an update on state of the art, detection, and management strategies in cancer survivors. Ann Oncol.;30(12):1925-40.
36. Janelsins MC, Kesler SR, Ahles TA, Morrow GR. (2014). Prevalence, mechanisms, and management of cancer-related cognitive impairment. Int Rev Psychiatry.;26(1):102- 13.
37. Collins B, Mackenzie J, Fennell E, et al. (2013). Cognitive effects of chemo therapy in breast cancer patients: a dose–response study. Psycho oncology;22(9):1950-9.
38. Ahles TA, Saykin AJ, McDonald BC, Li Y, Furstenberg CT, Hanscom BS, Mulrooney TJ, Schwartz GN, Kaufman PA. (2010). Longitudinal assessment of cognitive changes associated with adjuvant treatment for breast cancer: impact of age and cognitive reserve. J Clin Oncol.;28(29):4434-4440.
39. Liu S, Ni J, Yan F, Yin N, Li X, Ma R, Wu J, Zhou G, Feng J. (2022). Functional changes of the prefrontal cortex, insula, caudate and associated cognitive impairment (chemobrain) in NSCLC patients receiving different chemotherapy regimen. Front Oncol.;12:1027515.
40. Eggen AC, Richard NM, BosmaI, Jalving M, Leighl NB, Liu G, Mah K, Higazy R, Shultz DB, Reyners AKL, Rodin G, Edelstein K. (2022). Factors associated with cognitive impairment andcognitiveconcernsinpatientswithmetastaticnon-small cell lung cancer. Neuro Oncol Pract.;9(1):50-58.
41. Kuśmierek M, Jasionowska J, Maruszewska P, Kalinka-Warzocha E, Gałecki P, Mikołajczyk I, Talarowska M. (2020). The impact of cancer treatment on cognitive efficiency: Chemobrain – does it exist? Eur J Psychiatry.;34(1):20-26.
42. Simó M, Root JC, Vaquero L, Ripollés P, Jové J, Ahles T, Navarro A, Cardenal F, Bruna J, Rodríguez-Fornells A. (2015). Cognitive and brain structural changes in a lung cancer population. J Thorac Oncol.;10(1):38-45.
43. Michalak S, Rybacka-Mossakowska J, Gazdulska J, Golda-GockaI, Ramlau R, Kozubski W. (2016). The risk of cognitive impairment after chemotherapy in lung cancer patients in the context of neurotrophins expression in peripheral blood mononuclear cells (P4.249). Neurology.;86(16 Suppl) 249.
44. Alyssa Bernstein LJ, Sabiston CM, Jones JM, Trinh L. (2023). Feasibility of a remotely- delivered yoga intervention on cognitive function in breast cancer survivors: a mixed- methods study. Front Cogn.; [cited 2024 Sep 30].
45. Shetty L, Reddy GG, Krishnan P, TobyI, Ts S, KA. (2022). Effects of yoga on cognitive functions among adolescents. Adv Mind Body Med.;36(2):4-7.
46. Latha R, Sarveghna Lakshmi S. (2022). Effect of Bhramari Pranayama Practice on Cognitive Functions in Healthy Volunteers. Int J Physiol;10(4):123-126.
47. Inbaraj G, Sathyaprabha TN, Udupa K, Ram A, Patil S, Rajeswaran J, et al. (2022). Impact of integrated yoga therapy on cognitive impairment and cardiac dysfunction in relation to quality of life in breast cancer patients undergoing chemotherapy: Study protocol for a two-arm randomized controlled trial. Front Oncol.;12:955184.
48. Hoy S, Östh J, Pascoe M, Kandola A, Hallgren M. (2021). Effects of yoga-based interventions on cognitive function in healthy older adults: A systematic review of randomized controlled trials. Complement Ther Med.; 58:102690.
49. Gothe NP, KhanI, Hayes J, Erlenbach E, DamoiseauxJS. (2019). Yoga effects on brain health: A systematic review of the current literature. Brain Plast. 5(1):105-122.
50. Galantino ML, Greene L, Daniels L, Dooley B, Muscatello L, O'Donnell L. (2012). Longitudinal impact of yoga on chemotherapy-related cognitive impairment and quality of life in women with early-stage breast cancer: A case series. Explore (NY);8(2):127-135.
51. Karapolat S, Topaloglu O, Akdoğan A, Türkyılmaz A, Tekinbaş C. (2024). Surgical outcomes of lung cancer patients with dementia. J Exp Clin Med;41(1):119-124.
52. Chen Y-P, Zhang Y, Chen X, Luo J, Chen Z-Q, Zhao L-P, Xia G, Sui X-Q, Li Y-C. (2023). The effects of different surgical approaches on the psychological status, medical coping mode and quality of life of patients with lung cancer. Front Psychol.; 14:1039501.
53. Sprung J, Schulte PJ, Knopman DS, Mielke MM, Petersen RC, Weingarten TN, Martin DP, Hanson AC, Schroeder DR, Warner DO. (2019). Cognitive function after surgery with regional or general anesthesia: A population-based study. Alzheimer's Dement.;15(10):1243-1252.
54. Caza N, Taha R, Qi Y, Blaise G. (2008). The effects of surgery and anesthesia on memory and cognition. Prog Brain Res.; 169:409-422.
55. Sharm SK. (2018). Nursing research and statistics. 3rd ed. Elsevier India. p. 189.
56. Beck PDF. (2004). Nursing Research: Principles and Methods. 7th ed. Vol. 46(88-89), 114, 162, 289, 303. Lippincott Williams & Wilkins;. p. 317-318, 416-417, 422.
57. Dibekulu D. (2020). An overview of data analysis and interpretations in research.;1-27.
58. Babakhani M, Rahzani K, Hekmatpou D, Sheykh V. (2024). The effect of super brain yogaon the cognitive function of hemodialysis patients. Heliyon.;10(16).

VISUOSPATIAL ABILITIES

➢ Ask the subject to identify the letters	Visuospatial [Score 0-4] ☐



MEMORY

➢ Ask "Now tell me what you remember about that name and address we were repeating at the beginning"

Sunil Kumar Singh 52, Station Road, Gandhinagar, Allahabad.	…… …… …… ……

Memory [Score 0-7] ☐

MEMORY

➢ This test should be done if the subject failed to recall one or more items above. If all items were recalled, skip the test and score 5. If only part was recalled start by ticking items recalled in the shadowed column on the right hand side; and then test not recalled items by telling the subject "ok, I'll give you some hints: was the name X, Y or Z?" and so on. Each recognised item scores one point, which is added to the point gained by recalling.

Memory [Score 0-5] ☐

Sunil Kumar Sharma		Sunil kumar Singh		Rakesh Yadav		recalled	
25		52		37		recalled	
Market Road		Sastri Marg		Station Road		recalled	
Prakash Nagar		Gandhi Nagar		Patel Nagar		recalled	
Allahabad		Gwalior		Indore		recalled	

SCORES

TOTAL ACE-III SCORE	/100
Attention	/18
Memory	/26
Fluency	/14
Language	/26
Visuospatial	/16

DOI:10.31579/2690-4861/1008