

CHAPTER II

LITERATURE REVIEW

A. Concept of Cancer

1. Definition

Cancer is a new tissue that grows abnormally malnormally and is malignant. The term cancer comes from Latin *Carcinamon*, where *Carci* means crab and *Run* means enlargement. This disease is described as resembling a crab because it is firmly attached to the surface of the tissue it occupies. Cancer growth takes place through a process of progressive infiltration, invasion, destruction, and penetration of the surrounding tissues (Wardana) *et al.*, 2025).

Cancer arises due to changes or mutations in genes in cells that trigger uncontrolled growth without regulation from other body signals. This condition allows cancer cells to spread to tissues or organs far from their original location. Cancer is defined as a group of diseases characterized by uncontrolled abnormal growth as well as spread, which can eventually lead to death (Summons) *et al.*, 2025).

2. Etiology

Any factor that can cause cancer to occur is called a carcinogen. Carcinogens cause changes in DNA whose smallest unit is genes, so they are often thought to have mutagenic properties. Based on various studies, carcinogens can be grouped into four types, namely chemical carcinogens, viruses, radiation (ionic and non-ionizing), and biological agents (Pearl *et al.*, 2025).

a. Chemical Carcinogens

Most chemical carcinogens fall under pro carcinogens, which are substances that require metabolic processes to turn into an active carcinogen (*Ultimate carcinogen*) that are capable of causing changes in the DNA, RNA, or proteins of the body's cells. This process results

in the formation of neoplasms at the site of the chemical's metabolism which then acts as an active carcinogen. However, there are also carcinogens that can directly trigger the formation of neoplasms in exposed tissues without going through metabolic changes. Some chemical carcinogens can even work simultaneously or interact with other carcinogens, such as viruses or radiation, in influencing the formation of neoplasms (Jayanti *et al.*, 2023).

b. Viral Carcinogens

Viruses that have carcinogenic properties are called oncogenic viruses. Various studies show that both DNA viruses and RNA viruses can trigger cell transformation.

- 1) *Human Papilloma Virus* (HPV) types 1, 2, 4, and 7 often cause *squamous papillomas*, while HPV types 16, 18, and 31 are associated with the appearance of uterine cervical carcinoma.
- 2) The herpes virus group is related to the onset of *nasopharyngeal carcinoma*, *Burkitt's lymphoma*, as well as several subtypes of Hodgkin's disease.
- 3) *Hepatitis B Virus* (HBV) infection in areas with high levels of endemism correlates with an increase in cases of liver cell carcinoma.
- 4) *Cytomegalovirus* (CMV), which belongs to the herpesvirus group, is also associated with the occurrence of Kaposi's sarcoma in AIDS patients.
- 5) *Helicobacter pylori* What was initially thought to be only the cause of peptic ulcers is now thought to play a role in the onset of gastric carcinoma and gastric lymphoma. RNA viruses like Human *T-cell Leukemia Virus type I* (HTLV-I) can cause T-cell leukemia, while HIV is associated with the formation of B-cell lymphoma in people with AIDS (Yanti *et al.*, 2021).

c. Radiation Carcinogens

Radiation from various sources such as light *Ultraviolet* (UV) sunlight, X-rays, nuclear fission, and radionuclides have been proven to be carcinogens. Exposure to UV radiation can lead to the formation of pyrimidine dimers that damage bonds *Phosphodiester* DNA. This is evident from the many pioneers in the development of X-rays who later suffered from skin cancer. In addition, the miners of the radioactive element showed a tenfold increase in the incidence of lung cancer. Research on atomic bomb survivors in Hiroshima and Nagasaki also revealed a significant increase in leukemia cases (Dewi & Widari, 2022).

Natural UV radiation from the sun can trigger a variety of skin cancers, including melanoma, squamous cell carcinoma, and basal cell carcinoma. The greatest risk is experienced by light-skinned or white-skinned individuals who live in areas with high sun exposure. In patients with *Xeroderma Pigmentosum* (XP) which has an inherent disorder in the form of an enzyme deficiency to repair DNA damage, skin cancer is very easy to occur if frequently exposed to UV radiation (Kartika *et al.*, 2024).

d. Biological Agent

1) Hormones

Several hormones can act as co-factors in the process of carcinogenesis. Estrogen is known to trigger the formation of endometrial and breast cancers, while steroid hormones are associated with the onset of liver cell carcinoma.

2) Mitotoxins

Mitotoxins are toxins produced by fungi. *Aspergillus flavus*, which is a fungus that grows on legumes with poor processing and storage, produces *aflatoxin*, especially *aflatoxin B1*. *Aflatoxin B1* has strong carcinogenic properties and is closely related to the incidence of liver cell carcinoma. After ingesting, *aflatoxin* will

undergo an oxidation process in liver cells and produce intermediate compounds that then bind to guanine in DNA.

3) Parasites

Parasites can also play a role in carcinogenesis. *Schistosoma* infection is associated with the appearance of bladder cancer in the form of squamous cell carcinoma, while infection *Clonorchis sinensis* associated with the occurrence of gallbladder adenocarcinoma (Pearl *et al.*, 2025).

3. Pathophysiology

Non-lethal genetic damage is a major factor in the process of carcinogenesis, both caused by environmental exposure such as chemicals, radiation, and viruses, and passed down through germ cells. Under normal circumstances, cell growth is regulated by a number of key gene groups. Proto-oncogenes regulate cell growth and differentiation, but can transform into oncogenes when mutated or activated by retroviruses. Meanwhile, tumor-suppressing genes (antioncogens) function to control cell growth, so when these genes lose function recessively, control over abnormal cell division can be lost.

The genes that regulate apoptosis are in charge of guaranteeing that damaged or abnormal cells undergo programmed death. The mutations that occur in this gene allow pathological cells to survive and assemble. On the other hand, DNA repair genes play a role in maintaining the stability of genetic material by repairing non-lethal DNA damage. When these repair mechanisms are inhibited, mutations can accumulate on a variety of important genes, which in turn increases the likelihood of neoplastic transformation and cancer development. (Murillo *et al.*, 2025).

4. Classification

There are five main groups used in the classification of cancer, namely carcinoma, sarcoma, lymphoma, adenoma, and leukemia.

- a. Carcinoma is a type of cancer that originates from the skin or tissues that line the internal organs.

- b. Sarcoma is a cancer that develops from bone, cartilage, fat, muscle, blood vessels, or connective tissue.
- c. Lymphoma is a cancer that arises from lymph nodes as well as immune system tissues.
- d. Adenoma is a cancer that originates from glandular tissue such as the thyroid, pituitary gland, adrenal glands, and other glands.
- e. Leukemia is a cancer that arises from blood-forming tissues such as the bone marrow and generally accumulates in the bloodstream.

5. Clinical Manifestations

Both benign and malignant tumors can cause problems for sufferers, namely:

a. Weight Loss and Obesity

Patients suffering from cancer often experience persistent weight loss caused by inflammatory processes in the body, increased metabolic rate, and loss of desire to eat. This condition is characterized by loss of muscle mass as well as prolonged fatigue, which contributes to sleep problems due to physical weakness and overall body discomfort.

b. Severe fatigue (*cancer-related fatigue*)

Prolonged fatigue is a problem often faced by cancer patients, arising from inflammation, anemia, and changes in energy metabolism. This makes it difficult for patients to maintain normal sleep patterns and often has difficulty sleeping.

c. Chronic Pain

Tumor growth and spread of cancer cells put pressure on tissues and nerves, triggering prolonged pain. Unmanaged pain can cause problems when starting sleep, often waking up in the middle of the night, and negatively impacting sleep quality.

d. Psychological Disorders (Anxiety & Depression)

Anxiety, emotional distress, and depression arising from a cancer diagnosis or treatment process can increase cortisol levels as

well as overactivate the sympathetic nervous system. This ultimately leads to insomnia and fragmented sleep.

e. Sleep Disorders

Sleep disorders are a common clinical symptom experienced by individuals with cancer in complex responses to physiological, psychological, and treatment effects. Biologically, cancer cell growth triggers inflammatory reactions that increase the release of cytokines such as interleukin-1 (IL-1), interleukin-6 (IL-6), and tumor necrosis factor- α (TNF- α), which can interfere with sleep regulation in the hypothalamus. The activation of these cytokines contributes to changes in circadian rhythms, increased fatigue during the day, and disruption of sleep patterns. In addition, physical symptoms such as prolonged pain, nausea, vomiting, shortness of breath, and discomfort due to disease progression also hinder patients from obtaining good and quality sleep.

Other factors that worsen sleep disorders stem from the side effects of therapy, such as chemotherapy, radiotherapy, immunotherapy, hormone therapy, and corticosteroid use. These therapies can cause excessive fatigue, *hot flashes*, neuropathy, and changes in body temperature that interfere with comfort when resting. In patients undergoing hospital treatment, the sleep cycle is also often disrupted by examination schedules, medication at night, room noise, and exposure to light that does not match the natural biological rhythm.

From a psychological point of view, a cancer diagnosis often triggers anxiety, stress, and fear of the course of the disease. This condition stimulates the activation of the sympathetic nervous system and increases the production of stress hormones such as cortisol, thereby inhibiting the relaxation process before bed and triggering insomnia. Concerns about treatment outcomes, the possibility of relapse, family burdens, and financial stress further exacerbate the hyper-arousal state. If it lasts for a long time, sleep disturbances can

worsen fatigue, decrease cognitive function, increase sensitivity to pain, and interfere with the patient's immunity and overall quality of life.

f. Night Sweats & Fever

The systemic inflammatory processes that occur as a result of cancer, especially lymphoma, can cause heavy night sweats and discomfort during sleep.

g. Nausea and Indigestion

Cancer treatments such as chemotherapy can trigger nausea, vomiting, and digestive problems that interfere with the quality of sleep of the patient.

6. Laboratory and diagnostic examinations

a. Tumor Markers

Tumor marker examination is carried out using blood samples to detect the presence of cancer cells. Examples of commonly used markers include *Alpha-fetoprotein* (AFP) which normally appears during pregnancy, *carcinoembryonic antigen* (CEA), as well as other antigens such as Ca 72-4, Ca 19-9, and Ca 12-5. Each of these markers plays a role in helping the diagnosis of cancer in various organs of the body.

b. *Human Chorionic Gonadotropin* (HCG)

Increased HCG levels can be an indication of malignancy, for example in cases of mola hydatidosa or testicular choriocarcinoma.

c. Cancer Antigen 15-3 (Ca 15-3)

The Ca 15-3 test is commonly used to detect and monitor the progression of breast cancer.

d. Prostate-Specific *Antigen* (PSA)

A PSA test is done to help diagnose prostate cancer by measuring the levels of specific antigens in the blood.

e. *Neuron-Specific Nulase* (NSE)

NSE screening is beneficial in the assessment of several types of cancer, especially small cell bronchial carcinoma and neuroblastoma.

f. Squamous Cell Carcinoma (SCC) Antigen

SCC antigens can be found in squamous cell carcinoma tissues, for example in the uterine cervix. The level of this antigen can also increase in malignancy in the pharynx and laryngeal regions.

g. Anatomical Pathology

This examination includes macroscopic and microscopic analysis of tumor shape and structure through biopsy tissue samples.

h. *Ultrasound* (ultrasound)

This method utilizes high-frequency sound waves to assess the presence and characteristics of additional tumors, for example in the case of testicular tumors.

i. Mammography

This examination uses X-ray techniques to evaluate breast tissue. Mammography is able to detect small abnormalities with an accuracy rate of about 90%.

j. Imaging Examination

This procedure includes various medical visualization techniques that function to support the enforcement of cancer diagnosis and help determine the stage of tumor development (Dewi & Widari, 2022).

7. Governance

a. Chemotherapy

Chemotherapy aims to kill or damage cancer cells, control the growth rate, and stop tumor growth. This therapy is systemic, so it is able to reach cancer cells that have spread to other parts of the body. The use of chemotherapy can be done as the main therapy, or applied before or after surgery and radiotherapy. The success rate of chemotherapy depends on the type of cancer the patient is facing.

b. Radiotherapy

Radiotherapy is given before or after surgery to shrink the size of the tumor by destroying the cancerous tissue. Side effects that may

appear include nausea, decreased leukocyte count, infection, inflammation, skin reactions, fatigue, pain in the mouth and throat area, diarrhea, and hair loss.

c. Surgery (Operation)

Surgery is the oldest treatment method still used today. Many types of cancer can be effectively treated through surgery, especially if action is taken in the early stages of disease progression (Kartika *et al.*, 2024).

B. Concept of Chemotherapy

1. Definition

Chemotherapy is a cancer treatment method that utilizes antineoplastic drugs to inhibit the growth of cancer cells in the body. These substances function by damaging the process of cancer cell division, so that the cells cannot survive and multiply. Due to its systemic nature, chemotherapy not only focuses on the main tumor, but can also reach cancer cells that have spread to other parts of the body. This therapy can be done alone or in combination with other methods, such as surgery or radiotherapy, to increase the effectiveness of treatment (Brown & Martinez, 2025).

2. Objectives of Chemotherapy

The main goal of chemotherapy is to inhibit the process of cell proliferation and slow down the multiplication of tumors, so that the spread and growth of cancer cells can be suppressed. Although it focuses on malignant cells, this therapy can also affect normal cells in the body, which then causes toxic effects due to chemotherapy (Huang *et al.*, 2024).

Chemotherapy can be divided into several types, namely neoadjuvant, adjuvant, combination, and metastatic therapy. Neoadjuvant therapy is given before the main treatment is performed, whereas adjuvant therapy is given at the same time as the main therapy to suppress or eliminate the growth of hidden cancer cells. Adjuvant therapy has now become the

standard of treatment in patients with breast, ovarian, colorectal, and lung cancers (H. X. Yang *et al.*, 2024).

3. Chemotherapy Indications

Chemotherapy is used for a wide range of clinical situations that require systemic treatment of cancer cells. This treatment not only serves as the main therapy, but also as an additional option before or after the surgical procedure, as well as at an advanced stage when the cancer has spread to other parts of the body (Anand *et al.*, 2023)

a. As a primary treatment (*primary chemotherapy*)

It is applied when surgery or radiation therapy cannot be performed, either because the cancer has spread significantly or is located in an area that cannot be operated on.

b. Before surgery (*neoadjuvant chemotherapy*)

Chemotherapy is done to reduce the size of the tumor to make the surgical procedure easier and reduce the risk of spreading cancer cells.

c. Postoperative (*adjuvant chemotherapy*)

This therapy is done to destroy the remnants of microscopic cancer cells that may still be present after surgery, thereby reducing the likelihood of recurrence.

d. In the case of metastatic or advanced cancer

Chemotherapy drugs are used to slow the progression of the disease, reduce the tumor burden, and maintain the stability of the patient's health condition.

e. As palliative therapy

In some situations, chemotherapy serves to reduce the suffering caused by cancer growth, such as pain or tightness, so that patients can feel more comfortable and experience an improved quality of life.

4. Contraindications to Chemotherapy

There are two types of contraindications in the administration of chemotherapy, namely absolute contraindications and relative

contraindications. Absolute contraindications include conditions that completely prohibit the use of chemotherapy, such as patients with terminal cancer, pregnancy in the first trimester (unless an abortion is performed), septicemia, and patients in a coma (Summons) *et al.*, 2025).

Meanwhile, relative contraindications include situations that require clinical consideration before chemotherapy is given. These conditions include old age, especially in patients with tumors with slow growth and low sensitivity to therapy, very poor physical status, severe impairment of vital organs such as liver, kidneys, heart, and bone marrow, the presence of cognitive disorders such as dementia, patients who are unable to come regularly to health care facilities, lack of patient cooperation in undergoing therapy, tumor resistance to drugs, as well as limited adequate supporting facilities (F. Yang *et al.*, 2024).

5. Complications of Chemotherapy

Cancer and its treatment methods can cause various complications that affect the patient's physical and psychological condition. Some common complications include:

a. Metastasis

Metastasis is the process of spreading cancer cells to other organs or tissues outside their original location. This condition causes treatment to be more complex and affects the patient's prognosis, often requiring more intensive therapy or a combination of several types of treatment.

b. Treatment Side Effects

Chemotherapy and radiotherapy can cause various side effects, such as fatigue, nausea, hair loss, and disturbances in the function of certain organs of the body. This condition requires additional management to maintain the stability of the patient's condition during therapy.

c. Immune System Disorders

Both cancer and its therapeutic process can reduce the function of the immune system. Decreased immunity increases the risk of infection and slows down the patient's recovery process.

d. Nutritional Disorders

Cancer can affect the function of the digestive tract so that it decreases appetite, causes difficulty swallowing, and causes malnutrition. This condition can worsen the general health of the patient and decrease the effectiveness of the therapy undergoing.

e. Emotional Impact

Cancer diagnosis and treatment process often cause psychological distress in the form of stress, anxiety, and depression. Therefore, patients need emotional support and counseling services to maintain mental balance during the treatment period.

f. Fatigue Syndrome

Cancer patients generally experience severe fatigue which can significantly reduce quality of life. This condition requires a special management strategy so that patients are still able to carry out activities according to their abilities.

g. Sleep disorders

Chemotherapy works by damaging cells that divide rapidly, including cancer cells and some healthy cells. This process triggers systemic inflammatory reactions characterized by an increase in pro-inflammatory cytokines such as *interleukin-1* (IL-1), *interleukin-6* (IL-6), and tumor necrosis factor- α (TNF- α). These increased cytokines not only cause flu-like symptoms and fatigue, but also interfere with the regulation of circadian rhythms and sleep quality. Pro-inflammatory cytokines affect the function of the hypothalamus and the central nervous system that regulates the sleep-wake cycle, so patients may have difficulty starting sleep, wake up often at night, or experience shallow, unrefreshing sleep.

In addition, chemotherapy can disrupt the balance of hormones that play a role in sleep regulation, especially melatonin and cortisol. Biological and psychological stress during therapy can alter the pattern of cortisol secretion that should be high in the morning and low at night, causing circadian rhythms to become irregular. Melatonin production, which normally increases at night, can also decrease due to inflammatory processes and metabolic changes. This hormonal imbalance contributes to the appearance of insomnia, waking up too early, as well as uncontrolled sleepiness during the day.

The use of chemotherapy drugs also worsens sleep disorders. Corticosteroids such as dexamethasone can increase alertness and trigger insomnia, especially when given in the afternoon or at night, while analgesics, antiemetics, and some antidepressants can provide stimulating or sedative effects that disrupt natural sleep patterns. Environmental factors of treatment, such as noise, overlighting, medical device alarms, and nighttime checkups, also exacerbate this condition. Coupled with changes in routines, including nap habits due to fatigue, sleep disorders in chemotherapy patients become complex issues that impact physical recovery, emotional stability, immunity, and overall quality of life.

h. Hematological Complications

Some types of cancer and their therapies can interfere with the process of blood cell formation in the bone marrow, causing anemia and bleeding disorders. Patients with this condition may require blood transfusions or additional therapy to maintain their hematological stability (Valencia *et al.*, 2025).

C. Concept of Sleep Disorders in Cancer Patients Undergoing Chemotherapy, Sleep Disorder Management and Sleep Disorder Instruments

1. Definition

Sleep disorders are conditions characterized by abnormalities in a person's sleep patterns. This condition can cause a decrease in sleep quality which has an impact on the physical health and safety of the sufferer. Sleep disorders are generally characterized by excessive sleepiness during the day, difficulty sleeping at night, or irregular sleep-wake cycles (Maqbali *et al.*, 2022).

2. Factors That Affect Sleep Disorder

A person's sleep quality can be categorized as good or poor, depending on the various factors that affect it (Burch *et al.*, 2024).

a. Age

Age has a big influence on sleep habits and the rate of sleep disturbances in people with cancer. Younger patients often face sleep problems due to psychosocial stress, such as worries about education, career, social interactions, or life plans that are disrupted due to a cancer diagnosis and treatment. On the other hand, older patients are more prone to having trouble sleeping due to physiological changes that occur with age, decreased bodily function, dependence on others, and chronic health problems that are more common among the elderly. In addition, patients' ability to adapt to medical procedures and manage physical discomfort also varies among different age groups. All of these factors make age one of the important factors in the occurrence of sleep disorders in cancer patients.

b. Number of chemotherapy cycles

The number of chemotherapy cycles undergone by a patient is closely related to the level of sleep disturbances. In the first cycle, patients often have difficulty sleeping due to uncertainty about the body's reactions, physical changes, and concerns about the treatment process. In subsequent cycles, sleep disorders can arise as a result of

an "anticipatory response", which is a condition in which the body and mind react to uncomfortable experiences from the previous cycle with stress that disrupts the sleep rhythm. The more cycles are passed, the longer the body experiences the physical and emotional burden of chemotherapy, increasing the likelihood of the appearance of prolonged fatigue, insomnia, or other sleep problems. Differences in the number of these cycles can result in noticeable variations in sleep quality among patients.

c. Gender

Gender is one of the factors that can affect the quality and pattern of a person's sleep. This difference is generally related to hormonal changes that occur in men and women. Women tend to have a higher risk of having sleep disorders, especially during certain periods such as menstruation, pregnancy, and menopause. Changes in the levels of the hormones estrogen and progesterone can affect sleep rhythms and increase the likelihood of insomnia or difficulty sleeping. In addition, complaints that often appear during menopause, such as sudden hot flashes, can cause sleep to be unwell and often wake up at night. Meanwhile, in men, sleep disorders are more often associated with certain health conditions, such as *sleep apnea* and snoring habits, which can lower overall sleep quality.

d. Stage of cancer

The stage of cancer disease is one of the key elements that affect sleep problems in individuals with cancer, patients typically experience higher physical and emotional stress due to disease progression, risk of spread, as well as diminishing expectations of therapy success. This condition can be stressful both physically and mentally that has a direct impact on sleep patterns, such as difficulty sleeping, waking up often at night, or unrefreshed sleep. In addition, the final stages usually require stronger treatment, more hospitalizations, and intensive medical procedures, which cause

excessive fatigue and disrupt sleep and wake rhythms. Therefore, differences in cancer stages can result in very pronounced variations in sleep disorders among patients.

e. Comorbidities

The presence of comorbidities such as type 2 diabetes, hypertension, heart disease, asthma, or other metabolic problems can worsen sleep disorders in cancer patients. Comorbidities usually prolong the healing process, increase the risk of complications from chemotherapy, and cause additional physical symptoms such as pain, difficulty breathing, or nighttime urination that interferes with sleep. In addition, patients with comorbidities often feel physically weaker, making it harder for them to achieve ideal relaxation before bed. The combination of cancer burden and comorbidity conditions makes patients more susceptible to chronic insomnia, poor quality sleep, and irregular sleep patterns.

3. Clinical Manifestations

Sleep disorders can have an impact on a decrease in quality of life and be associated with an increase in mortality rates. As we age, sleep patterns undergo distinctive changes that distinguish the elderly from Individuals younger ones. These changes include (Maqbali) *et al.*, 2022):

a. Difficulty starting sleep

Patients take a long time to fall asleep due to pain, anxiety, or physical discomfort.

b. Waking up often at night

Midnight sleep disturbances appear as a result of pain, night sweats, nausea, or the effects of medication.

c. Restless sleep/restlessness

Sleep feels shallow and uncomfortable, often changing positions due to discomfort.

d. Waking up too early

Patients often wake up early in the morning and have difficulty falling asleep again.

e. Waking Up Tired

The body still feels tired even after sleeping, because the quality of sleep is poor.

f. Sleepiness during the day

Excessive sleepiness and fatigue interfere with the patient's daily activities.

g. Decreased concentration & memory

Difficulty focusing, forgetting, and cognitive performance decreased due to lack of sleep.

h. Mood swings (irritability, anxiety, sadness)

Patients become sensitive, irritable, or anxious due to lack of rest.

i. Headache when waking up

Morning headaches can occur as a result of poor sleep quality.

j. Decreased activity ability

Energy is reduced, daily activities are disrupted, and patients quickly feel tired.

4. Sleep Disorder Measurement Instruments

This study used the *Pittsburgh Sleep Quality Index* (PSQI) questionnaire as a measuring tool to assess the sleep quality of respondents. This instrument was developed by Buysse and colleagues, and to date it is one of the most widely used instruments in sleep-related research.

The appendix to Carpi, et al.'s research (2025) contains the format of the item and the PSQI assessment sheet, which is accompanied by detailed guidance on how to use it. The document can also be accessed through *the University of Pittsburgh's Center for Sleep and Circadian*

Science website. To date, the questionnaire has been translated into more than 60 languages, allowing for its widespread use in different countries.

a. How to Use the *Pittsburgh Sleep Quality Index* (PSQI) Instrument

The Pittsburgh Sleep Quality Index (PSQI) instrument is a self-report questionnaire designed to assess an individual's subjective sleep quality over the past 1 month. It consists of 19 closed-ended questions covering seven dimensions of sleep quality: subjective sleep quality, time to fall asleep (latency), sleep duration, sleep efficiency, sleep disorders, sleep drug use, and daytime activity dysfunction. Each item was rated by respondents based on their sleep experience over the past month.

The filling process is carried out by:

1. Giving questionnaires directly or digitally to respondents, without the help of a third party to maintain the objectivity of subjective perception.
2. Respondents were asked to answer questions according to their sleep experience over the past 1 month.
3. Filling is usually done independently, but some individuals can be assisted by researchers to minimize misunderstandings.

Table 2. 1 Pittsburgh Sleep Quality Index (PSQI) Measurement Instrument

NO	QUESTION	Score			
		0	1	2	3
1	How efficient is your sleep in a night? What time does bed usually start? What time do you usually wake up in the morning? $\frac{\text{Long bed}}{\text{long in bed}} \times 100\%$ If the following results are obtained, then the score: > 85% = 0 75 – 84% = 1 65 – 74% = 2 < 65% = 3				
2	How long do you usually sleep each night?				

	Description: ≤ 15 minutes = 0 16-30 minutes = 1 31-60 minutes = 2 >60 minutes = 3				
3	How long do you sleep at night? Description: >8 hours = 0 8-7 hours = 1 5-6 hours = 2 <5 hours = 3				
4	Unable to fall asleep for 30 minutes from lying down Description: Never = 0 Once a week = 1 2 times a week = 2 > 3 times a week = 3				
5	How often do the problems below interfere with your sleep? a. Do you wake up in the middle of the night? Description: Never = 0 Once a week = 1 2 times a week = 2 > 3 times a week = 3 b. Do you often wake up to go to the bathroom? Description: Never = 0 Once a week = 1 2 times a week = 2 > 3 times a week = 3 c. Do you often have trouble breathing while sleeping? Description: Never = 0 Once a week = 1 2 times a week = 2 > 3 times a week = 3 d. Do you cough/sneeze while sleeping? Description: Never = 0 Once a week = 1 2 times a week = 2 > 3 times a week = 3 e. Do you often feel cold? Description: Never = 0 Once a week = 1 2 times a week = 2 > 3 times a week = 3 f. Do you often feel overheated?				

	Description: Never = 0 Once a week = 1 2 times a week = 2 > 3 times a week = 3 g. Do you often have nightmares while sleeping? Description: Never = 0 Once a week = 1 2 times a week = 2 > 3 times a week = 3 h. Do you wake up often because of pain? Description: Never = 0 Once a week = 1 2 times a week = 2 > 3 times a week = 3 i. Other reasons Description: Never = 0 Once a week = 1 2 times a week = 2 > 3 times a week = 3				
	Total score (5a-5i) Score 0 = 0 Score 1 – 9 = 1 Score 10 – 18 = 2 Score 19 – 27 = 3				
6	How often do you use sleeping pills? Description: Never = 0 Once a week = 1 2 times a week = 2 > 3 times a week = 3				
7	How often do you get sleepy during the day? Never = 0 Once a week = 1 2 times a week = 2 > 3 times a week = 3				
8	How enthusiastic are you about solving the problem you face? Not enthusiastic = 0 Small = 1 Medium = 2 Large = 3				
	Total question scores 7&8 Score 0 = 0 Score 1 – 2 = 1 Score 3 – 4 = 2 Score 5 – 6 = 3				

Source: (Capri, 2025)

Final score: sum all scores from components 1 to 7

Description:

Good Sleep Quality : 0-5

Poor sleep quality : >5

A systematic review and comprehensive meta-analysis summarized the various evidence regarding the psychometric nature of PSQI, with a particular focus on its dimensionality and factor structure. Although more research is still needed, the one-factor model generally shows a poor match, while the two- or three-factor model is considered more appropriate based on recent findings. In some studies, the components of sleep drug use and daytime dysfunction showed a low factor loading. However, because the global PSQI score has been shown to be highly reliable in a variety of contexts, this instrument remains considered practical for measuring overall sleep quality in large populations. Meanwhile, a single item or component can be more beneficial for clinical assessment and decision-making, given the validity of the content as well as the coverage of the key domains of sleep quality it possesses. (Carpi, 2025).

D. Concept of Yoga for Cancer Survivors (YOCAS)

1. Definition

YOCAS (*Yoga for Cancer Survivors*) is a yoga program developed specifically for cancer patients and survivors, with the aim of helping physical and psychological recovery after undergoing cancer treatment. The program combines elements of *Hatha Yoga* gentle, restorative yoga, breathing exercises (*Pranayama*), as well as meditation or *mindfulness* (Spider-Girls) *et al.*, 2024).

YOCAS is designed to improve quality of life, reduce fatigue due to cancer (*cancer-related fatigue*), as well as improving sleep quality and mood. The implementation is usually carried out over several weeks, with light to moderate intensity, under the guidance of a certified yoga instructor (Giridharan *et al.*, 2024).

2. Benefits of Yoga for Cancer Survivors (YOCAS)

a. Reduces chemotherapy-related fatigue

Phase III research shows that a four-week YOCAS program can significantly lower fatigue levels, which is often a major complaint in patients undergoing chemotherapy.

b. Improving the quality of sleep of cancer patients during the chemotherapy phase

YOCAS is a mind-based intervention designed to address sleep disorders in cancer patients undergoing chemotherapy. Chemotherapy can disrupt circadian rhythms, causing extreme fatigue, muscle and joint pain, and anxiety that contribute to insomnia. Through a combination of breathing techniques (*pranayama*), Hatha/restorative *gentle movements*, and relaxation meditation, YOCAS helps balance the autonomic nervous system, increase parasympathetic dominance (*rest and digest*), and prepare the body for sleep. Light stretching also helps relieve muscle tension so that the body can more easily reach a state of relaxation.

Psychologically, YOCAS is effective in reducing stress, anxiety, and excessive thoughts that often hinder the sleep process. Structured relaxation and meditation help stabilize cortisol levels at night, improve mood, as well as speed up the early phases of sleep and maintain sleep duration. Various RCT studies have shown that YOCAS is able to improve overall sleep efficiency and quality, reduce daytime sleepiness, and in some patients reduce dependence on sleep medications.

c. Reduces psychological distress (anxiety, tension, and negative moods)

Patients undergoing chemotherapy often face anxiety and mood disorders, YOCAS contributes to reducing emotional stress through a combination of relaxation techniques and regular breathing.

d. Improves subjective cognitive function (*Chemobrain*)

YOCAS helps improve mental clarity, focus, and subjective memory, which often decreases during chemotherapy.

e. Reduces musculoskeletal pain

For breast cancer patients who receive hormone therapy or chemotherapy, YOCAS plays a role in reducing joint stiffness and muscle pain.

f. Improving Quality of Life

With a combination of physical and psychological benefits, YOCAS improves overall well-being, allowing patients to be better able to cope with the chemotherapy cycle.

3. *Yoga Procedure for cancer survivors (YOCAS)*

This yoga movement is performed for 30 minutes for 2 sessions.

a. *Sun Salutations with Twists*

It is done by sitting up straight and keeping the body relaxed. The exercise begins by inhaling while raising both hands upwards, while exhaling, the body is rotated slowly to the right, with the right hand placed on the back of the chair and the left hand on the right knee and do it with the left side.



Figure 2. 1 *Sun Salutations with Twists*

b. *Assisted Neck Stretches*

It is done by sitting up straight while keeping the shoulders relaxed. Once the body position is comfortable, the head is tilted

slowly to the right to feel a gentle stretch on the left side of the neck. The right hand is then placed on the left side of the head and applies very light pressure to deepen the stretch without causing pain. After that, the head returns to the center position before repeating the same movement to the opposite side.



Figure 2. 2 *Assisted Neck Stretches*

c. High Altar Side Leans

It is done by sitting up straight and making sure the soles of the feet are on the floor, inhale while raising both hands straight above the head and bringing the palms together. When exhaling, the body slowly leans towards the right so that the left side of the body feels a gentle stretch. After that, take a breath and return to the center position. The movement is followed by exhaling while leaning slowly to the left to stretch the right side of the body.



Figure 2. 3 *High Altar Side Leans*

d. *Sun Greetings Arms*

Start by sitting up straight while leaving both hands at the sides of the body. When inhaling, both hands are raised upwards until the palms can be brought together. When exhaling, the hands are brought back and forth as if performing a bending motion. After that, inhale again while straightening your back so that your body resembles a "flat table," with your hands resting on your thighs. Next, inhale once more to raise both hands back up. The movement ends with exhaling while lowering the hands to the sides of the body.



Figure 2. 4 *Sun Greetings Arms*

e. *Eagle Post (Garuda Arm)*

The movement begins by lifting both arms to the sides until the upper arm is parallel to the shoulder, while the forearm is bent upwards forming a 90-degree angle. Inhale and slowly raise both hands until they are at the same level as the ears. When exhaling, slowly lower your arms back to their original position at shoulder level and repeat the movement.



Figure 2. 5 *Eagle Post*

f. *Backbend Arch*

This movement starts by sitting up straight on the front edge of a sturdy chair so that the body has room to move. Both hands then hold the side of the chair as support. When exhaling, the chest is lifted upwards while pushing the shoulders slowly back so that the back forms a gentle arch without causing pain. The gaze is directed slightly upwards but remains in a relaxed state. After that, exhale and return the body to an upright sitting position. This movement helps to open the chest and make the back feel lighter.



Figure 2. 6 *Backbend Arch*

4. The Effect of *Yoga For Cancer Survivors* (Yocas) on Sleep Disorders

The YOCAS (*Yoga For Cancer Survivors*) program works through the interaction of physiological and neurobiological mechanisms to reduce muscle tension and improve sleep problems in cancer patients undergoing chemotherapy. Physically, the YOCAS program involves a series of gentle stretching movements and restorative poses that focus on muscles that are normally stiff due to stress, anxiety, poor sleep patterns, and the side effects of chemotherapy. These muscles include the neck muscles (*sternocleidomastoid*), upper back muscles (*trapezius*), middle back (*rhomboid*), lower back (*erector spinae*), and respiratory muscles (*intercostal*). Tension in this area often leads to complaints such as pain, cramps, and discomfort that can impair the quality of sleep. With slow,

regular stretching, muscle fibers can become longer and more relaxed, and increased blood flow in the area helps reduce stiffness and pain.

In physiological terms, YOCAS stretching activates the sensory system of the muscles, especially the Golgi tendon organ, which functions to send signals to the nervous system to reduce muscle contraction. As the stretch lasts for a few breaths, the body will react by releasing the accumulated tension, so that the muscles become calmer. This effect is crucial for chemotherapy patients, as cytotoxic drugs often cause muscle tension, neuropathy, and postural problems due to excessive fatigue.

In addition to having a biomechanical impact, YOCAS also affects the regulation of the nervous system. Breathing techniques performed slowly and regularly can reduce sympathetic nerve activity, the nervous system that is active when the body faces stress or anxiety, and increase parasympathetic nerve activity (*n. vagus*) associated with relaxation responses. This increase in parasympathetic activity leads to a decrease in overall muscle tension, slows down heart rate, lowers blood pressure, and calms the body ahead of bedtime. When parasympathetic activity increases, the body more easily enters the resting phase so that the process for sleep (*sleep onset*) becomes faster.

YOCAS also affects the hormonal and neurochemical systems that play an important role in dealing with sleep problems. In cancer patients, levels of the stress hormone cortisol usually increase due to anxiety, fear, and emotional distress during chemotherapy. High cortisol levels can cause muscle tension, make it difficult for the body to relax, and disrupt sleep patterns. Yoga practice that is done regularly has been shown to lower cortisol levels and normalize levels of the hormone melatonin, a hormone that controls sleepiness at night. In addition, YOCAS helps improve levels of serotonin, a neurotransmitter that supports mood regulation, calmness, and melatonin production. This increase in serotonin helps reduce anxiety and improve mood, making sleep easier and more quality.

For cancer patients undergoing chemotherapy, muscle tension, fatigue, and emotional symptoms such as stress and anxiety are often causes of sleep insomnia. By reducing muscle tension through stretching and improving relaxation responses through breathing and meditation techniques, YOCAS seeks to overcome the physical and psychological barriers that interfere with patients' sleep. The combination of reduced sympathetic activity, increased parasympathetic activity, decreased cortisol, increased serotonin, and better muscle relaxation makes YOCAS an effective and safe intervention method to improve sleep quality in cancer patients undergoing chemotherapy (Spider-Girls) *et al.*, 2024).

Research by Selvaraj, et al (2024) on *Yoga for Cancer Survivors (YOCAS): A Systematic Review of the YOCAS Program's Impact on Physical and Psychological Well-Being*. Explains that YOCAS has a very positive effect on improving sleep patterns. The YOCAS program improves sleep quality by improving sleep efficiency, reducing the frequency of waking up at night, and reducing dysfunction during the day. In addition, the program also plays a role in reducing dependence on sleeping pills for cancer patients, making it a safe and sustainable therapy option. In a large study involving 410 patients, the YOCAS intervention showed a 21% reduction in the use of sleeping pills in the group receiving the intervention compared to 5% in the non-intervention group, accompanied by a significant improvement in overall sleep quality (Giridharan *et al.*, 2024).

YOCAS can also reduce fatigue and anxiety, two key elements known to be closely related to sleep problems in cancer patients. The success of the program supports the idea that mind- and body-focused interventions could be an important part of holistic treatment for cancer patients, as they not only improve sleep quality but also help reduce emotional distress and improve mental health.

YOCAS-based yoga programs have been shown to provide clinical benefits for cancer patients, particularly those with chemotherapy-induced

peripheral neuropathy. Qualitative research shows that most cancer survivors report improved physical comfort, relaxation, reduced anxiety, and improved sleep after participating in an eight-week online yoga intervention. Although the effect on neuropathy symptoms varied, improvements in sleep quality and mental health were consistently felt by participants. This proves that yoga is a widely accepted, safe, and beneficial supportive approach in helping the physical and mental well-being of cancer patients, especially in the management of long-term symptoms (Knoerl *et al.*, 2022).

YOCAS, which is an intervention that uses yoga, has been shown to be effective in improving the physical and mental state of cancer patients who have trouble sleeping due to fatigue caused by the disease. In a randomized clinical study involving 173 cancer patients, practicing yoga for eight weeks could significantly reduce levels of physical and general fatigue, as well as lower symptoms of depression and improve their quality of life. This reduction in fatigue clinically contributes to improved sleep quality, as fatigue, stress, emotional problems, and sleep disorders are intertwined in cancer patients. The results of this study showed significant improvements in fatigue scores ($p = .033$) and physical fatigue ($p = .048$), as well as improvements in quality of life ($p = .026$), especially in patients who participated in seven or more yoga sessions. These findings confirm that YOCAS is an effective and safe adjunct therapy to help restore sleep function in cancer patients by addressing the physical and psychological factors that cause sleep disorders (Zetzl *et al.*, 2021).

Recent research shows that the positive impact of yoga can increase when combined with the use of aroma therapy. Goa, et al. (2022) on *the Effectiveness of Aromatherapy Yoga in Stress Reduction and Sleep Quality Improvement among Chinese Female College Students: A Quasi-Experimental Study* conducted a direct comparison between the group that only did yoga and the group that did yoga with aromatherapy, with results

showing that this combination provided a more significant improvement in sleep problems than yoga alone.

Research by Yahara, et al. (2025), on *Evaluation of the efficacy of aromatherapy and complementary yoga on indicators of medication regimen complexity: A retrospective study* that found that yoga practice with aromatherapy produced a more consistent effect in terms of relaxation and regulation of responses to stress compared if each method was used separately. Overall, both studies showed that the combination of yoga and aromatherapy creates a more profound relaxation effect, so this combination is considered more effective than yoga alone.

E. Aromatherapy Concept *Metha Piperita L.*

Aromatherapy can be described as the use of essential oils from plants for therapeutic purposes through inhalation, massage, or topical application. When essential oils are inhaled, aromatic molecules reach olfactory receptors in the nasal cavity and are passed on to the brain's limbic system, which is the center for emotion, memory, and hormonal regulation. The activity of this system triggers the release of neurotransmitters such as serotonin, dopamine, and endorphins, which produce calming effects, reduce anxiety, and improve sleep quality (Bakım *et al.*, 2023).

Aromatherapy with essential oils *Mentha piperita L.* (*Peppermint*) is one of the complementary therapies used to help overcome sleep disorders through physiological and psychological relaxation mechanisms, which belong to the family *lamiaceae*. Main content of essential oils *Mentha piperita L.* such as *menthol*, *menthone*, and *Menthyl Acetate*. *Menthol* have the ability to influence *Kappa Opioid Receptor* and lowers the secretion of stress hormones such as cortisol through stimulation hypothalamus, thus providing a relaxation effect and *anxiolytic* which supports the natural sleep process. In addition, it has a calming effect on the central nervous system, improves respiratory ventilation, and provides a cool and fresh sensation that can reduce muscle tension and stress (Lorens *et al.*, 2023).

1. Effect of *Mentha Piperita L.* Aromatherapy on Sleep Disorders

Physiologically, aroma *Peppermint* Inhaled through the sense of smell stimulates the limbic system in the brain, specifically the hypothalamus and amygdala, which play a role in regulating emotions, mood, and sleep cycles. This stimulation can trigger an increase in the production of the hormone serotonin and a decrease in cortisol levels, so that the body becomes more relaxed and easier to rest (Lestari *et al.*, 2025). In addition, the refreshing effect of the *Peppermint* help reduce mental and physical fatigue, improve the quality of non-REM sleep, and reduce the frequency of waking up at night. The combination of these physiological and psychological effects makes aromatherapy *Mentha piperita L.* as an effective and safe non-pharmacological approach in helping to improve sleep quality, especially for individuals who experience stress, anxiety, or mild to moderate sleep disorders (Tianto *et al.*, 2023).

For cancer patients, aromatherapy has been shown to help improve sleep quality in several ways related to nerves and feelings. Volatile compounds from essential oils such as lavender and *Peppermint* inhaled and binding to olfactory receptors, which then activate the part of the brain that regulates emotions, stress, and sleep patterns, namely the limbic system. By activating this limbic system, there is a decrease in sympathetic activity and an increase in the release of chemicals in the brain that are calming and reduce anxiety, thus helping to create a sense of calm and improve sleep (Bakım *et al.*, 2023).

Physiologically, the effects of *Mentha piperita L.* Sleep can be done through three main mechanisms:

a. Neurological Mechanisms

The menthol component in *Mentha piperita L.* stimulates the limbic and parasympathetic systems which decreases sympathetic activity, resulting in a decrease in blood pressure and heart rate.

b. Endocrine Mechanisms

Decreased secretion of the hormone cortisol which helps the body enter the relaxation phase and prepare for sleep.

c. Psychological Mechanisms

Lowers anxiety, stress, and tension which is often the cause of sleep disorders (Bakim *et al.*, 2023)



F. Theoretical Framework

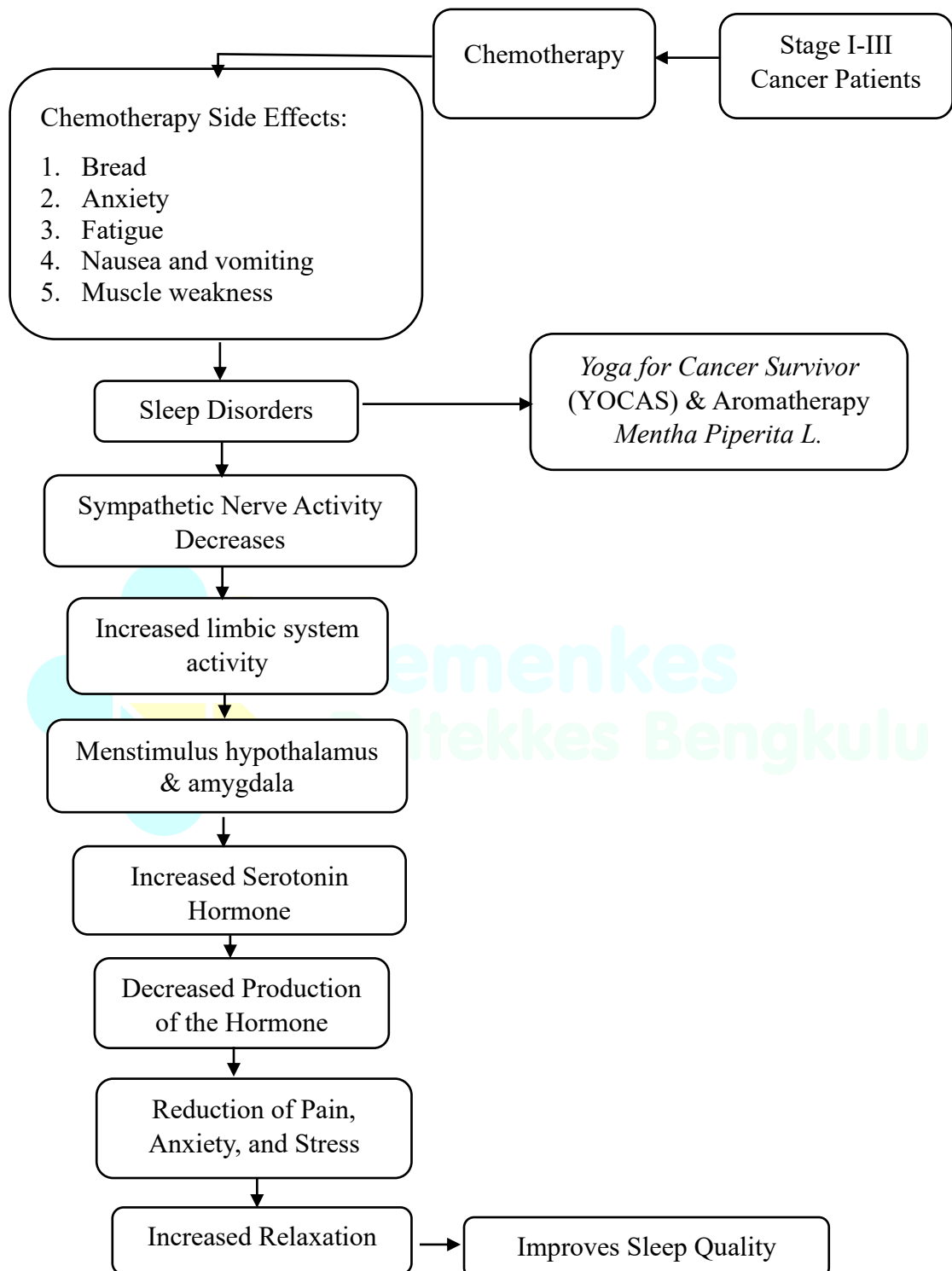


Chart 2. 1 Shellfish Research Theory

Source: (Lorens *et al.*, 2023) (Spider-Girls) *et al.*, 2024)