FATIGUE AND ITS INFLUENCING FACTORS IN ADOLESCENTS AND YOUNG ADULTS WITH CANCER DURING CHEMOTHERAPY

ZHIZHI JIN

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF
THE REQUIREMENTS FOR MASTER DEGREE OF NURSING SCIENCE
(INTERNATIONAL PROGRAM)
IN ADULT NURSING PATHWAY
FACULTY OF NURSING
BURAPHA UNIVERSITY
2025

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ZHIZHI JIN

วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรพยาบาลศาสตรมหาบัณฑิต (หลักสูตรนานาชาติ)

คณะพยาบาลศาสตร์ มหาวิทยาลัยบูรพา

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The Thesis of Zhizhi Jin has been approved by the examining committee to be partial fulfillment of the requirements for the Master Degree of Nursing Science (International Program) in Adult Nursing Pathway of Burapha University

Advisory Committee

Principal advisor

.....

(Professor Dr. Chintana Wacharasin)

Co-advisor

.....

(Associate Professor Dr. Jinjutha Chaisena Dallas)

Examining Committee

.....

Principal examiner

(Associate Professor Dr. Aporn Deenan)

.....

Member

(Professor Dr. Chintana Wacharasin)

.....

Member

(Associate Professor Dr. Jinjutha Chaisena Dallas)

.....

Member

(Assistant Professor Dr. Khemaradee Masingboon)

.....

Dean of the Faculty of Nursing

(Associate Professor Dr. Pornchai Jullamate)

.....

This Thesis has been approved by Graduate School Burapha University to be partial fulfillment of the requirements for the Master Degree of Nursing Science (International Program) in Adult Nursing Pathway of Burapha University

.....

Dean of Graduate School

(Associate Professor Dr. Witawat Jangiam)

.....

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ZHIZHI JIN : FATIGUE AND ITS INFLUENCING FACTORS IN ADOLESCENTS AND YOUNG ADULTS WITH CANCER DURING CHEMOTHERAPY. ADVISORY COMMITTEE: CHINTANA WACHARASIN, Ph.D. JINJUTHA CHAISENA DALLAS, Ph.D. 2025.

This study aims to explore the fatigue and its influencing factors in adolescent and young adult cancer patients during chemotherapy. A total of 176 adolescent and young adult patients with cancer were recruited from the Second Affiliated Hospital of Wenzhou Medical University by a simple random sampling method. The research tools included a demographic data questionnaire, Chinese version of Piper Fatigue Scale Revised, Chinese version of Pittsburgh Sleep Quality Index, Chinese version of Hamilton Anxiety Rating Scale, Chinese version of Scored Patient-Generated Subjective Global Assessment, and Chinese version of Family APGAR. Descriptive statistics and multiple linear regression analysis were used for data analysis. This study showed that adolescent and young adult cancer patients had a mean score of 6.0 (SD=0.81) for fatigue during chemotherapy, which was moderate. The results also found that AYA self-efficacy anxiety (β =.468, $p<.01$), nutritional status (β =.271, $p<.01$), and sleep quality (β =.243, $p<.01$) explained 64.00% ($p<.05$) of the variance of AYA fatigue during chemotherapy. Clinical nurses can reduce AYA fatigue during chemotherapy by reducing anxiety, improving nutritional status, and improving sleep quality.

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CHAPTER 1
INTRODUCTION

Background and significance of the problem

Cancer is one of the world's leading public health issues, accounting for 1 in 7 deaths (Ferrari et al., 2024). Although the incidence of cancer in adolescents and young adults (AYA) is relatively low, the biological, epidemiologic, and clinical features of AYA are markedly different from those of children and older adults (Bhatia et al., 2023). In 2022, there were 1,300,196 new cancer cases and 377,621 cancer deaths in AYA globally, and the prevalence is on the rise in the past ten years (Li et al., 2024). The widely accepted age range recommended by the Adolescent and Young Adult Oncology Progress Review Group (AYAOPRG) is 15 to 39 years (Bhatia et al., 2023; Smith et al., 2016). In China, social development defines adolescents and young adults as 14 to 35 years old, an age range that is not used for medical research (Yi, 2017). The few studies focusing on AYA have followed the 15-39 age range. AYA aged 15 to 30 years were selected as the study population in this study. The 15-30 years span the critical transition periods of late adolescence (15-19 years), early adulthood (20-25 years), and early adulthood (26-30 years) (Kroger, 2006). Individuals in this stage need to complete physiological maturation, psychological identity, and face major social role changes such as the completion of education, career initiation, and the establishment of close relationships (Wood et al., 2018). People aged 31-39 years had generally established a stable career, family and economic foundation, and their social support network was better (Walen & Lachman, 2000). Narrowing the age range can help to accurately identify vulnerable subgroups and provide evidence for the development of targeted interventions.

The top five AYA cancer incidence rates for 15-30 years old were: thyroid, leukemia, breast, Non-Hodgkin Lymphoma (NHL), and brain & central nervous system (CNS), with leukemia having the highest mortality rate (Li et al., 2024). In addition to thyroid cancer, chemotherapy is the mainstay of treatment for four other cancers. The same as adult and child patients, AYA experience various symptoms during chemotherapy. Moreover, AYA patients who received the same chemotherapy regimen as children also experienced more severe toxicity. Therefore, the symptoms

experienced by AYA are also more severe (Bukowinski et al., 2015).These symptoms are associated with poor prognosis, including low survival, reduced treatment compliance and reduced quality of life (Quinn et al., 2015). Among many symptoms, fatigue is one that cannot be ignored. Studies have shown that fatigue is a very common and high-scoring symptom in AYA with cancer (Nowe et al., 2017). In a systematic review of multiple symptoms, fatigue was one of the most frequently reported physical symptoms in 61 studies (Hong et al., 2023). Fatigue was reported by 78% of AYA who had cancer and received treatment (Jones et al., 2020). With the development of medical technology, more than 80% of AYA with cancer can survive for more than five years (Janssen et al., 2021). Fatigue can significantly reduce AYA's daily activities, learning/work efficiency, and social participation. Fatigue in some AYA may persist for months or even years after the end of treatment, affecting their ability to return to society (Sansom-Daly et al., 2021).

Fatigue, as one of the most painful symptoms, should be paid enough attention to adolescents and young adults with cancer. In some studies, it has been determined that the main cause of fatigue is cancer treatment, including chemotherapy, radiotherapy, bone marrow transplantation (Bower, 2014). Other causes of fatigue caused by cancer include changes in muscle metabolism, endocrine dysfunction, interruption of day and night sleep, anemia, and cognitive and emotional disorders (Wang, 2008). Many scholars believe that the mechanism of Cancer-Related Fatigue (CRF) may be related to skeletal muscle metabolism, as well as pro-inflammatory and anti-inflammatory functions. In addition, neurological or central nervous system dysfunction is the main factor inducing the occurrence or persistence of CRF (Yang et al., 2019). Fatigue has serious physical and psychological effects on AYA. Especially for adolescents, fatigue can lead to increased dependence on others, resulting in loss of self-confidence and increased sense of social isolation and guilt. Cancer related fatigue is defined as painful, persistent, subjective physical, emotional and / or cognitive fatigue or fatigue related to cancer and / or cancer treatment, which is not proportional to recent activities and interferes with normal function (Berger et al., 2015). Fatigue is a subjective experience, and patient self-report is the gold standard method to evaluate fatigue. Fatigue is now considered to be one of the most common and painful side

effects of cancer and its treatment of fatigue may increase before treatment begins, usually during cancer treatment, including radiotherapy, chemotherapy, hormone and or biotherapy. China's Clinical Practice Guidelines for the Diagnosis and Treatment of cancer-related fatigue (Professional Committee of Cancer Rehabilitation and Palliative Care & Oncology, 2022) shows that the incidence of fatigue at the time of cancer diagnosis is 40%; The incidence of CRF during active treatment ranged from 62% to 85%, and the proportion of moderate to severe CRF ranged from 30% to 60% (There is no specific age breakdown). In a study of adolescents with cancer, 40.3% of adolescents with cancer thought they were tired, and 26.2% thought that fatigue would last for a long time (Kelada et al., 2019).

The effects of CRF should include AYA' physical strength and activity endurance, making them less attentive and lasting, and even affecting their self-esteem. Cancer-related fatigue may also deprive AYA of the ability to engage in daily activities such as reading, learning, movement, socializing, and outdoor leisure activities, which severely impair their quality of life (Arpaci et al., 2018). Due to fatigue, AYA use sedentary activities instead of active physical activities. It also believes that fatigue is a deep sense of fatigue, which is multidimensional. It emphasizes that fear and worry occur at the same time and affect them sleeping, leading to fatigue the next day (Whitsett et al., 2008).

Fatigue in adult patients with cancer has been clearly studied, but much less is known about fatigue and its related characteristics in AYA. In many studies, many possible related factors affecting fatigue, including sleep quality, nutritional status, depression and anxiety, types of cancer, treatment methods, family function or social support (Grusdat et al., 2022). The symptoms of sleep disorders in patients seriously affect their daily activities and energy. The more serious the sleep disorder, the higher the degree of fatigue of patients (Maisel et al., 2021). On the contrary, patients sever fatigue symptoms can also lead to their inability to sleep normally at night, or sweating and dyspnea after falling asleep (Findlay, 2008). Poor sleep quality at night will affect the energy of the next day, resulting in more rest time during the day and inability to engage in activities or play normally (Baranwal et al., 2023). Patients' sleep disorders and fatigue interact to form a vicious circle. The quality of nutritional status can be used as one of the criteria for determining the degree of health and

disease. Patients with poor nutritional status are more prone to fatigue (Chen et al., 2021). The metabolism of energy, carbohydrate, fat and protein in patients with cancer has changed greatly (Gyamfi et al., 2022). In addition, due to the loss of appetite caused by tumor treatment (such as chemotherapy and radiotherapy) and malnutrition, the nutrient supply of the body is lower than that required by the body, resulting in fatigue (Ravasco, 2019). Anxiety is the most abundant of AYAs' mental diseases. The main manifestations are tension and anxiety, no clear objective object, restlessness and autonomic nerve dysfunction symptoms such as palpitation, handshake, sweating, frequent urination and restlessness (Barbui et al., 2014). Anxiety can consume patients' energy and often lead to sleep disorders. Sleep disorder syndrome is one of the important causes of fatigue (Essau et al., 2002). During chemotherapy, patients may face physical discomfort, mood swings, and lifestyle changes. In collectivist cultures, the family is the primary source of support, and its function may have a much greater impact on individual health than generalized social support (Glazer, 2006). If the family can flexibly adjust and effectively cope with these changes, the patient's stress will be reduced, and fatigue will be reduced accordingly (Kuang et al., 2023). Specifically, the greater the cooperation and shared decision making among family members, the more practical support the patient felt, which helped to reduce her physical burden (Gledhill et al., 2023). In addition, the emotional support provided by the family can relieve the psychological stress of the patients, reduce anxiety and depression, and thus further reduce the sense of fatigue (Reuvers et al., 2023). Therefore, good family function can significantly improve the overall state of patients and reduce the degree of fatigue by providing practical and emotional support.

Although fatigue is one of the most frequently reported symptoms of cancer, it is also the most complex one of the least explained phenomena (Al Maqbali, 2021). Research on cancer fatigue in adolescents and young adults is insufficient compared with adults. Many studies have looked at fatigue in adults with cancer, while AYA's fatigue has received slightly less attention. The AYA is a unique period of development characterized by autonomy and identity development, the pursuit of educational and career goals, the establishment of financial independence, independent living and the building of intimate relationships (Bagautdinova et al.,

2024). It is also a time of increased mental health problems and risk-taking behaviors. Adolescents and young adults with cancer have unique physical and psychological needs (Lee, 2024). More efforts are needed to fill the gap between pediatric and adult medical research to better understand AYA and their suffering (Close et al., 2019). In 2006, the National Cancer Institute (NCI), the Children's Oncology Group (COG), and the SEER database worked in collaboration to release a detailed publication regarding cancer incidence and survival in AYA. After analysis, a concept was proposed: AYA gap (Zebrack et al., 2010). The low rate of improvement in AYA cancer survival compared to other age groups in recent decades is known as the AYA gap. The suggestion of this gap provides impetus for medical workers to pay attention to this population and conduct research. Due to the lack of a clear definition of this group in China, there is a lack of data on their disease characteristics and cancer profile. The lack of research on this population leads to the lack of targeted clinical work. Whether fatigue in AYA is related to these factors in a specific cultural context remains to be investigated. The purpose of this study is to describe fatigue in patients with AYA and to explore the factors predicting fatigue in patients with AYA.

Research objectives

1. To explore the fatigue among adolescents and young adults with cancer.
2. To examine the factors predicting fatigue among adolescents and young adults with cancer.

Research hypothesis

Sleep quality, nutritional status, family function and anxiety can predict fatigue in adolescents and young adults with cancer.

Scope of the study

The purpose of this study was to investigate the effects of sleep quality, nutritional status, family function, and anxiety on fatigue in AYA with cancer during chemotherapy. This study was investigated AYA with cancer in the Second Affiliated Hospital of Wenzhou Medical University and Yuying children's hospital. The data was collected from November 2022 to November 2024.

Conceptual framework

The conceptual model of this study derives from Piper's comprehensive fatigue model (Piper et al., 1987). Piper's Integrated Fatigue Model (IFM) is a nursing theory on fatigue of cancer patients after synthesizing the fatigue literature of healthy and clinical populations. Fatigue manifestations are divided into psychological, biochemical, and behavioral components. It includes 14 biochemical, physiological and psychosocial models, which are the most likely factors to affect fatigue.

In this study, fatigue in adolescents and young adults with cancer was set as a dependent variable. All variables in the model may affect fatigue. Based on the theory and review, this study hypothesized four variables, namely sleep quality nutritional status, anxiety, family function. They belong to sleep / wake patterns, energy patterns, psychological patterns and social patterns. Poor nutritional status and sleep quality were associated with higher levels of fatigue. Anxiety can lead to psychological problems and increase levels of fatigue. When family function was sufficient, patients' fatigue levels decreased. As shown in Figure 1.

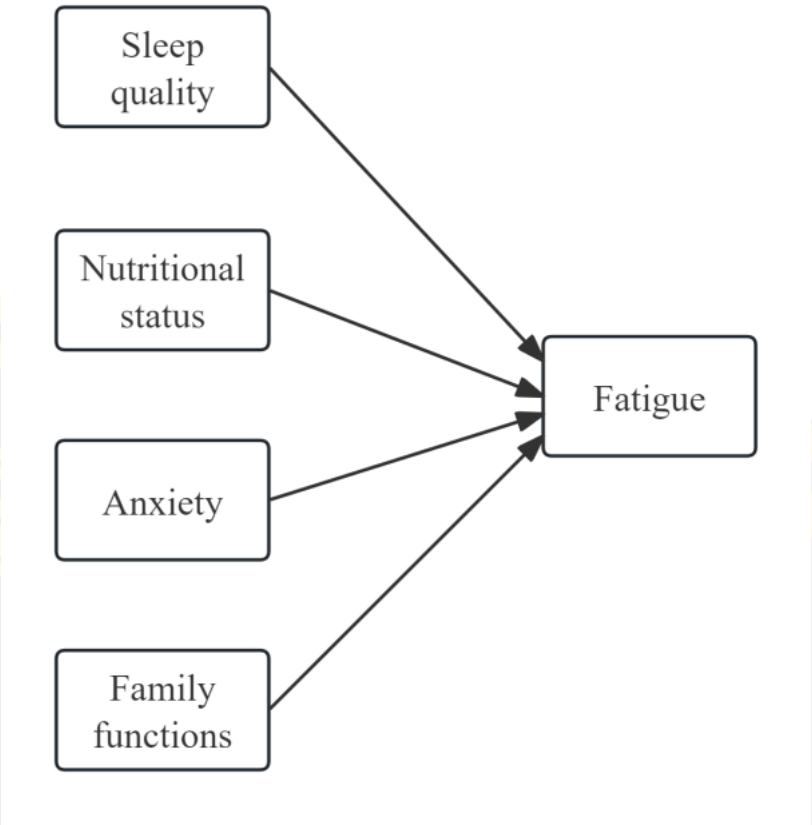

Figure 1 Conceptual framework

Definition of terms

Fatigue is an overall feeling of tiredness or lack of energy. Fatigue is divided into physical fatigue and mental fatigue. It measured by Piper Fatigue Scale-Revised (PFS-R) (Reeve et al., 2012).

Sleep quality refers to how well adolescents and young adults with cancer undergo chemotherapy sleep. It measured by Pittsburgh Sleep Quality Index (PSQI) (Buysse et al., 1989).

Nutritional status refers to the self evaluation of adolescent and young adult cancer patients receiving chemotherapy related to normal physiological functions through dietary intake, energy metabolism, and body reserves. The Patient-Generated Subjective Global Assessment (PG-SGA©) (Bauer et al., 2002) used to indicate nutritional status.

Anxiety refers to the state of excessive worry, tension, or fear caused by illness, treatment uncertainty, and physical discomfort in adolescent and young adult

cancer patients undergoing chemotherapy. There are also motor restlessness and autonomic symptoms. Anxiety measured using the Hamilton anxiety rating scale (HAMA) (Clark & Donovan, 1994).

Family function refers to the ability of a family to meet the physical, emotional, and social needs of its members, maintain healthy relationships, and effectively manage challenges and changes. Family function encompasses various dimensions, including communication, problem-solving, emotional support, roles and responsibilities, and adaptability to stressors. It was measured by using the Family APGAR (Smilkstein, 1978).

CHAPTER 2
LITERATURE REVIEW

The literature review briefly introduces the situation of cancer among AYA in China, cancer treatments and impacts, fatigue in AYA with cancer, the theories related to fatigue, and the factors affecting fatigue among AYA with cancer.

Situation of cancer among adolescent and young adults in China

According to GLOBOCAN 2022, in 2022, there were 1,300,196 incident cases and 377,621 cancer deaths among AYA aged 15-39 years globally. China has one of the highest cancer incidence rates in the world, ranging from 53.3 to 78.3 per 100,000. The mortality rate of cancer was 6.4-9.6 per 100,000, which was relatively low compared with other countries. The most common cancer type was thyroid cancer, and the most common cancer death type was liver cancer (Li et al., 2024).

In the past, it was believed that tumors were senile diseases. Now it is not uncommon to find malignant tumors in adolescents and young adults. With the development of society, more and more families have only one child, which causes one tumor, affects three families and triple the fear of cancer. Malignant tumor is the leading cause of death in adolescents except accidental injury (Pui et al., 2018). Adolescents suffering from malignant tumors no longer means being sentenced to death but can be cured or relieved for a long time. The etiology of cancer in adolescents and young adults has its unique biological and sociological characteristics, involving the interaction of multiple factors such as genetics, environment, hormones, immunity and lifestyle (Tricoli et al., 2016).

Cancer among AYA

Leukemia

Leukemia is a clonal proliferation of hematopoietic stem cells in the bone marrow. The four most common subtypes are acute lymphocytic, acute myeloid, chronic lymphocytic, and chronic myeloid. Acute lymphoblastic leukemia (ALL) is more common in children, whereas the other subtypes are more common in adults. Risk factors include genetic predisposition as well as environmental factors. Treatment may include chemotherapy, radiotherapy, monoclonal antibodies, or hematopoietic stem cell transplantation (Davis et al., 2014). Taking ALL as an example, the chemotherapy regimen for the low-risk group includes induction, consolidation and maintenance, while the high-risk group also needs intensive chemotherapy and even hematopoietic stem cell transplantation.

Lymphoma

Lymphoma is a group of malignant neoplasms of lymphocytes with more than 90 subtypes. It is traditionally classified broadly as non-Hodgkin or Hodgkin lymphoma. Chemotherapy treatment plans differ among the major subtypes of lymphoma. The main chemotherapy regimen for Hodgkin is ABVD (doxorubicin + bleomycin + vinblastine + dacarbazine) combined with involved-field radiotherapy (IFRT), and the cure rate can exceed 90%. The first-line chemotherapy regimen for non-Hodgkin's lymphoma, such as diffuse large B-cell lymphoma (DLBCL), is R-CHOP (rituximab + cyclophosphamide + doxorubicin + vincristine + prednisone), and high-risk or relapsed patients need CAR-T therapy.

Breast cancer

Breast cancer was classified into three major subtypes based on the presence or absence of the molecular markers estrogen or progesterone receptor and human epidermal growth factor 2 (ERBB2): Hormone-receptor-positive/ERBB2-negative (in 70% of patients), ERBB2-positive (15%-20%), and triple-negative (tumors lacking all three standard molecular markers; 15%) (Waks & Winer, 2019). According to different subtypes, the treatment methods are also different, mainly including surgery, radiotherapy, chemotherapy, immunotherapy, etc (Sharma et al., 2010). Taking HER2-positive as an example, the neoadjuvant treatment was TCHP regimen chemotherapy (docetaxel + carboplatin + trastuzumab + pertuzumab) before surgery.

Gastrointestinal Cancers

Gastrointestinal (GI) cancer refers to malignant tumors that occur in the epithelial tissues of the esophagus, stomach, liver, bile duct, pancreas, and colon and rectum (Xie et al., 2021). GI mainly, including the malignancies derived from esophageal, stomach, and colorectum, are among the most common cancers in humans. According to data provided by GLOBOCAN 2020, GI cancers accounted for 18.7% of new cancer cases and 22.6% of cancer deaths in 2020, both the highest among all cancer types (Ferlay et al., 2020). However, the geographic and temporal distribution of GI cancers, major risk factors, and prevention strategies differ substantially between East and West. The treatment strategy is based on the stage: early lesions can be cured by endoscopic resection or radical surgery, and advanced lesions need to be combined with chemotherapy, radiotherapy and targeted therapy (Zhan et al., 2025).

Cancer treatments

The common treatments of cancer are surgery, radiotherapy, targeted therapy, immunotherapy, biotherapy, and chemotherapy.

Radiotherapy

Radiotherapy is a local treatment, but it can also cause systemic fatigue. Previous studies have shown that patients will experience radiotherapy related fatigue when receiving radiotherapy, and the degree of fatigue is related to radiation field, radiation dose and radiotherapy interval (Karthikeyan et al., 2012). In one study, it was suggested that fatigue in radiotherapy population may be related to neutrophil level and erythrocyte count (Wratten et al., 2004).

Biological therapy

Biological agents are mainly found in interferon, colony stimulating factor, etc., but after the application of this method, influenza like fatigue will appear, manifested as headache, muscle soreness, fever, chills and other discomfort symptoms (Shimabukuro-Vornhagen et al., 2018). Take intravenous immunoglobulin (IVIG) for example. As a common adjuvant biological agent for children and adolescents with cancer, its common complications include headache, chest tightness, myalgia, fatigue, dyspnea, nausea and so on (Association, 2021).

Surgical treatment

Surgical treatment belongs to traumatic stress, which will lead to the enhancement of sympathetic nerve tension and the increase of adrenaline level in the body, resulting in the patient's mental and psychological state of tension and anxiety for a long time and fatigue (Rich, 2020). Postoperative fatigue is also considered to be related to the lower energy level after operation than before operation, and energy deficiency is a major cause of fatigue.

Targeted therapy

Targeted therapy is more targeted and non-cytotoxic than traditional chemotherapy. It directly blocks the occurrence and development of tumor by targeting functional molecules and tumor cell specific structures, combined with corresponding antibodies and ligands (Zhong et al., 2021). Molecular targeted drug therapy can cause adverse reactions such as oral ulcer, hair change, paronychia, dry skin, diarrhea and rash (Lacouture & Sibaud, 2018). Oral ulcers can cause eating pain, affect eating desire, and reduce the intake of nutrients in children and adolescents with cancer. Diarrhea can affect the nutritional status of children to a certain extent. Lack of nutrition is easy to lead to fatigue.

Immunotherapy

Immunotherapy combined with chemotherapy has gradually become the first choice for cancer treatment in hospitals at all levels in China (Wang et al., 2021). Immunotherapy is often combined with chemotherapy, and whether it influences fatigue has not been clearly determined.

Chemotherapy

Chemotherapy is the abbreviation of chemical drug therapy. It achieves the purpose of treatment by killing cancer cells with chemical drugs (Carrington et al., 2010). Long term debilitation and intensive treatment have changed the body of adolescents and brought many symptoms (Kunstreich et al., 2016). Whether chemotherapy is sensitive or not is an important factor in determining the prognosis of AYA. Chemotherapy is an important means to treat cancer. Chemotherapy is the abbreviation of chemical drug therapy. It achieves the purpose of treatment by killing cancer cells with chemical drugs (Carrington et al., 2010). Long term debilitation and intensive treatment have changed the body of AYA and brought many symptoms

(Kunstreich et al., 2016). AYA with cancer sometimes has various symptoms at the same time. These symptoms are associated with poor prognosis, including low survival, reduced treatment compliance and reduced quality of life. The importance of evaluating and intervening symptoms, whether in terms of patient survival, or during and after treatment, to ensure a better quality of life, has been well confirmed. At present, it is one of the pillars of clinical oncology research and the focus of cancer nursing research.

According to relevant data, after the patient stops chemotherapy and all biochemical indexes return to normal, the patient still has a sense of fatigue, which can last for months to years (Yang et al., 2019). Because chemotherapy drugs are not only anti-tumor, but also highly lethal to healthy tissue cells, especially normal cells in the active stage of division. With the damage and apoptosis of many normal cells, it will increase the nutrients consumed by the body's self-healing and can induce or aggravate fatigue.

Classification of chemotherapy regimens

1. Radical chemotherapy: Some cancers sensitive to chemotherapy drugs, such as leukemia and lymphoma, chorionic epithelial carcinoma and germ cell malignancies, can be cured by chemotherapy alone. This kind of chemotherapy aimed at curing cancer is called radical chemotherapy. Taking acute leukemia as an example, chemotherapy can be divided into three different phases: induction phase, enhancement phase and consolidation phase. The intensity and side effects of the medication vary at different phase, so fatigue levels vary at different phase.

2. Palliative chemotherapy: most advanced cancer cells have widely metastasized, and it is impossible to cure them with the current level of science and technology. The main purpose of chemotherapy is to control the development of cancer to prolong the life of patients, or to improve the quality of life of patients through chemotherapy, which is called palliative chemotherapy.

3. Postoperative adjuvant chemotherapy: although the tumor has been surgically removed, potential metastasis that could not be clinically detected may occur before surgery, or a small number of cancer cells may fall off around the surgical wound. Chemotherapy can kill these remaining cancer cells to prevent cancer recurrence and metastasis.

4. Preoperative chemotherapy (neoadjuvant chemotherapy): preoperative chemotherapy can reduce the lesions to facilitate surgical resection or reduce some of the lost lesions to obtain surgery, and at the same time, it can kill potential metastatic lesions and reduce the possibility of recurrence and metastasis.

5. Intra - luminal chemotherapy: through intra - luminal administration (such as intra - abdominal and thoracic administration), high drug concentration can be temporarily maintained locally in the body cavity to improve the local efficacy.

6. Salvage Chemotherapy is a strategy in cancer therapy that is commonly used in patients whose first-line treatment regimens have failed, and whose cancer has recurred or progressed. Its core goals are to regain disease control, relieve symptoms, or gain opportunities for subsequent therapies (e.g., stem-cell transplantation, immunotherapy)(Zsiros & Brugières, 2010).

Different chemotherapy drugs are used for different cancers. Common chemotherapy drugs and their side effects are as follows:

Alkylating agent: Nitrogen mustard, Nitrosorea, Platinum analogue, Triazene, Alkyl sulfonate, Ethylene imine. Toxicity: myelosuppression, mucositis, nausea and vomiting, neurotoxicity, alopecia, pulmonary fibrosis, infertility, secondary malignancy.

Antimetabolite: Cytidine analogue. Toxicity: General myelosuppression. High doses of cytarabine cause neurotoxicity and conjunctivitis. Gemcitabine can cause elevated liver enzymes and interstitial pneumonia.

Folic acid antagonist: Methotrexate, Pemetrexed. Toxicity: myelosuppression, mucositis, hepatotoxicity, nephrotoxicity, skin reaction.

Purine analogues: Clatribin, Clofarabine, Nellabine. Toxicity: Bone marrow suppression, immunosuppression (suppression of CD4+ cells) puts patients at risk of opportunistic infections.

Pyrimidine analogues: Fluorouracil (5-FU), Capecitabine (5-FU prodrug). Toxicity: hand, foot, mucositis, diarrhea, myelosuppression, cardiac dysfunction, colitis, neutropenia, and encephalopathy.

Antimicrotubule drugs: Topoisomerase II inhibitors: anthracyclines. Toxicity: myelosuppression, cardiotoxicity (accumulation), mucositis.

Podophyllotoxin. Toxicity: myelosuppression -- primary leukopenia.

Topoisomerase I inhibitors: Irinotecan, Topotecan. Toxicity: diarrhea, neutropenia, thrombocytopenia. Taxanes: paclitaxel, docetaxel, cabataxel. Toxicity: hypersensitivity, bone marrow suppression, peripheral neuropathy

Vinca alkaloids: Vinblastine, Vincristine, Vinorelbine. Toxicity: peripheral neuropathy (motor and sensory function are affected), bone marrow suppression

Antibiotics: Actinomycin D, Bleomycin, Donormycin. Toxicity: cumulative pulmonary toxicity, hyperpigmentation (Amjad et al., 2021).

Impacts of chemotherapy

The effect of chemotherapy on fatigue involves multi-level biological mechanisms. Chemotherapy drugs (such as paclitaxel and cisplatin) induce cell damage and release proinflammatory factors (Behranvand et al., 2022). These cytokines can penetrate the blood-brain barrier, act on the hypothalamus and amygdala, and induce symptoms such as fatigue, lethargy, and loss of appetite (Yarlagadda et al., 2009). Clinical studies have confirmed that serum IL-6 levels are significantly positively correlated with fatigue scores in breast cancer patients after chemotherapy (Inglis et al., 2021). Anthracyclines, such as doxorubicin, reduce ATP production by inhibiting mitochondrial complex I activity, leading to muscle and neuronal energy depletion (Huot et al., 2023). Chemotherapy damages the intestinal mucosa, leading to increased absorption of tryptophan, and increased synthesis of central 5-hydroxytryptamine (5-HT), leading to fatigue and drowsiness (He et al., 2023). Morning peak cortisol in chemotherapy patients decreased by 40% compared with baseline, and circadian rhythm disturbance was associated with increased fatigue (Amidi & Wu, 2022).

Fatigue is also affected by the characteristics of the chemotherapy regimen, such as the type of drug, the intensity of the dose, and the combination strategy (Bower, 2014). Anthracycline-induced fatigue occurs at a high rate due to mitochondrial damage and reactive oxygen species production (Gilliam & St Clair, 2011; van Norren et al., 2009). Platinum also increases the risk of fatigue by causing hypomagnesemia through renal tubular damage (Oun et al., 2018). Different dose-intensity chemotherapy regimens elicited different levels of fatigue, with higher fatigue levels in the intensive regimen compared with the standard regimen (Khan et al., 2022). The risk of fatigue can also be further amplified by the cumulative effects

of medications. When the cumulative dose of adriamycin reached a certain low level, the risk of severe fatigue increased by 2.3 times (Kundnani et al., 2025). In addition, the combination of drugs during chemotherapy can also affect fatigue. In the case of glucocorticoids, although short-term use can alleviate acute fatigue, long-term use can inhibit HPA axis function, leading to a rebound of fatigue after drug withdrawal (Papadopoulos & Cleare, 2012). Some studies have also demonstrated that 5-HT3 receptor antagonists not only control vomiting but also reduce fatigue (Lalani et al., 2023).

Fatigue in AYA with cancer

Fatigue is a term used to describe an overall feeling of tiredness or lack of energy. Fatigue is divided into physical fatigue and mental fatigue. Fatigue is defined as a state of extreme tiredness and inability to work/study properly due to lack of energy. Adolescents with cancer face many symptoms during treatment. One symptom is fatigue, which can also lead to other symptoms, such as sleep disorders, decreased sleep quality, mood disorders, depression, pain, nausea, vomiting and decreased physical function. Fatigue is described as the most common and debilitating side effect of cancer treatment and is often reported as a long-term complication of treatment. Although fatigue is widespread and has a far-reaching negative impact on the quality of life of patients, little is known about the specific mechanism of fatigue in cancer patients and how to prevent and treat it effectively. Fatigue is difficult to define as a subjective discomfort, but objectively it will lose the ability to complete normal activities or work under the same conditions.

The pathogenesis of fatigue is still unclear, and existing studies suggest that it may be related to inflammation, neuroendocrine system disorder, abnormal adenosine triphosphate (ATP) metabolism, circadian rhythm changes, 5-hydroxytryptamine system dysfunction and genetic factors. At present, the most concerned and supported is the inflammation hypothesis, that is, cancer (cancer cells themselves or surrounding stroma and immune cells) and cancer treatment can activate the immune system, release proinflammatory factors, affect the central nervous system and change the nerve conduction process, resulting in abnormal sleep, anorexia Fever and severe fatigue (Wang, 2008).

The four dimensions of fatigue

Behavioral/Severity: The objective impact of fatigue on individual's daily function and social role execution ability reflects the "external manifestation" of fatigue. Attention should be paid to the activity limitations caused by fatigue, and the completion of daily tasks of patients should be quantified.

Affective: The emotional response and mental state changes caused by fatigue reflect the subjective emotional experience of individuals. The bidirectional relationship between fatigue and negative emotions such as depression, anxiety, and helplessness were emphasized.

Sensory: Physical discomfort or abnormal physiological feelings directly related to fatigue reflect the fatigue signal at the physiological level.

Cognitive/Mood: Fatigue impairs both cognitive function (attention, memory) and emotional regulation.

Pathology of cancer-related fatigue (CRF)

The exact pathophysiology of CRF is poorly understood, but in any individual. It can be multifactorial, involving interrelated cytokine, muscle, neurotransmitter, and neuroendocrine changes (O'Higgins et al., 2018).

Cytokine dysregulation hypothesis

As key signaling molecules of immunity and inflammation, cytokines act directly on the central nervous system through blood or vagal afferents to trigger fatigue (Scheff & Saloman, 2021). It has been found that fatigued cancer patients have significantly increased serum levels of proinflammatory factors such as CRP, IL-6, and TNFα (Maurer et al., 2021). Tissue damage after chemotherapy may activate cytokines (Behranvand et al., 2022), but whether they are causative or aggravating factors of CRF remains unclear. It is important to note that abnormal signaling of proinflammatory cytokines is not only directly related to CRF symptoms, but also cross-interacts with hypothalamic-pituitary-adrenal (HPA) axis disorders (Turnbull & Rivier, 1999) and abnormal serotonin metabolism (Kanova & Kohout, 2021), suggesting that proinflammatory cytokines play a pivotal role in the pathophysiology of CRF.

Hypothalamic-pituitary-adrenal axis disruption hypothesis

Cancer or its treatment causes CRF by directly or indirectly interfering with the function of the hypothalamic-pituitary-adrenal axis (HPA axis), which induces endocrine disturbances. The expression of hypothalamic corticotropin-releasing hormone (CRH) is enhanced when the body is under physiological/psychological stress (James et al., 2023). However, chronic inflammation can inhibit the synthesis and release of CRH, leading to abnormal cortisol secretion (Sukhareva, 2021). Cortisol can regulate cardiovascular, immune and metabolic functions, and play an anti-inflammatory role by inhibiting the production of cytokines (Mohd Azmi et al., 2021). The disorder of cortisol secretion leads to the decline of anti-inflammatory ability and cytokine storm, forming a self-reinforcing cycle of "low cortisol-high inflammation-high fatigue", which becomes the key driving mechanism of CRF.

Serotonin dysregulation hypothesis

The mechanism of the association between 5-hydroxytryptamine (5-HT) system and cancer-related fatigue (CRF) is complex and controversial. High or low levels of 5-HT in the brain may induce fatigue, and its effect is bidirectional: On the one hand, high 5-HT levels stimulate corticotropin-releasing hormone (CRH) secretion by activating 5-HT receptors in the paraventricular nucleus of the hypothalamus, increasing cortisol and pro-inflammatory cytokines in the short term, but inhibiting hypothalamic-pituitary-adrenal (HPA) axis function in the long term. Results in decreased cortisol secretion and impaired exercise capacity (Chaves et al., 2021); On the other hand, low 5-HT levels, which are associated with sleep disturbances and mood disturbances commonly seen in patients with cancer (Kim et al., 2012). In contrast, the neurotoxic metabolites of kynurenine, such as quinolinic acid, not only directly exacerbate fatigue, but also further inhibit HPA-axis activity (Truyens et al., 2024). This process forms a vicious cycle of "low cortisol, high inflammation, and high fatigue".

Peripheral hypotheses

Fatigue in healthy and diseased individuals is associated with skeletal muscle structure and functional abnormalities (Davis & Walsh, 2010). Cancer or its treatment causes abnormalities in the sarcoplasmic reticulum function (e.g., intracellular calcium accumulation, mitochondrial ATP aplasia), resulting in

insufficient energy for muscle contraction (Fontes-Oliveira et al., 2013; Giordano et al., 2003). It can also cause the accumulation of metabolites, interfere with the release of sarcoplasmic reticulum calcium ions or the sensitivity of action/myosin to calcium ions, and directly trigger metabolic fatigue (Rowland, 2020). ATP is the main energy source for muscle contraction, and its regeneration depends on mitochondrial oxidative phosphorylation (Gnaiger, 2009). Insufficient ATP production or delayed regeneration can lead to decreased muscle strength, decreased exercise tolerance, and subjective fatigue (Place & Westerblad, 2022).

Timing of cancer-related fatigue

Fatigue can occur within 24 hours after chemotherapy drug infusion, which may be related to direct drug damage to cells, inflammatory response, or metabolic disorders (Kaur et al., 2022). It manifests as muscle weakness, lethargy, and decreased concentration, often accompanied by nausea or loss of appetite (Morrison & Keating, 2001). Remission was gradual over 3-7 days but may reappear after the next chemotherapy (Richardson et al., 1998). Fatigue may accumulate with the increase of chemotherapy cycles, especially in patients receiving high-dose or dense regimens (Nieboer et al., 2005). Fatigue usually reaches its peak 4-6 months after chemotherapy, and some patients continue for weeks to months after the end of treatment (Schwartz et al., 2000). More seriously, about 30% of cancer patients still report significant fatigue 1 year after the end of chemotherapy (Schmidt et al., 2012).

Theories related to fatigue and factors affecting fatigue

Piper et al. (1987) were among the first to propose a multidimensional measurement model for fatigue. In this model, subjective perception was believed to be key to understanding how fatigue manifestations might very between healthy and ill individuals. This model was strongly influenced by the clinical experience of the investigators, by what was known about fatigue, pain, and symptom measurement theories at the time, d by clinically useful “sign and symptom” model used by medicine (Piper et al., 1987).

The Piper Fatigue Integrated Model was developed from a deductive approach based on a review of fatigue literature from five disciplines, including physiology, ergonomics, medicine, and nursing. It describes 14 biological, psychological, and social

factors that influence the subjective and objective signs and symptoms of fatigue. These factors or patterns include innate host factors, accumulation of metabolites, change in energy and energy substrates, activity/rest, sleep/wake, disease, treatments, environment, symptoms, psychological, change in regulation/transmission, social, life events, and oxygenation patterns.

According to Piper, fatigue is the subjective feeling of tiredness, which can vary in unpleasantness, intensity, and duration (Jacobs & Piper, 1996). In the current study, under the guidance of IFM, its relationship with fatigue in adolescents with cancer was supported by empirical evidence and included in the hypothetical research model. The analysis of the existing literature reveals three factors that may lead to fatigue. These determinants show three influence modes on fatigue in IFM. These patterns include nutritional status (energy and energy matrix patterns), sleep quality (sleep / wakefulness patterns), anxiety (psychological patterns), family function (social patterns). The study focused on adolescents and young adults undergoing chemotherapy, a treatment pattern that affects fatigue.

General patient data, including age, sex, etc., belong to the innate host patterns. The patient's disease type, both diagnostic, belongs to the disease patterns. Through the study of this theory, it was found that it mainly focused on the influence of influencing factors on fatigue and did not focus on the interaction between these factors. Through the collation of previous studies, found that there are also some effects among the factors affecting fatigue. For example, anxiety can affect the quality of sleep.

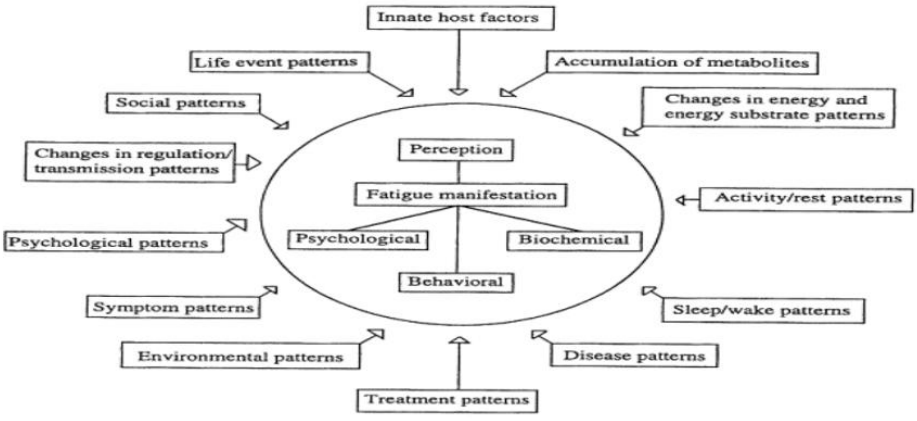

Figure 2 Piper integrated model

Source: Piper, B. F., Lindsey, A. M., & Dodd, M. J. (1987). Fatigue mechanisms in cancer patient: Developing nursing theory. *Oncology Nursing Forum*, *14*(6), p.19.

Factors influencing fatigue among AYA with cancer

According to the Clinical Practice guidelines for the Diagnosis and Treatment of Cancer-related fatigue in China, cancer-related fatigue is a common symptom of cancer caused by the interaction of multiple factors. Influencing factors include tumor factors, anti-tumor therapy-related factors, tumor complications or comorbidities related factors, Chronic co-symptomatic factors and psychosocial factors. The guidelines recognize the positive value of assessing treatable factors and intervening to reduce fatigue symptoms. After analyzing the characteristics of the study population in combination with IFM, it is found that the following four factors may have a high correlation with fatigue. And it is beneficial to provide intervention suggestions for clinical nursing work (Zhang & Qian, 2021).

Sleep quality

The term “sleep quality” is commonly used in sleep medicine, yet we lack an established definition for the term. “Sleep quality” is sometimes used to refer to a collection of sleep measures including total sleep time (TST), sleep on set latency (SOL), degree of fragmentation, total wake time, sleep efficiency, and sometimes sleep disruptive events such as spontaneous arousals or apnea. Sleep quality is a measure of how well a patient is sleeping. In other words, whether they are getting enough sleep to recover. (Buysse et al., 1989) measured sleep quality using the Pittsburgh Sleep Quality Index (PSQI). Sleep, at the most basic level, is key for wellbeing, learning and memory, and improving energy. Various complications during chemotherapy in adolescent cancer patients can lead to sleep disturbances and then affect sleep quality. Adolescents with cancer have a variety of sleep problems, including changes in sleep habits and difficulties starting and maintaining sleep. Symptoms of sleep disorders include difficulty falling asleep, difficulty walking back to sleep, daytime sleepiness and early wakefulness. A cohort study of adolescent cancer described the prevalence of subjective sleep disorders in adolescents with cancer after treatment, ranging from 1.8 to 9.6%. Among them, insomnia and circadian sleep disorder are the

most common (Peersmann et al., 2022). The experience of illness places a great deal of physical and mental stress on teenagers. The unfamiliar environment of hospitals and various treatment procedures are also prone to fear and anxiety among adolescents. As a result, they cannot sleep peacefully in the ward and develop symptoms of various sleep disorders, such as sleep-wake transition disorder, which affects sleep quality. Poor sleep quality in adolescents severely affects their daily activities and energy levels (Baddam et al., 2021). On the other hand, severe fatigue symptoms of teenagers can also lead to symptoms such as sweating and breathing difficulties after they fall asleep or cannot sleep properly at night. They cannot promote physical recovery through normal sleep, which will affect the energy of the next day, resulting in more time to rest during the day, unable to carry out normal activities or learning, and even cognitive fatigue symptoms, such as decreased attention and memory (Alhola & Polo-Kantola, 2007). Sleep disorders are associated with fatigue and are certified in adolescents. Sleep diary measurements also showed that the worse the sleep quality of adolescents, the more severe fatigue (Orsey et al., 2013). Evidence shows that adolescents' poor sleep quality is accompanied by general fatigue and cognitive fatigue in addition to poor daytime performance. A study of breast cancer patients undergoing chemotherapy showed a significant relationship between fatigue and sleep quality ($r = .21$, $p < .05$) (Imanian et al., 2019).

There was a negative correlation between sleep quality in cancer patients, with better sleep quality associated with lower levels of fatigue. It could be concluded that sleep quality has a negative effect on fatigue among AYA with cancer.

Nutritional status

The state of nutrition is closely related to food intake, digestion, absorption and metabolism (Arends, 2018). Its quality can be used as one of the standards to identify the degree of health and disease. It is usually described by obesity and weight loss. Studies have shown that all adolescents have experienced at least one nutritional problem. The most common problems are loss of appetite (85.5%), nausea (84.1%), vomiting (81.2%), fatigue (79.7%) and mucositis (66.7%)

(Arpaci et al., 2018). In China, the overall prevalence of malnutrition among adolescents with cancer is 55.8 (Ouyang et al., 2021). Adolescents with poor nutritional status will have more side effects in treatment, which will affect their participation in social activities with their peers and affect their emotional and social functions (Rodgers et al., 2016). The metabolism of energy, carbohydrate, fat and protein in tumor patients largely changed. In addition, due to the loss of appetite, nausea, vomiting, diarrhea and intestinal obstruction caused by tumor treatment (such as chemotherapy and radiotherapy) and malnutrition, the food intake is reduced, which may make the nutrient supply of the body less than the nutrients required by the body, resulting in fatigue (Qu et al., 2020). Providing nutritional support has a positive effect on alleviating fatigue（$r = .37$, $p < .05$), which indicates that nutritional status has an impact on fatigue (Zhou & Lan, 2021). In a Chinese controlled trial ($n = 92$), fatigue scores in the observation group with adequate nutritional support were significantly lower than those in the control group with regular nutritional support ($p < .05$) (Zhang et al., 2021). Low levels of nutrition are associated with high levels of fatigue.

Adequate nutritional support can reduce fatigue levels. Thus, there is a negative effect of nutritional status on fatigue.

Anxiety

Anxiety is a feeling of fear, dread, and uneasiness. The main manifestations are: nervousness and anxiety without clear objective objects, restlessness, and autonomic nerve dysfunction symptoms, such as palpitation, hand shaking, sweating, frequent urination, and motor restlessness (Helsley & Vanin, 2008). About 25% to 35% of adolescents with cancer are affected by anxiety disorders (Yardeni et al., 2021) . Anxiety will consume patients' energy and often cause sleep disorders and sleep disorder syndrome is one of the important causes of fatigue. Many studies have shown that there is a positive correlation between anxiety and fatigue (Vassend et al., 2018). Anxiety and other adverse mental states will reduce adolescents' appetite and affect adolescents' nutritional status (Qu et al., 2020), and then affect the patient's fatigue. In studies of cancer survivors, anxiety was associated with both general fatigue ($r = .42$ $p < .001$) and mental fatigue ($r = .51$, $p < .001$) (Zhou & Zhou, 2020).

In some cancer populations, there is a significant positive correlation between anxiety and fatigue. When anxiety levels are low, not only do you sleep better, but you also experience less fatigue. Thus, there was a positive effect anxiety on fatigue.

Family function

Family function is defined as how family members communicate with each other, relate to each other, maintain relationships, and make decisions and solve problems together (Walker & Shepherd, 2008). The social patterns were one of the 14 factors affecting fatigue in the Piper Fatigue Integrated Model. The higher the perceived social support, the lower the level of fatigue (Mardanian-Dehkordi & Kahangi, 2018). However, East Asians are less willing than Westerners to seek social support when needed, possibly due to cultural differences between East and West (Zheng et al., 2021). In collectivist cultures, the family is the primary source of support, and its function may have a much greater impact on individual health than generalized social support (Glazer, 2006). The course of illness comes with dependency, and family members need to adjust household habits and change situations, especially about caring for the sick (Coppetti et al., 2018). As proposed in one study, adolescents with cancer with Post-Traumatic Stress Disorder (PTSD) are more than 5 times more likely to emerge from a poorly functioning family compared to a well-functioning family (Alderfer et al., 2009). Sleep disorder is the core feature of PTSD, and sleep disorder can easily lead to fatigue (Slavish et al., 2022). Home caregivers are critical to providing care for patients with cancer at all stages of the disease. They assist patients with activities of daily living, dietary preparation, self-care programmers, physical symptom management, treatment management, medication compliance, emotional and psychological support, financial management and housework (Hu et al., 2018). Family members' wrong decision- making and insufficient care ability will increase the incidence of complications in adolescents and young adults with cancer (Wozniak & Izycki, 2014). A study shows that patients cared for by less educated mothers are prone to malnutrition (Mercadante et al., 2024). Studies have shown that the perceived family function of an adolescent survivor with cancer is closely related to his psychological adjustment (Rait et al., 1992).Patients with strong psychological adjustment are better able to manage stress

and reduce the negative effects of stress on the body, thereby reducing perceived fatigue (Seiler & Jenewein, 2019).

Family function plays an important role in the treatment of patients with cancer, which plays a positive role in reducing complications and improving quality of life. Family function had a positive effect on fatigue.

Summary

Cancer-related fatigue (CRF) in adolescent and young adults (AYA) with cancer presents as a multidimensional and multifactorial phenomenon shaped by biological, psychological, and social interactions. With a high cancer incidence (53.3–78.3 per 100,000) and unique challenges such as delayed diagnosis, aggressive treatments (e.g., chemotherapy, radiotherapy), and sociofamilial pressures in one-child households, AYAs endure profound physical and emotional burdens. CRF pathophysiology involves cytokine dysregulation (elevated IL-6, TNFα), hypothalamic-pituitary-adrenal (HPA) axis disruption, serotonin imbalance, and peripheral muscle ATP depletion, exacerbated by treatment toxicities like mucositis, neuropathies, and malnutrition. Guided by Piper's Integrated Fatigue Model, fatigue manifests behaviorally, affectively, sensorially, and cognitively. Key modifiable factors include sleep quality, malnutrition, anxiety, and compromised family function—particularly critical in China's collectivist culture, where familial decision-making and caregiving directly impact complication risks and psychological resilience.

CHAPTER 3
RESEARCH METHODOLOGY

Research design

This is a cross-sectional study of fatigue and influencing factors in adolescents and young adults with cancer.

Setting of study

This study had been conducted in the Second Affiliated Hospital of Wenzhou Medical University and Yuying Children's Hospital. As the largest tertiary hospital in southern Zhejiang and northern Fujian, it covers 20 million people in Wenzhou and surrounding areas, and its patients cover different socioeconomic backgrounds in urban and rural areas. It is the only hospital in Wenzhou that can accept cancer patients of all ages. The hospital has maintained inpatient and outpatient chemotherapy departments, including the pediatric hemato-oncology department, adult hemato-oncology department, radiotherapy and chemotherapy department, and day ward. Specialized cancer patients requiring chemotherapy have also been hospitalized in departments such as respiratory medicine, gastroenterology, neurology, and orthopedics.

Population and sample

Population

The population consisted of adolescents and young adults with cancer hospitalized in the Second Affiliated Hospital of Wenzhou Medical University.

Sample

The sample consisted of adolescents and young adults with cancer undergoing chemotherapy at the Second Affiliated Hospital\ Yuying Children's Hospital of Wenzhou Medical University. Inclusion criteria included: 1) age 15 to 30 years, 2) inpatient or outpatient chemotherapy, at least one stage or chemotherapy, 3) being able to read and write Chinese and answer questionnaires, 4) no history of neurological disorders, visual or hearing impairment, motor impairment, cognitive developmental delay, as documented in the patient's health record.

Sample size estimation:

The sample size of this study estimate based on the number of independent variables (Mertler et al., 2021). The sample size had been set at 40 for each independent variable. This study included four independent variables. Therefore, the total number of participants had been calculated as 160 AYAs with cancer. To account for an anticipated sample loss rate and sampling error of 10%, the sample size had been expanded to 176.

Sampling technique

The participants in this study had been AYA cancer patients who had received chemotherapy at the Second Affiliated Hospital of Wenzhou Medical University between November 2022 and November 2024. A random sampling method has been employed. All eligible inpatient chemotherapy patients have been listed by Sequential numbers had been assigned to the list, and participants had been selected through a lottery system after randomization. Based on the weekly admission rate of cancer patients, approximately 1 to 3 participants were recruited per week. For adolescent patients under 18 years of age, written informed consent has been obtained from their parents or legal guardians. Young adult patients (≥18 years) had signed their own consent forms.

Research instruments

1. Demographic record form collect data includes the general information of AYA age, gender, weight, embryonic age, ranking of brothers and sisters, past medical history, type of disease, length of hospital stays, severity of illness and payment method of medical expenses.

2. Piper Fatigue Scale- Revised (PFS-R) (Reeve et al., 2012) was used to measure fatigue. In 2012, Reeve et al developed PFS-R based on Piper revised Scale, including four dimensions (Behavioral/Severity, Affective Meaning, Sensory and Cognitive/Mood), using the Likert 11 scoring method, and the scoring standards were 0 (no fatigue), 1-3 (mild fatigue), 4-6 (moderate fatigue) and 7-10 (severe fatigue). PFS-R can range from 0 to 220, higher scores indicate higher levels of fatigue. Cronbach alpha of the scale ranged from 0.87-0.89 (So et al., 2003).

3. Pittsburgh sleep quality index (PSQI) (Smyth, 1999) was used to measure sleep quality. The PSQI scale consists of 19 self-evaluation items and 5 other evaluation items, of which the 19th self-evaluation item and 5 other evaluation items do not participate in scoring. All items were divided into seven dimensions: subjective sleep quality, sleep time, sleep time, sleep efficiency, sleep disorder, hypnotic drugs and daytime function. Each component is scored by 0-3 (See the scale in the appendix for specific answers). The cumulative score of each component is the total score of PSQI, and the total score range is 0-21. The higher the score, the worse the sleep quality. 0-4: good sleep quality, 5-10: mild sleep disorder, 11-15: moderate sleep disorder, 16-21: severe sleep disorder. The scale was validated in a Hong Kong Study for children with cancer. Cronbach alpha of Chinese PSQI is .71. The intra group correlation coefficient is .90 (Ho et al., 2021).

4. Hamilton Anxiety Rating Scale (HAMA) was used to measure anxiety. There are fourteen items. Each item has five points (0 = never, 1 = almost not, 2 = sometimes, 3 = often, 4 = always). The total score can range from 0 to 56. The higher the score, the higher the anxiety: no anxiety(0-6), mild(7-13), moderate(14-20), severe (≥21). Its reliability and validity have been demonstrated in adolescents (Clark & Donovan, 1994). Cronbach's alpha for the HAMA total score is .92.

5. Patient-Generated Subjective Global Assessment (PG-SGA©) (Bauer et al., 2002) was used to measure nutritional status. It is divided into a patient self-evaluation component and a medical staff evaluation component. Patient self-assessment included weight change, dietary intake, symptoms, and mobility, while health care provider components included diagnosis, metabolic needs, physical examination, and so on. Numerical scores on the PG-SGA patient self-rating section range from 0 to 12: well-nourished (0-1), moderate nutritional risk (2-8), severely malnourished (≥9). The higher the score, the more serious the nutritional problems and the worse the nutritional status. The PG-SGA score had a sensitivity of 98% and a specificity of 82% at predicting SGA classification (Yingying et al., 2013).

6. The Family APGAR (Smilkstein, 1978) is a five-item measure of satisfaction with the functional status of one's Family. Each item is rated on a three-point scale[0 (hardly ever), 2 (almost always)] and higher scores reflect greater

satisfaction with family function: good function (7-10), moderate dysfunction (4-6), high dysfunction (0-3). The Family APGAR has been found to be a reliable tool when used on patients with cancer, with an alpha coefficient of .88 reported in a study of bone marrow transplant survivors (Hacker, 2001).

Psychometric properties of the instruments

Validity

All the research instruments used in this study were Chinese versions, and since all the research instruments are widely used instruments and their validity has been established, their validity was not tested.

Reliability

A pilot study had been conducted on 30 adolescents with cancer recruited from the Second Affiliated Hospital of Wenzhou Medical University and Yuying Children's Hospital. These participants had shared demographic and clinical characteristics with the target population of the main study but had not been included in the final cohort. Cronbach's Alpha was used to test the reliability of the questionnaire. Cronbach's α coefficients for each dimension were as follows: Cronbach's α coefficient of the Piper Fatigue Scale-Revised (PFS-R) part was .973, and the Hamilton Anxiety Rating Scale (HAM-A) part was .804, Pittsburgh the Sleep Quality Index (PSQI) was .829. The results show that the three scales have good internal consistency and high correlation among items, which are suitable for research evaluation. PG-SGA is a clinical nutritional screening tool characterized by multidimensional and semi-structured, containing subjective reports and objective indicators instead of psychometric scales in the traditional sense, without the need to calculate Cronbach's α. The Cronbach's α of the Chinese version of Family APGAR was 0.673, which did not reach the ideal level, probably due to the small number of items and insufficient sample size.

Protection of Human subjects

This study was approved by the Institutional Review Board (IRB) of Buarapa University (ID#G-HS056/2565(C3)) and the Research Ethics Committee of the Second Affiliated Hospital of Wenzhou Medical University and Yuying Children's

Hospital (ID#2022-K-131-02). The purpose of the study was explained to the adolescent participants and their parents (or directly to the young adult participants). Written informed consent was obtained from parents of adolescents younger than 18 years of age, and young adults (≥18 years of age) signed their own consent form. This process ensures compliance with the principle of bioethical autonomy. Confidentiality and privacy of all collected data are strictly maintained. Participants have been informed both verbally and in writing of their right to refuse to participate or withdraw from the study at any time without penalty.

Data collection procedures

AYA had been recruited from hospitalized patients at the Second Affiliated Hospital of Wenzhou Medical University and Yuying Children's Hospital between November 2022 and November 2024. Eligible participants had been identified on the first or second day of admission, prior to the initiation of chemotherapy. Each adolescent (along with their caregiver) or young adult who had agreed to participate had received and signed an informed consent form and completed the corresponding questionnaire. Investigators randomly selected three to five eligible participants daily from 9:00 a.m. to 12:00 a.m. until the target sample size had been reached. To minimize fatigue and avoid morning sessions or siesta periods, participants had been asked to complete the questionnaire in the afternoon or evening. The questionnaire had been available in both paper and electronic formats, and segmented testing had been permitted to reduce respondent burden. The research team provided detailed instructions on how to complete the questionnaire and emphasized key considerations to minimize bias. Participants had completed the questionnaire independently in a quiet, private environment within the hospital's reception room. The data collection process took approximately 40 to 50 minutes per participant. After each survey, the data collected was reviewed and entered by the researcher until the sample size was reached.

Data analysis

In this study, computer software had been used to analyze data, with the significance level set at .05. Descriptive statistics had been employed to summarize demographic data and the mean and standard deviations of Piper Fatigue Scale Revised (PFS-R) scores for adolescents and young adults receiving chemotherapy. Multiple regression analysis had been conducted to examine the relationships between sleep quality, anxiety, family functions, nutritional status, and fatigue among AYAs undergoing cancer chemotherapy in Wenzhou, China. Prior to the analysis, all assumptions of regression had been tested and confirmed.

CHAPTER 4
RESULTS

This chapter presents the study's findings including a description of the sample's demographic characteristics, a description of the variables studied, and the factors associated with fatigue during chemotherapy using Pearson correlation analysis and multiple linear regression in adolescents and young adults in Wenzhou, China.

Demographic characteristics and health information

A total of 188 participants were recruited, of which 12 participants dropped out of the study midway because the questionnaire was too long. A total of 171 questionnaires were completed. There were more females than males, with females (61.40%) and males (38.60%). The age groups of participants were mainly 15-18 years old and 26-30 years old, with 40.35% 15-18 years old and 51.46% 26-30 years old. Most of them were Han nationality, accounting for 94.15%. Their education background was junior high school or above, accounting for 45.61%. Most of them were unmarried (58.48%) and lived in cities (76.61%). The occupations were mainly students (43.27%) and unemployed (23.39%). Most of the participants (94.74%) lived with family members, 33.33% of the families had a monthly income of more than 10,000 yuan, and most of the participants had medical insurance (97.66%). The demographic characteristics of the participants are shown in Table 1.

Table 1 Description of demographic characteristics of the participants（n=171）

Variables	Number (*n*)	Percentage (%)
Gender		
Males	66	38.60
Females	105	61.40
Age (year) (Range =15-30, mean =22.94, SD =6.38)		
15-18	69	40.35
19-25	14	8.19
26-30	88	51.46
Ethnicity		
Han	161	94.15
Minority	10	5.85
Education Background		
Junior High School and Below	78	45.61
High School/Vocational High School/ Technical Secondary School	50	29.24
College/Undergraduate	40	23.39
Master's Degree and Above	3	1.76
Marital status		
Unmarried	100	58.48
Married	62	36.26
Divorce	6	3.51
Widowed	3	1.75
Residence		
Urban area	131	76.61
Rural area	40	23.39
Occupations		
Worker	32	18.13
Farmer	2	1.17
Personnel of Enterprises and Institutions	13	7.60
Civil servants or managers	1	0.58
Self-employed	3	1.75
Freelancer	6	3.51
Unemployed	40	23.39
Students	74	43.27
Family members		
Live alone	9	5.26
Not living alone	162	94.74
Family Monthly income (RMB)		
< 1000	1	0.58
1000 - 2999	3	1.75
3,000 - 4999	34	19.88
5,000 - 9999	40	23.39
≥10,000	57	33.33
Don't know	36	21.05

Table 1 (Continued)

Variables	Number (*n*)	Percentage (%)
Medical insurance		
Urban employee medical insurance	38	22.22
Urban resident medical insurance	88	51.46
New rural cooperative medical insurance	37	21.64
Other medical insurance	4	2.34
No medical insurance	4	2.34

Health information of the participants

Table 2 lists the health information of the participants: Most participants (60.23%) had normal body mass index (BMI), the largest number had hematologic cancers (39.77%), 103 participants had high-risk disease (60.23%), and more than half had undergone surgery before chemotherapy (61.99%). Most participants were currently receiving intensive cycles of (28.65%) or adjuvant therapy (23.98%). Most of the participants were hospitalized for less than one week (69.01%), and the diagnosis time was less than six months (65.50%).

Table 2 Health Information of the Participants (n = 171)

Variables	Number (*n*)	Percentage (%)
BMI Kg/m^2 (Range =12.5-31.2, mean =20.97, SD =3.82)		
<18.5	46	26.90
18.5-25	103	60.23
> 25	30	17.54
Types of cancer		
Hematologic Cancers	68	39.77
Gastrointestinal Cancers	38	22.22
Breast Cancer	25	14.62
Cancers of the Reproductive System	12	7.02
Lung Cancer	6	3.51
Other	22	12.87
Cancer Risk		
Low Risk	10	5.85
Intermediate Risk	58	33.92
High Risk	103	60.23

Table 2 (Continued)

Variables	Number (*n*)	Percentage (%)
Surgery		
Yes	106	61.99
No	65	38.01
Current Chemotherapy Cycle		
Intensive Chemotherapy	49	28.65
Consolidation Therapy	31	18.13
Salvage Chemotherapy	20	11.70
Multimodal Therapy	29	16.96
Adjuvant Therapy	41	23.98
Neoadjuvant Chemotherapy	1	0.58
Hospitalization Period (Day) (Range =1-42, mean =5.61, SD =7.22)		
<7	118	69.01
7-14	21	12.28
> 14	32	18.71
Time of Diagnosis (Month) (Range =1-40 mean = 6.18, SD =7.11)		
< 6	112	65.50
6 - 12	35	20.47
>12	24	14.04

Demographic characteristics of family caregivers

As shown in Table 3, the age of family caregivers was mainly 30-39 years old (45.03%). Most of them (55.55%) were mothers. Most of the family caregivers were married (95.91%), no religious belief (81.29%), and on-the-job (50.29%). They had high school education (36.84%) and college education (35.09%).

Table 3 Demographic Characteristics of family Caregivers (n=171)

Variables	Number (*n*)	Percentage (%)
Age (year) (Range =20-58, mean =38.24, SD =8.21)		
20-29	18	10.53
30-39	77	45.03
40-49	51	29.82
≥50	25	14.62
Relationship with participants		
Brother or sister	4	2.34
Spouse	58	33.92
Mother	95	55.55
Father	8	4.68
Other	6	3.51
Marital status		
Unmarried	2	1.17
Married	164	95.91
Divorce	2	1.17
Widowed	3	1.75
Education Background		
Junior high school and below	47	27.49
High school/vocational high school/ technical secondary school	63	36.84
College/undergraduate	60	35.09
Master's degree and above	1	0.58
Occupation		
On-the-job	86	50.29
Laid off/waiting for a job	73	41.69
Farming	12	7.02
Religion		
Christianity	16	9.36
Buddhism	10	5.85
Daoism	6	3.51
No religion	139	81.29

Description of the study variables

A total of 171 participants reported fatigue, accounting for 97.1% of the total sample size. The level of fatigue in this study included 4 dimensions, namely Behavioral/Severity and Affective Meaning, Sensory, Cognitive/Mood. As shown in Table 4, the overall mean level of fatigue was 6.0 (SD=0.81). The mean level of Behavioral/Severity scale was 6.2 (SD=0.89). The mean score of Affective Meaning scale was 5.9 (SD=0.94). The mean score of the Sensory scale was 5.8 (SD=0.78). The mean score of Cognitive/Mood scale was 6.1 (SD = 0.93).

Table 4 Description of the fatigue（n=171）

Variable/Dimensions	Range of scores		Total score		Standardized score		Level
	Possible score	Actual score	Mean	SD	Mean	SD	
Fatigue	0-220	63-162	125.92	17.05	6.0	0.81	
Behavioral/Severity	0-60	17-40	31.43	4.59	6.2	0.89	
Affective Meaning	0-50	13-39	30.56	4.67	6.1	0.93	Moderate
Sensory	0-60	18-44	34.61	4.69	5.8	0.78	
Cognitive/Mood	0-50	15-41	29.32	4.72	5.9	0.94	

Description of selected factors

Factors associated with fatigue included anxiety, sleep quality, nutritional status, and family function, as shown in Table 5. Table 5 shows that anxiety level scores ranged from 12 to 34 with a mean of 21.00 (SD = 3.73). The total score of sleep quality was 4-19, with an average of 11.26 (SD = 3.10). The mean nutritional status score was 8.46 (SD=2.65), ranging from 0 to 9. The family function score was 0-10, with an average score of 5.55 (SD=1.85).

Table 5 Description of selected factors of fatigue among AYA (n=171)

Variables	Possible range	Actual range	Mean	SD	Level
Anxiety	0-56	12-34	21.00	3.73	Severe
Sleep quality	0-21	4-19	11.26	3.10	Poor
Nutritional status	0-12	0-9	8.46	2.65	Moderate
Family function	0-10	0-10	5.55	1.85	Moderate

Correlation analysis of fatigue with anxiety, sleep quality, nutritional status and family function

Kurtosis and skewness were used to test for normal distribution. The kurtosis and skewness of fatigue, anxiety, nutritional status, sleep quality, and family function ranged from (-1.96) to (+1.96), which was consistent with the normal distribution. Pearson correlation coefficient was used for analysis, as shown in Table 6. Multivariate linear regression was used to analyze the relationship between the four

variables and fatigue, which were shown in table 7.

The correlation between variables showed that there was no correlation between family function and sleep quality or nutritional status (p >.01). Family function was negatively correlated with fatigue (r= -.193, p <.05) and anxiety (r = -.247, p <.01). Fatigue was positively correlated with anxiety (r = .726, p <.01), sleep quality (r = .559, p <.01), and nutritional status (r = .578, p <.01). Sleep quality was positively correlated with anxiety (r = .474, p <.01) and nutritional status (r = .374, p <.01). There was a positive correlation between anxiety and nutritional status (r = .451, p <.01).

Table 6 Correlation matrix between factors and fatigue among AYA (n=171)

Variables	Fatigue	Anxiety	Sleep Quality	Nutritional status	Family function
Fatigue	1	.726**	.559**	.578**	-.193*
Anxiety		1	.474**	.451**	-.247**
Sleep Quality			1	.374**	.09
Nutritional status				1	-.065
Family function					1

Note: **p < .05, **p < .01*

Factors predicting fatigue

Prior to analysis, the assumptions of the multiple regression tests were tested. The dependent variable was multivariate. The Durbin-Watson statistic was 1.580, indicating that the observed values/independent variables were independent of each other. Variance inflation factor (VIF) was used to test multicollinearity among independent variables. All VIFs < 10 indicate a well-constructed model. The ratio of the independent variable to the log is linear. Anxiety (VIF = 1.613), sleep quality (VIF = 1.426), nutritional status (VIF = 1.309), and family function (VIF = 1.132). "All VIF values were < 5, indicating that all variables had no severe multicollinearity, no outliers, and significant homoscedastic test results (p <.001)."

Table 7 presents the results of the multiple regression analysis. An α <.05 was considered statistically significant. Multiple linear regression analysis showed that the regression equation was significant, F =76.509, p <.001. Anxiety (β =.468, p <.001), nutritional status (β =.271, p <.001), and sleep quality (β =.243, p <.001) had significant positive predictive effects on fatigue. Family function (β = -.082, p >.05) did not predict fatigue level. Together, these variables explained 64.80% of the variance in fatigue among the participants.

Table 7 Multiple linear regression analysis 8(n=171)

Factors	B	SE	**β**	t	p-value
Anxiety	.102	.013	.468	8.011	<.001
Sleep Quality	.064	.015	.243	4.420	<.001
Nutritional status	.084	.016	.271	5.149	<.001
Family function	-.036	.022	-.082	-1.675	.096

R = .805, R^2 = .648, Adjusted R^2= .640, P-value < .05, Constant value = .4896

CHAPTER 5
CONCLUSION AND DISCUSSION

This study aims to investigate the incidence of fatigue during chemotherapy among adolescents and young adults (AYA) and to explore the factors influencing fatigue, including anxiety, sleep quality, nutritional status, and family function. This chapter summarizes and discusses the findings, draws conclusions, highlights implications for nursing practice, and provides recommendations for future research.

Summary of the study

This study aimed to assess fatigue levels during chemotherapy among AYA and to examine the predictive relationships between fatigue and factors such as anxiety levels, sleep quality, nutritional status, and family function A simple random sampling method was employed to collect data from inpatients in the Department of Pediatric Hematology, Adult Hematology, Oncology and Radiotherapy, Chemotherapy, Breast Surgery, and other departments at the Second Affiliated Hospital of Wenzhou Medical University. Data was collected using a self-administered questionnaire, which included sections on demographic information, fatigue levels, anxiety levels, sleep quality, nutritional status, and family function.

The results indicated that the participants' ages were primarily concentrated in two groups: 15–18 years old and 26–30 years old. Females outnumbered males of the sample. In terms of educational background, the majority had completed junior high school or less. Most participants were married and resided in urban areas. Additionally, most of the participants lived with their families. Regarding health-related characteristics, most participants had a normal body mass index (BMI). Hematologic cancers were the most common diagnosis, and more than half of the participants were classified as having high-risk disease. More than half had undergone surgery prior to chemotherapy. In terms of treatment, most participants were currently receiving either an intensive cycle or an adjuvant cycle. The majority had been hospitalized for less than one week and had been diagnosed for less than six months.

A total of 171 participants reported experiencing fatigue. The overall mean fatigue level was moderate. Among these participants, one in three reported chronic

fatigue lasting more than six months.

Results showed that anxiety, sleep quality, nutritional status, and family function together explained 64.8% of the variance in fatigue in AYA with cancer ($F = 76.509$, $p<.001$). Because fatigue as a dependent variable is affected by many factors, this independent variable can explain 64.8% of fatigue, but the significance of the independent variable of family function is low, so the adjusted $R^2=.640$ is relatively low. AYA anxiety, sleep quality, and nutritional status could significantly and positively predict AYA fatigue. AYA family function did not predict AYA fatigue. According to Pearson correlation coefficient analysis, AYA anxiety, sleep quality, nutritional status and fatigue were significantly positively correlated. Family function was negatively correlated with fatigue.

Discussion

Fatigue during chemotherapy in AYA with cancer

Fatigue is one of the most reported symptoms among patients with cancer. While numerous studies have focused on fatigue in elderly patients with cancer, limited research in China has addressed fatigue in AYA with cancer. This study revealed that AYA with cancer in Wenzhou, China, experienced varying degrees of fatigue during chemotherapy, consistent with findings from other studies. For instance, a study on symptom distress among patients with cancer aged 10–18 years in China found that 30.6% of participants with high levels of symptom distress and 69.4% with low levels of symptom distress reported significant fatigue (Yanyan et al., 2023) .Among adults, the incidence of fatigue was 92.1% in colorectal patients with cancer (Xiujuan, 2019), the incidence of fatigue in lymphoma patients was 80.5% (Wuping et al., 2019), 80.5% in lymphoma patients (Lipin, 2025). A Canadian study showed that 59% of AYA reported moderate to severe fatigue (Gupta et al., 2023).

The mechanism of fatigue in patients with cancer during chemotherapy is complex and usually involves the comprehensive effect of multiple factors. Direct damage to normal cells by chemotherapy triggers insufficient oxygen transport and abnormal energy metabolism (Akman et al., 2021). Chemotherapy also activates the immune system and releases a large number of pro-inflammatory factors (such as TNF-α, IL-6, IL-1β), which act on the central nervous system through the blood-brain

barrier and interfere with the balance of neurotransmitters, directly causing fatigue and depressed mood (Was et al., 2022). Chemotherapeutic agents may damage mitochondria, resulting in decreased ATP production and inadequate cellular energy supply. It also interferes with the hypothalamic-pituitary-adrenal axis, leading to abnormal cortisol secretion and affecting the body's stress response and energy regulation (Yang et al., 2019).

In a cohort study, researchers found significant associations between fatigue and cytokines (TNF-α, MCP-4, IL-15) in younger adults($p < .01$) but not in older adults (Alibhai et al., 2020).This may account for the differences in reported fatigue between AYA and older adults. In addition, in contrast to older individuals, AYA must simultaneously deal with their illness and the emotional, social, and professional development of the watershed that is critical to building their adult lives (Sanford et al., 2014).This burden may exacerbate fatigue. As reported in a multicenter longitudinal study, AYA reported increased emotional distress (Kwak et al., 2013).

Influencing factors of fatigue during chemotherapy among AYA

Anxiety

The results demonstrated that anxiety levels in AYA patients during chemotherapy significantly predicted fatigue. This finding is consistent with studies involving patients with colorectal cancer, which reported that patients with significant anxiety symptoms experienced greater fatigue ($\beta = .73$, $p < .05$) (Renna et al., 2022). One possible explanation is that anxiety increases cognitive burden, as persistent worry consumes substantial psychological resources, leading to Cognitive fatigue (Hockey, 2011). Additionally, anxiety can interfere with working memory and attention allocation, making it more challenging to concentrate on daily activities and thereby exacerbating feelings of fatigue. Anxiety is often accompanied by persistent negative emotions, such as fear, helplessness, and hopelessness, which drain psychological energy. According to the Emotion Regulation Theory (Gross, 1999), individuals need to expend additional emotional regulation efforts to manage anxiety, and the long-term accumulation of these efforts can lead to emotional exhaustion, further increasing fatigue. While anxiety is frequently studied alongside depression in relation to fatigue, some scholars argue that anxiety and depression are interrelated,

with anxiety sometimes being overshadowed by depression, and depression representing a progression of anxiety (Izard, 2013). However, other studies have identified anxiety as an independent factor with a distinct association with fatigue (Huang et al., 2022). From a physiological perspective, anxiety activates the sympathetic nervous system, triggering the release of stress hormones such as cortisol and adrenaline (Chu et al., 2025).

Sleep quality

The results indicated that sleep quality predicted fatigue. This finding is consistent with a study conducted in Iran, which reported that the average sleep quality score of patients with cancer was a positive predictor of fatigue.(β =.54,$p <$ 0.001) (Momayyezi et al., 2021). Similarly, a study in China confirmed a positive prediction between sleep quality and fatigue in patients with breast cancer (β =.414, $p < 0.001$) (Huang et al., 2021).

Sleep is a critical process for physical and cognitive recovery. Poor sleep quality directly impairs the body's ability to recover, both physically and psychologically. Deep sleep, particularly slow-wave sleep, plays a vital role in energy restoration and immune system function. Reduced sleep quality decreases the time spent in deep sleep (Desai et al., 2024), leading to insufficient physical recovery and increased daytime fatigue. Additionally, poor sleep quality negatively affects cognitive functions such as attention, memory, and decision-making (Khan & Al-Jahdali, 2023). These cognitive impairments can exacerbate feelings of fatigue, particularly during tasks requiring high levels of concentration. Furthermore, decreased sleep quality disrupts emotional regulation, contributing to increased negative emotions such as anxiety and depression (Tomaso et al., 2021). These emotions can further intensify fatigue, creating a vicious cycle. Prolonged activation of this state can result in physical fatigue. Furthermore, anxiety is a leading cause of sleep disturbances. Sleep deprivation directly impairs the body's ability to recover (Trill, 2013), leading to increased daytime fatigue. This relationship is further supported by Korean scholars who found a significant correlation between anxiety and sleep disturbances (β =.26, $p <.001$) (Cho & Hwang, 2021). Studies have shown that improving sleep quality can alleviate fatigue, and patients with cancer may benefit from interventions aimed at regulating sleep patterns and optimizing sleep

quality. A randomized controlled trial in 36 patients with breast cancer showed that melatonin for insomnia significantly improved sleep quality and reduced fatigue levels compared with controls ($p < .001$) (Palmer et al., 2020).

Nutritional status

The results demonstrated that nutritional status could predict fatigue in AYA. This finding aligns with a study of colorectal patients with cancer, Patients with cancer frequently experience malnutrition or nutritional imbalance during chemotherapy, thereby exacerbating fatigue($\beta = .98$, $p < .001$) (Sharour, 2020) . AYA are particularly vulnerable due to their higher nutritional requirements compared to middle-aged and elderly individuals. AYA has a higher basal metabolic rate and requires an increased intake of protein, water, and trace elements to meet their physiological needs(Love et al., 2013). Malnutrition disrupts energy metabolism, leading to an inadequate energy supply. Protein-energy malnutrition, in particular, reduces muscle mass and strength, contributing to fatigue (Alberda et al., 2006). Muscle loss caused by insufficient physical activity and inadequate protein intake significantly impairs mobility and exacerbates behavioral fatigue in patients with cancer. A study of outpatients with cancer confirmed nutritional status as a positive predictor of fatigue ($\beta = 0.306$, $p < .001$) (Schulz et al., 2017). Malnutrition also affects the synthesis and function of neurotransmitters, thereby influencing central nervous system function. For example, tryptophan, a precursor of serotonin—a neurotransmitter associated with mood and fatigue—is often deficient in malnourished patients (Schlemmer et al., 2015). Low tryptophan levels lead to reduced serotonin production, which can trigger fatigue. Research has shown that malnutrition reduces the activity of natural killer (NK) cells and T-cells, which are critical for immune surveillance. This immune suppression can lead to increased fatigue and susceptibility to infections (Maggini et al., 2018). A randomized controlled trial of 150 patients with cancer demonstrated that nutritional counseling and supplementation significantly improved nutritional status and reduced fatigue levels compared to a control group ($p < .001$) (Kim et al., 2019). Another study found that a 12-week dietary intervention improved nutritional status and reduced fatigue in 100 survivors with cancer ($p < .01$) (Zick et al., 2017).

Family function

This study confirmed that family function was not a predictor of fatigue. This result aligns with a study, which also reported no significant association between family function and fatigue in AYA ($r = -.14$, $p > .05$) (Daniel et al., 2013). One possible explanation for these findings lies in Piper's Integrated Fatigue Model, which posits that fatigue is perceived through three dimensions: psychological, physiological, and behavioral. Family function may primarily influence emotional fatigue, whereas physical fatigue, which is more prominent in patients with cancer, may show a weaker correlation with family function. In the present study, family function was a predictor of the Affective Meaning dimension of fatigue ($\beta = -.231$, $p < .01$), suggesting that family function may affect fatigue through other mediating variables, such as emotional well-being or quality of life. One study confirmed that family functioning indirectly affects fatigue by affecting quality of life ($p < .001$) (Huang et al., 2013). Research has shown that poor family functioning increases the risk of anxiety and depression, which in turn exacerbates fatigue in patients with cancer (Grassi et al., 2023). Additionally, AYA represents a unique population that may rely more on peer support than family support. For adolescents, family support often manifests as direct care and management by parents, while young adults may prioritize emotional support and involvement in decision-making. In some theoretical models, spousal support is categorized as partner support, which combines elements of family support and peer support (Rothbaum et al., 2002; Sarason, 2013). This distinction may explain why family function's impact on fatigue varies depending on the patient's age and relationship dynamics.

When participants were stratified as adolescent and young adults, family function was a negatively correlated predictor of fatigue. This suggests that the relationship between family function and fatigue may be influenced by developmental stage and individual perceptions of support. According to the Stress Cognitive Appraisal Theory (Lazarus & Folkman, 1984), the impact of family function on fatigue may be moderated by cognitive appraisal. For instance, if patients perceive family support as "excessive control," it may trigger psychological resistance and exacerbate fatigue. AYA, who are in the autonomy-dependence conflict stage (Orenstein & Lewis, 2025), may exhibit ambivalent attitudes toward family support. Some patients may deliberately minimize family assistance to assert independence,

potentially creating a disconnect between family function scores and the actual support received.

The results demonstrated that anxiety, sleep quality, and nutritional status were significant predictors of fatigue during chemotherapy in the AYA. These findings align with and support the Piper Fatigue Model, which defines fatigue as "a subjective, multidimensional experience involving the depletion of physical, emotional, cognitive, and social functioning." In the context of the Piper model, anxiety, sleep quality, and nutritional status correspond to factors such as energy and energy matrix changes, activity/rest patterns, sleep/wake cycles, symptom management, and psychological well-being.

The study revealed that anxiety, nutritional status, sleep quality, and family function collectively explained 64.8% of the variance in fatigue among AYA patients undergoing chemotherapy. An adjusted R^2 value greater than 10% indicates that the model provides a relatively strong explanation of the data, underscoring the importance of these variables in understanding fatigue in this population.

Strengths and Limitations

This study primarily described the level of fatigue among AYA undergoing chemotherapy in Wenzhou, China, and explored the predictive relationships between fatigue and variables such as anxiety, nutritional status, sleep quality, and family functioning. In China, most research on cancer-related fatigue has focused on older patients, with limited attention given to the AYA population. This group is often underrepresented in cancer research, despite the unique challenges they face during a critical stage of physical and mental development, such as identity crises, career interruptions, and educational disruptions, which may uniquely influence the mechanisms of fatigue.

This study incorporated psychological patterns(anxiety), changes in energy and energy substrate patterns (nutritional status), sleep/wake patterns (sleep quality), and social patterns (family function), aligning with the Piper Integrated Model to avoid single-dimensional interpretation bias. By moving beyond the traditional biomedical framework, this study considered family function as a core variable of social patterns, which is particularly relevant in the context of China's family-centered

cultural background. These findings contribute to filling the research gap on fatigue in AYA with cancer in Eastern China and support the development of age-stratified care strategies.

However, this study has several limitations. As a single-center study with a relatively small sample size, the findings may not be representative of the broader AYA population in China. The limited sample size may also reduce statistical power, potentially affecting the generalizability of the results. Additionally, the cross-sectional design precludes the establishment of causal relationships between the studied variables. Future research should consider multicenter, longitudinal studies with larger sample sizes to validate these findings and explore causal mechanisms.

Implications for nursing

Nursing practice

The results of this study provide a valuable foundation for predicting fatigue during chemotherapy in AYA with cancer. Based on these findings, healthcare providers, particularly nursing staff, can identify individuals at higher risk of fatigue by screening for anxiety levels, sleep disturbances, malnutrition, and family dysfunction. This proactive approach enables the development of early intervention programs tailored to the dominant factors contributing to fatigue in each patient. The findings also underscore the importance of interdisciplinary collaboration among nursing teams, psychologists, nutritionists, sleep specialists, and social workers. By addressing key factors such as anxiety, sleep quality, nutritional status, and family function early in the treatment process, healthcare providers can reduce the incidence of severe fatigue. This, in turn, may lower the risk of treatment interruptions and improve overall treatment outcomes for AYA with cancer.

Nursing research

AYA are in a critical period of physiological development and psychosocial transformation. The mechanisms underlying chemotherapy-induced fatigue in AYA patients may differ from those in children or older adults due to unique developmental challenges, such as heightened sensitivity to self-image and social isolation. This study addresses a significant research gap by exploring the factors influencing fatigue in this subgroup, providing a foundation for future comparative studies (e.g., AYA vs.

other age groups) and establishing baseline data for further investigation. This study also validates the applicability of the Piper Fatigue Model in the AYA population. By confirming the interaction of anxiety (Cognitive/Emotional dimension), sleep quality (Behavioral/Severity dimension), and nutritional status (Sensory dimension) on fatigue, the findings expand the theoretical boundaries of the model. Specifically, they highlight the unique pathways through which developmental stage-specific factors influence fatigue in AYA. Furthermore, the quantitative analysis of each factor's contribution to fatigue reveals the core drivers of fatigue in this population. This insight can guide future intervention research by prioritizing high-impact areas, thereby optimizing the allocation of resources and enhancing the effectiveness of fatigue management strategies.

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APPENDIX

APPENDIX A

Questionaire

Questionnaires

Fatigue and influencing factors in adolescents and young adults with cancer during chemotherapy

The questionnaires include 6 parts as follows:

Part 1. The Demographic data questionnaire with 16 items

Part 2. The Chinese version of Piper Fatigue Scale (PFS) with 27 items.

Part 3. The Chinese version of Pittsburg Sleep Quality Index (PSQI) with 24 items.

Part 4. The Chinese version of Hamliton Anxiety Rating Scale (HAM-A) with 14 items.

Part 5. The Chinese version of Scored Patient-Generated Subjective Global Assessment (PG-SGA) with four text boxes

Part 6. The Chinese version of Famliy APGAR with 5 items.

Please read each question carefully and then choose the answer that you think is suitable for your conditions.

Dear participants,

I am Miss Zhizhi Jin, a student in Master of Nursing Science (International Program) Faculty of Nursing, Burapha University Thailand. My study is “Fatigue and influencing factors in adolescents and young adults with cancer during chemotherapy”. The objective is to describe fatigue in adolescent and young adult cancer patients undergoing chemotherapy. They examined the relationship between nutrition, sleep quality, anxiety and family support and fatigue. Cancer is a major public health problem facing the world. More adolescents and young adults are suffering from cancer than ever before, but there is less attention paid to this population. The pain this population suffers during chemotherapy is also underappreciated, and fatigue, one of the most painful conditions, needs more attention. Therefore, to better understand fatigue and its influencing factors during chemotherapy in adolescents and young adults with cancer, we will conduct relevant investigations. Now, you need to fill out six questionnaires, which will take 30-50 minutes of your precious time. These questionnaires include:

1. The Demographic data questionnaire
2. The Chinese version of Piper Fatigue Scale Revised (PFS-R)
3. The Chinese version of Pittsburg Sleep Quality Index (PSQI)
4. The Chinese version of Hamliton Anxiety Rating Scale (HAM-A)
5. The Chinese version of Scored Patient-Generated Subjective Global Assessment (PG-SGA)
6. The Chinese version of Famliy APGAR

Zhizhi Jin
Master’s degree student
Adult Nursing Pathway
Faculty of Nursing, Burapha University, Thailand in collaboration with
School of Nursing, Wenzhou Medical University, China

第 1 部分：人口统计学数据记录表格

Part 1: The Demographic data record form

1. 登记号 Registration No.____

2. 年龄 Your age is:

3. 性别 Gender: □ Male（男） □ Female（女）

4. 民族 Your nationality:

□Han （汉）

□Minority （少数民族）

5.婚姻状况 Your marital status:

□ Unmarried (未婚)

□ Married （已婚）

□ Divorced （离婚）

□ Widowed （丧偶）

□ Others（其他）

6.教育水平 Your education level:

□ junior high school and below（初中及以下学历）

□ high school/vocational high school/ technical secondary school（高中/职业高中/技术中学）

□ college/undergraduate （本科/专科）

□ master's degree and above（研究生及以上）

7.居住地 Your place of residence:

□rural （农村）

□urban （城市）

8.就业情况 Your current working status:

□ on-the-job （在职）

□ students（学生）

□ laid off/waiting for a job （待业）

□ farming（务农）

9. 职业 Your occupation:

□ Worker （工人）

□ Farmer （农民）

□ Personnel of enterprises and institutions （企业、事业单位的人员）

□ Civil servants or managers（公务员或管理人员）

□ Self-employed （个体户）

□ Freelancer （自由职业）

□ Unemployed （失业）

□ Others（其他）

10.家庭成员 How many people in your family live together:

□ living alone （独居）

□ not living alone（合居）

11.家庭收入 The average monthly income of your family:

□＜1000 yuan

□1000～2999 yuan

□3000～4999 yuan

□5000～9999 yuan

□10000 yuan or more

□Don't know

10. 支付方式 Your type of medical insurance:

□Urban employee medical insurance （城镇职工医疗保险）

□Urban resident medical insurance （城镇居民医疗保险）

□New rural cooperative medical insurance （新型农村合作医疗保险）

□Other medical insurance （其他医疗保险）

□No medical insurance（无医疗保险）

健康信息 Health information

11.体重 Weight:　　Kg

12.身高 Height:　　cm

13.疾病种类 Type of cancer：

14.确诊时间 Duration of Cancer:……Years……Months

15.住院时长 Length of hospital stay…….

16. 恶性程度 Severity of illness:…….

17.化疗阶段 Phase or course of chemotherapy:……..

18.是否手术 surgery：□yes ☐no

19.既往史 Medical history…….

照护者信息 Caregiver information

20.关系 Caregiver status：□Mother ☐Father ☐……

21.年龄 Your age is:

22.婚姻状况 Your marital status:

□ Unmarried (未婚)

□ Married （已婚）

□ Divorced （离婚）

□ Widowed （丧偶）

□ Others（其他）

23.教育水平 Your education level:

□ junior high school and below （初中及以下学历）

□ high school/vocational high school/ technical secondary school （高中/职业高中/技术中学）

□ college/undergraduate （本科/专科）

□ master's degree and above（研究生及以上）

24.Disease situation（疾病史）…….

25.Religious（宗教信仰）…….

26.就业情况 Your current working status:

□ on-the-job（在职）

□ retired（退休）

□ laid off/waiting for a job （待业）

□ farming（务农）

第 2 部分：疲乏量表 （PFS-R）

Part 2: The Piper Fatigue Scale -Revised (PFS-R)

说明：许多人在生病、接受治疗或从疾病/治疗中恢复时，会有一种不寻常的或过度的疲劳感。这种不寻常的疲劳感通常不能通过一夜好眠或休息来缓解。有些人称这种症状为“疲乏”，以区别于通常的疲劳感。

Directions: Many individuals can experience a sense of unusual or excessive tiredness whenever they become ill, receive treatment, or recover from their illness/treatment. This unusual sense of tiredness is not usually relieved by either a good night's sleep or by rest. Some call this symptom "fatigue" to distinguish it from the usual sense of tiredness.

对于下面的每一个问题，请填写最能描述你现在或今天所经历的疲劳的回答所提供的空间。请尽最大努力回答每一个问题。如果你现在或今天没有感到疲劳，在圆圈中填写“0”表示你的回答。非常感谢！

For each of the following questions, please fill in the space provided for that response that best describes the fatigue you are experiencing now or for today. Please make every effort to answer each question to the best of your ability. If you are not experiencing fatigue now or for today, fill in the circle indicating "0" for your response. Thank you very much!

1.你感到疲劳有多久了？（只检查一个回复）
How long have you been feeling fatigued? (Check one response only).

1) not feeling fatigue
2) ……分钟Minutes
3) ……小时Hours
4) ……天 Days
5) ……星期 Weeks
6) ……月 Months
7) ……其他（请描述） Other (Please describe) ……..

2.你现在感到的疲劳使你苦恼到什么程度？ To what degree is the fatigue you are feeling now causing you distress?

没有痛苦No Distress									很多 A Great Deal
1	2	3	4	5	6	7	8	9	10

3. 你现在感到的疲劳在多大程度上影响了你完成工作或学校活动的能力？To what degree is the fatigue you are feeling now interfering with your ability to complete your work or school activities?

无 None 很多A Great Deal

1 2 3 4 5 6 7 8 9 10

4. 你现在感到的疲劳在多大程度上影响了你与朋友的社交能力？

To what degree is the fatigue you are feeling now interfering with your ability to socialize with your friends?

无 None 很多A Great Deal

1 2 3 4 5 6 7 8 9 10

5. 你现在感到的疲劳在多大程度上影响了你进行性活动的能力？To what degree is the fatigue you are feeling now interfering with your ability to engage in sexual activity?

无 None 很多A Great Deal

1 2 3 4 5 6 7 8 9 10

6. 总的来说，你现在经历的疲劳在多大程度上影响了你从事喜欢的活动的能力？Overall, how much is the fatigue which you are now experiencing interfering with your ability to engage in the kind of activities you enjoy doing?

无 None 很多 A Great Deal

1 2 3 4 5 6 7 8 9 10

7. 你如何描述你现在所经历的疲劳的强度和严重程度？How would you describe the degree of intensity or severity of the fatigue which you are experiencing now?

轻 Mild 重 Severe

1 2 3 4 5 6 7 8 9 10

8. 你认为你现在的疲劳程度如何？To what degree would you describe the fatigue which you are experiencing now as being?

愉快的Pleasant 不愉快的Unpleasant

1 2 3 4 5 6 7 8 9 10

9. 你认为你现在的疲劳程度如何？To what degree would you describe the fatigue which you are experiencing now as being?

可接受的 Agreeable 不可接受的 Disagreeable

1 2 3 4 5 6 7 8 9 10

10. 你认为你现在的疲劳程度如何？To what degree would you describe the fatigue which you are experiencing now as being?

无破坏性 Protective 有破坏性 Destructive

1 2 3 4 5 6 7 8 9 10

11. 你认为你现在的疲劳程度如何？To what degree would you describe the fatigue which you are experiencing now as being?

积极的Positive 消极的 Negative

1 2 3 4 5 6 7 8 9 10

12. 你认为你现在的疲劳程度是怎样的？To what degree would you describe the fatigue which you are experiencing now as being:

正常的 Normal 异常的 Abnomal

1 2 3 4 5 6 7 8 9 10

13.你现在感觉如何To what degree are you now feeling:

强壮 Strong 虚弱 Weak

1 2 3 4 5 6 7 8 9 10

14.你现在感觉如何To what degree are you now feeling:

清醒 Awake 困顿 Sleepy

1 2 3 4 5 6 7 8 9 10

15.你现在感觉如何To what degree are you now feeling:

活泼的 Lively 无精打采的 Listless

1 2 3 4 5 6 7 8 9 10

16.你现在感觉如何To what degree are you now feeling:

很有精神 Refreshed 累 Tired

1 2 3 4 5 6 7 8 9 10

17.你现在感觉如何To what degree are you now feeling:

有能量 Energetic 无力 Uunergetic

1 2 3 4 5 6 7 8 9 10

18.你现在感觉如何To what degree are you now feeling:

有耐心 Patient 没耐心 Impatient

1 2 3 4 5 6 7 8 9 10

19.你现在感觉如何To what degree are you now feeling:

放松 Relaxed 紧张 A Great Deal

1 2 3 4 5 6 7 8 9 10

20.你现在感觉如何To what degree are you now feeling:

兴奋的 Exhilarated 沮丧的 Depressed

1 2 3 4 5 6 7 8 9 10

21.你现在感觉如何To what degree are you now feeling:

能专注 Able to Concentrate 不能专注 Unable to Concentrate

1 2 3 4 5 6 7 8 9 10

22.你现在感觉如何To what degree are you now feeling:

记性好 Able to Remember 记性差 Unable to Remember

1 2 3 4 5 6 7 8 9 10

23.你现在感觉如何To what degree are you now feeling:

思路清晰 Able to Think Clearly 思路混乱 Unable to Think Clearly

1 2 3 4 5 6 7 8 9 10

24.总的来说，你认为是什么直接导致了你的疲劳？Overall, what do you believe is most directly contributing to or causing your fatigue?

_____

_____

_____

25.总的来说，你发现的缓解疲劳最好的方法是？Overall, the best thing you have found to relieve your fatigue is:

_____

_____

_____

26.你还有什么要补充的，可以更好地向我们描述你的疲劳吗？Is there anything else you would like to add that would describe your fatigue better to us?

_____

_____

_____

27.你现在还有其他症状吗？Are you experiencing any other symptoms right now?

_____

_____

_____

Part3.匹兹堡睡眠质量指数问卷

PITTSBURGH SLEEP QUALITY INDEX (PSQI)

说明：以下问题仅与你过去一个月的睡眠习惯有关。您的答案应表明最准确的答复，为大多数天和过去一个月的夜晚。请回答所有问题。

INSTRUCTIONS:The following questions relate to your usual sleep habits during the past month only.

Your answers should indicate the most accurate reply for the majority of days and nights in the past month. Please answer all questions.

1. 在过去的一个月里，你通常什么时候睡觉？

During the past month, when have you usually gone to bed at night?

通常的睡觉时间 USUAL BED TIME_____

2. 在过去的一个月里，你每天晚上通常要花多长时间（分钟）才能入睡？

During the past month, how long (in minutes) has it usually take you to fall asleep each night?

分钟数 NUMBER OF MINUTES _____

3.在过去的一个月里，你通常什么时候起床？

During the past month, when did you usually gotten up in the morning?

平常起床时间 USUAL GETTING UP TIME_____

4.在过去的一个月里，你晚上实际睡了多少个小时?

During the past month, how many hours of actual sleep did you get at night? (这可能和你躺在床上的时间不同。This may be different than the number of hours you spend in bed.)

每晚睡眠时间 HOURS OF SLEEP PER NIGHT_____

说明：对于每一个剩下的问题，检查一个最好的回答。

INSTRUCTIONS: For each of the remaining questions, check the one best response.

请回答所有问题

Please answer all questions.

5. 在过去的一个月里，你有多少次睡不好因为……

During the past month, how often have you had trouble sleeping because you...

	过去一个月没有 Not during the past month	一周不到一次 Less than once a week	一周一到两次 Once or twice a week	每周三次或更多 Three or more times a week
入睡困难（30 分钟内不能入睡） cannot get to sleep within 30 minutes	○	○	○	○
半夜或清晨醒来 wake up in the middle of the night or early morning	○	○	○	○
要起来上厕所 have to get up to use the bathroom	○	○	○	○
呼吸不舒服 cannot breathe comfortably	○	○	○	○
大声咳嗽或打鼾 cough or snore loudly	○	○	○	○
感觉太冷 feel too cold	○	○	○	○
感觉太热 feel too hot	○	○	○	○
做噩梦 had bad dreams	○	○	○	○
有疼痛 have pain	○	○	○	○

其他原因，请描述_____ Other reason(s), please describe_____	○	○	○		○
		非常好 Very good	一般 Fairly good	有点差 Fairly bad	很差 very bad
6.在过去的一个月里，你如何评价你的睡眠质量？During the past month, how would you rate your sleep quality overall?		○	○	○	○
		过去一个月没有 Not during the past month	一周不到一次 Less than once a week	一周一到两次 Once or twice a week	每周三次或更多 Three or more times a week
7.在过去的一个月里，你多久服用过帮助睡眠的药物（处方药或“非处方药”）？During the past month, how often have you taken medicine (prescribed or "over the counter") to help you sleep?		○	○	○	○
8.在过去的一个月里，你是否经常在开车、吃饭或参加社交活动时难以保持清醒？During the past month, how often have you had trouble staying awake while		○	○	○	○

driving,eating meals, or engaging in social activity?				
	不是问题 No problem at all	有一点问题 Only a very slight problem	有问题 Somewhat of a problem	问题很大 A very big problem
9.在过去的一个月里，对你来说，保持足够的热情去完成事情是一个多大的问题？During the past month, how much of a problem has it been for you to keep up enough enthusiasm to get things done?	○	○	○	○

Part4.焦虑量表

HAM-A

这里有一些短语，你可以用来描述你的某些感觉。通过寻找最能描述你有这些情况程度的答案来评估。在14个问题的5个答案中选择一个。

Here is a list of phrases you can use to describe certain feelings you have. Evaluate by finding answers that best describe the extent to which you have these conditions. Choose one of the five answers to the 14 questions.

0=不存在，1=轻度，2=中度，3=重度，4=非常重度。

0=Not present,1=Mild,2=Moderate,3=Severe,4=Very severe.

1.焦虑的情绪Anxious mood （0） （1） （2） （3） （4）

担心，对最坏情况的预期，恐惧的预期，易怒。Worries,anticipation of the worst,fearful anticipation,irritablilty.

2.张力Tension （0） （1） （2） （3） （4）

感觉紧张、疲劳、受惊反应、容易感动流泪、颤抖、烦躁不安、无法放松。Feelings of tension, fatigability,startle response,moved to tears easily,trembling,feelings of restlessness,inability to relax.

3.恐惧Fears （0） （1） （2） （3） （4）

黑暗、陌生人、孤独、动物、交通、人群。Of dark,of atrangers,of being left alone,of animals,of trafic,of crowds.

4.失眠Insomnia （0） （1） （2） （3） （4）

入睡困难，睡眠中断，睡眠不满意，醒来疲劳，做梦，噩梦，夜惊。

Difficulty in falling asleep,broken sleep,unsatisfying sleep and fatigue on waking,dreams,nightmares,night terrors.

5.知识Intellectual （0） （1） （2） （3） （4）

注意力不集中，记忆力差。Difficulty in concentration,poor memory.

6.抑郁情绪Depressed mood （0） （1） （2） （3） （4）

失去兴趣，缺乏兴趣爱好的乐趣，抑郁，早起，昼夜摇摆。Loss of interest,lack of pleasure in hobbies,depression,early waking,diurnal swing.

7.体细胞(肌肉)Somatic(muscular) （0） （1） （2） （3） （4） 疼痛，抽搐，僵硬，肌阵挛，磨牙，声音不稳定，肌张力增加。Pains and aches,twithing,stiffness,myoclonic jerks,grinding of teeth,unsteady voice,increased muscular tone.

8.体细胞(感官)Somatic(sensory) （0） （1） （2） （3） （4） 耳鸣，视物模糊，潮热潮冷，虚弱感，刺痛感。Tinnitus,blurring of vision,hot and cold flushes,feelings of weakness,pricking sensation.

9.心血管症状Cardiovascular symptoms （0） （1） （2） （3） （4）

心动过速，心悸，胸痛，血管搏动，晕厥感，心跳停止。Tachycardia, palpitations,pain in chest,throbbing of vessels,fainting feelings,missing beat.

10.呼吸道症状Respiratory symptoms （0） （1） （2） （3） （4）

胸部压迫或收缩，窒息感，叹气，呼吸困难。Pressure or constriction in chest,choking feelings,sighing,dyspnea.

11.胃肠道症状 Gastrontestinal symptoms （0） （1） （2） （3） （4）

吞咽困难，风腹痛，烧灼感，腹胀，恶心，呕吐，肠鸣，拉稀，体重下降，便秘。Difficulty in swallowing,wind abdominal pain, burning sensations,abdominal fullness,nausea,vomiting,borborygmi,looseness of bowels,loss of weight,constipation.

12.泌尿生殖器的症状Genitourinary symptoms （0） （1） （2） （3） （4）

尿频、尿急、闭经、月经过多、性冷淡、早泄、性欲减退、阳痿。Frequency of micturition, urgency of micturition, amenrrhea, menorrhagia, development of frigidity, premature ejaculation, loss of libido, impotence.

13.自主神经症状Autonomic symptoms （0） （1） （2） （3） （4）

口干、潮红、面色苍白、易出汗、头晕、紧张性头痛、毛发直立。Dry mouth,flushing,pallor,tendency to sweat,giddiness,tension headache,raising of hair.

14.面试时的行为Behavior at interview （0） （1） （2） （3） （4）

坐立不安、烦躁或踱步、双手震颤、眉头紧锁、面部紧张、叹气或急促复吸、面色苍白、吞咽等。Fidgeting, restlessness or pacing,tremor of hands,furrowed brow,strained face,sihging or rapid reapiration,facial pallor,swallowing,etc.

Part5.营养量表

Patient-Generated Subjective Global Assessment (PG-SGA)

1、体重变化 Changes IN WEIGHT

（1）已往及目前体重情形Past and current weight status：

我目前的体重约My current weight is t _____公斤kg, 我的身高约My height is _____公分cm ,

一个月前我的体重大约My weight a month ago _____公斤kg ；

六个月前我的体重大约 _____公斤cm

体重下降Weight loss ____ % ； 分值Score____

（≥ 10% 4 分； 5%-10% 3分； 3%-5% 2分； 2%-3% 1分； 1%-2% 0分；）

（2）在过去二个星期内，我的体重是呈现In the last two weeks, my weight is showing：□减少reduce（ 1） □没有改变No change（ 0） □增加Increase in（ 0）

2、饮食情况Dietary Profile ：（多选，选最高分Multiple choices, choose the highest score）

（1）过去几个月以来，我吃食物的量与以往相比For the past few months, I've been eating more than I used to：

□没有改变No change（ 0） □比以前多More than ever □比以前少Less than before（ 1）

（2）我现在只吃I just eat it now：

□比正常量少的一般食物Less than normal food（ 1）； □一点固体食物A little solid food（ 2）.

□只有流质饮食Only a liquid diet（ 3）； □只有营养补充品Only nutritional supplements（ 3）.

□非常少的任何食物 非常少的任何食物（ 4）；

□管灌喂食或由静脉注射营养Feeding by tube or by intravenous injection of nutrition （0）

3、症状Symptoms：（多选，累计加分Multiple choices, cumulative bonus points）

过去二个星期，我有下列的问题困扰，使我无法吃的足够For the past two weeks, I have had the following problems that have prevented me from eating enough：

□没有饮食方面的问题There were no dietary problems（0）

□没有食欲，就是不想吃No appetite, just don't want to eat（3）

□口干Dry mouth（1） □恶心Nausea（1） □呕吐Vomiting（3）

□便秘Constipation（1）

□腹泻Diarrhea（3） □口痛Sore mouth（2）

□容易饱胀Easy to fullness（1） □吞咽困难Difficulty swallowing（2）

□吃起来感觉没有味道，或味道变得奇怪Taste no taste, or taste strange（1）

□有怪味困扰着我 A strange smell bothers me（2）

□疼痛Pain（ 3）何处Where？_____ □其他Other（ 1）____

如：忧郁、牙齿、金钱方面等For example: depression, teeth, money, etc

4、身体状况Physical condition ：（单选，最符合项Single, best fit）

自我评估过去几个月来，身体状况处于Self-assessment of physical condition in the past few months：

□正常，没有任何限制Normal, no restrictions（0）

□与平常的我不同，但日常生活起居还能自我料理I am different from my normal self, but I can take care of myself in my daily life（1）

□感觉不舒服，但躺在床上的时间不会长于半天Feeling uncomfortable, but not lying in bed for more than half a day（2）

□只能做少数活动，大多数时间躺在床上或坐在椅子Only a few activities, most of the time lying in bed or sitting in a chair（3）

□绝大多数的时间躺在床上Most of the time lies in bed（3）

Part6.家庭关怀度问卷Family APGAR Questionnaire			
	几乎总是Almost always (2)	有时Some of the time (1)	几乎从来没有Hardly ever (0)
1. 当我遇到麻烦的时候 我很满意家人的帮助。I am satisfied with the help that I receive from my family when something is troubling me.			
2. 我很满意我的家人与我讨论共同感兴趣的问题和分享解决问题的方法。I am satisfied with the way my family discusses items of common interest and share problem solving with me.			
3.我发现我的家人接受了我的愿望，接受我参加新的活动或改变我的生活方式。 I find that my family accepts my wishes to take on new activities or make changes in my lifestyle.			
4. 我对我的家人表达爱的方式感到满意，并对我的感受（如愤怒、悲伤和爱）做出回应。I am satisfied with the way my family expresses affection and responds to my feelings such as anger, sorrow, and love.			
5. 我对我和家人在一起的时间很满意。I am satisfied with the amount of time my family and I spend together.			

APPENDIX B

IRB Approval

MHESI 8137/1597

Graduate School, Burapha University
169 Longhaad Bangsaen Rd.
Saensuk, Muang, Chonburi
Thailand, 20131

November 8th, 2022

To The director of the Second Affiliated Hospital of Wenzhou Medical University,

Enclosure: 1. Certificate ethics document of Burapha University
2. Research Instruments

On behalf of the Graduate School, Burapha University, I would like to request permission for Ms. Zhizhi Jin to collect data for conducting research.

Ms. Zhizhi Jin, ID 63910142, a graduate student of the Master of Nursing Science program (International Program) in Adult Nursing Pathway, Faculty of Nursing, Burapha University, Thailand, was approved her thesis proposal entitled: "Fatigue and its influencing factors in adolescents and young adults with cancer during chemotherapy" under supervision of Assist. Prof. Dr. Jinjutha Chaisena Dallas as the principle advisor. She proposes to collect data from 90 patients who aged 15 - 30 years old, and were diagnosed with malignant tumors in the Second Affiliated Hospital of Wenzhou Medical University.

The data collection will be carried out from November 20, 2022 to January 31, 2023. In this regard, you can contact Ms. Zhizhi Jin via mobile phone +86-1570-5776-913 or E-mail: 429096049@qq.com

Please do not hesitate to contact me if you need further relevant queries.

Sincerely yours,

(Assoc. Prof. Dr. Nujjaree Chaimongkol)
Dean of Graduate School, Burapha University

CC: Runping Wang
Hematology and Oncology Department

Graduate School Office
Tel: +66 3810 2700 ext. 701, 705, 707
E-mail: grd.buu@go.buu.ac.th
http://grd.buu.ac.th

MHESI 8137/1596

Graduate School, Burapha University
169 Longhaad Bangsaen Rd.
Saensuk, Muang, Chonburi
Thailand, 20131

November 8th, 2022

To The director of the First Affiliated Hospital of Wenzhou Medical University,

Enclosure: 1. Certificate ethics document of Burapha University
2. Research Instruments

On behalf of the Graduate School, Burapha University, I would like to request permission for Ms. Zhizhi Jin to collect data for conducting research.

Ms. Zhizhi Jin, ID 63910142, a graduate student of the Master of Nursing Science program (International Program) in Adult Nursing Pathway, Faculty of Nursing, Burapha University, Thailand, was approved her thesis proposal entitled: "Fatigue and its influencing factors in adolescents and young adults with cancer during chemotherapy" under supervision of Assist. Prof. Dr. Jinjutha Chaisena Dallas as the principle advisor. She proposes to collect data from 86 patients who aged 15 - 30 years old, and were diagnosed with malignant tumors in the First Affiliated Hospital of Wenzhou Medical University.

The data collection will be carried out from November 20, 2022 to January 31, 2023. In this regard, you can contact Ms. Zhizhi Jin via mobile phone +86-1570-5776-913 or E-mail: 429096049@qq.com

Please do not hesitate to contact me if you need further relevant queries.

Sincerely yours,

(Assoc. Prof. Dr. Nujjaree Chaimongkol)
Dean of Graduate School, Burapha University

CC: Wenrui Sun

Graduate School Office
Tel: +66 3810 2700 ext. 701, 705, 707
E-mail: grd.buu@go.buu.ac.th
http://grd.buu.ac.th

MHESI 8137/1595

Graduate School, Burapha University
169 Longhaad Bangsaen Rd.
Saensuk, Muang, Chonburi
Thailand, 20131

November 8th, 2022

To The director of the First Affiliated Hospital of Wenzhou Medical University,

Enclosure: 1. Certificate ethics document of Burapha University
2. Research Instruments (Try out)

On behalf of the Graduate School, Burapha University, I would like to request permission for Ms. Zhizhi Jin to collect data for testing the reliability of the research instruments.

Ms. Zhizhi Jin, ID 63910142, a graduate student of the Master of Nursing Science program (International Program) in Adult Nursing Pathway, Faculty of Nursing, Burapha University, Thailand, was approved her thesis proposal entitled: "Fatigue and its influencing factors in adolescents and young adults with cancer during chemotherapy" under supervision of Assist. Prof. Dr. Jinjutha Chaisena Dallas as the principle advisor. She proposes to collect data from 30 patients who aged 15 - 30 years old, and were diagnosed with malignant tumors in the First Affiliated Hospital of Wenzhou Medical University.

The data collection will be carried out from November 1 - 15, 2022. In this regard, you can contact Ms. Zhizhi Jin via mobile phone +86-1570-5776-913 or E-mail: 429096049@qq.com

Please do not hesitate to contact me if you need further relevant queries.

Sincerely yours,

(Assoc. Prof. Dr. Nujjaree Chaimongkol)
Dean of Graduate School, Burapha University

CC: Wenrui Sun

Graduate School Office
Tel: +66 3810 2700 ext. 701, 705, 707
E-mail: grd.buu@go.buu.ac.th
http://grd.buu.ac.th

Please type or write with readable hand writing

GRD-109 (Eng)
(Main study)

Graduate School Burapha University

Request form for issuing a requesting letter for data collection (Main Study)

To Dean of Graduate School

I am (Mr./Mrs./Ms.) Zhizhi Jin Student ID #……63910142……..

❑ Doctoral degree ❑ √Master degree - plan ○ A ○√ B Study type ○ √Full-time ○ Part-time

Program Master of Nursing Science (International Program) Major/Pathway...Adult Nursing...Faculty of Nursing

Telephone +8615705776913 E-mail 429096049@qq.com

Doctoral dissertation/ Master thesis/ IS **Title**: Fatigue and influencing factors in adolescents and young adults with cancer during chemotherapy

Principal advisor' name…Assistant Professor Dr.Jinjutha Chaisena Dallas….

I would like to request for issuing **a requesting letter for data collection (Main study)**:

By issuing to (name of the director of Institute/ University/ Organization)

1) Wenrui Sun, The First Affiliated hospitals of Wenzhou Medical University, Zhejiang Province, China 86 patients

2)Runping Wang,Hematology and Oncology Department,The Second Affiliated hospitals of Wenzhou Medical University, Zhejiang Province, China 90 patients

To collect data from (details of participants and sample size)…A total of 176 patients aged 15-30 years who were diagnosed with malignant tumors will included in the study. They will from the First Hospital and the Second Hospital of Wenzhou Medical University

Duration of data collection: from date……..20th November. .2022….to…31th January….2023……..

My contact information: # cellphone and E-mail .....+8615705776913 429096049@qq.com.....

With this request, I have enclosed documents…1..copies

1) A copy of proof of ethical approval from Burapha university, and
2) Research instruments

Please be informed accordingly,

Student's name ……*Zhizhi Jin*……

(……Ms Zhizhi Jin…….)

Date…31… Month……October…Year…2022……..

Principal advisor acknowledged	Dean of Faculty/College acknowledged	Dean of Graduate School approved
(Signed)…Jinjutha…… (Assist Prof. Dr.Jinjutha Chaisena Dallas) Date…Oct 31, 2022…	(Signed)…Pornchai…… (Assist. Prof. Dr. Pornchai Jullamate) Date…Oct 29, 2022…	(Signed)…Nj Chul…… (Assoc. Prof. Dr. Nujjaree Chaimongkol) Date…8 November 2022…

Please type or write with readable hand writing

GRD-109 (Eng)
(Try out)

Graduate School Burapha University

Request form for issuing a requesting letter for data collection (Try out)

To Dean of Graduate School

I am (Mr./Mrs./Ms.) Zhizhi Jin Student ID #……63910142……..

❑ Doctoral degree ❑ √Master degree - plan ○ A ○√ B Study type ○ √Full-time ○ Part-time

Program Master of Nursing Science (International Program) Major/Pathway...Adult Nursing...Faculty of Nursing

Telephone +8615705776913 E-mail 429096049@qq.com

Doctoral dissertation/ Master thesis/ IS **Title**: Fatigue and influencing factors in adolescents and young adults with cancer during chemotherapy

Principal advisor' name…Assistant Professor Dr.Jinjutha Chaisena Dallas….

I would like to request for issuing **a requesting letter for data collection (Try out)**:

By issuing to (name of the director of Institute/ University/ Organization)

Wenrui Sun, The First Affiliated hospitals of Wenzhou Medical University, Zhejiang Province, China

To collect data from (details of participants and sample size)…A total of 30 patients aged 15-30 years who were diagnosed with malignant tumors will included in the study. They will from the First Hospital and the Second Hospital of Wenzhou Medical University

Duration of data collection: from date……..1st November. .2022….to…15th November. .2022……..

My contact information: # cellphone and E-mail .....+8615705776913 429096049@qq.com.....

With this request, I have enclosed documents 1.copies

1) A copy of proof of ethical approval from Burapha university, and
2) Research instruments

Please be informed accordingly,

Student's name ……*Zhizhi Jin*……

(……Ms Zhizhi Jin…….)

Date…31… Month……October…Year…2022……..

Principal advisor acknowledged	Dean of Faculty/College acknowledged	Dean of Graduate School approved
(Signed)……Jinjutha…… (Assist Prof. Dr.Jinjutha Chaisena Dallas) Date……Oct. 31, 2022. …	(Signed)……Pornchai…… (Assist. Prof. Dr. Pornchai Jullamate) Date……Oct. 31, 2022……	(Signed)…… (Assoc. Prof. Dr. Nujjaree Chaimongkol) Date…8 November 2022……

涉及人的生物医学研究伦理审查意见通知函

意见号：伦审（2022-K-131-01）

项目名称	青少年和青年癌症患者在化疗期间的疲劳程度及影响因素		
项目来源	自选课题		
承担科室	儿童血液内科	主要研究者	金芝芝
受理号	2022-K-131-01		
审查类别	☑初始审查 ☐跟踪审查 ☐复审		
审查方式	☐会议审查 ☑快速审查 ☐紧急会议审查		
审查日期	2022 年 9 月 27 日	审查地点	/
审查文件（主要）	1. 初始审查申请表 2. 研究者履历 3. 试验方案（版本号：V1.0；版本日期：2022.08.11） 4. 知情同意书-成人版（版本号：V1.0；版本日期：2022.07.24） 5. 知情同意书-15-17 周岁版（版本号：V1.0；版本日期：2022.07.24） 6. 病例报告表（版本号：V1.0；版本日期：2022.07.24）		
审查决定	经我院医学伦理委员会的审查，审查结果为：修改后批准 具体意见见伦理审查意见通知单（YJ-2022-K-131-01）。 主任委员签字： 签发日期：2022 年 9 月 27 日 医学伦理委员会（盖章）		

注意：

1.“同意继续进行”的研究应按照医学伦理委员会已批准的方案执行，应符合 NMPA/GCP 和《赫尔辛基宣言》的原则。

2.“作必要的修改后同意/修改后批准”和“修改后再审”：研究在提交复审申请前，应按评审意见进行逐条修改，并将带有修改标记的资料和修改后的资料一并递交医学伦理委员会申请复审。请在 1 年内提交复审申请，逾期将按照新项目受理。

3.“不同意/不批准”和“终止或暂停已同意的研究”，申办方和研究者可就医学伦理委员会的意见和建议中提及的问题做书面申诉，并陈述理由（收到伦理意见 1 年之内），医学伦理委员会可就申诉作重新审查。若医学伦理委员会意见仍为“不同意/不批准”或“终止或暂停已同意的研究”，研究不得进行，已经开展的项目应递交暂停/终止研究报告等。

涉及人的生物医学研究伦理审查批件

Ethics Committee Approval Letter of Biomedical Research Involving Humans

批件号 Approval NO.：伦审（2022-K-131-02）

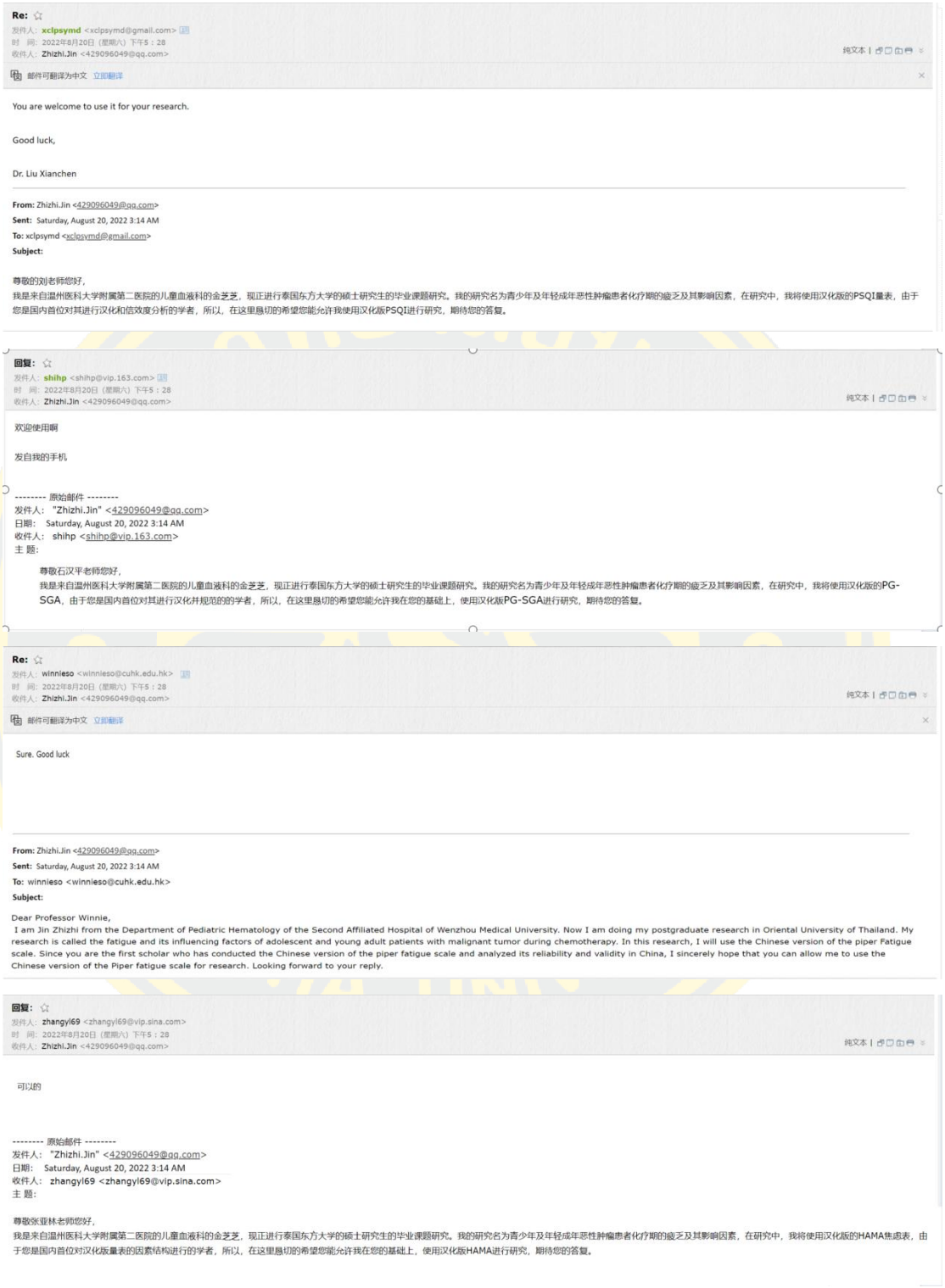
项目名称 Study Title	青少年和青年癌症患者在化疗期间的疲劳程度及影响因素		
项目来源 Source	自选课题		
受理号 Acceptance Number	2022-K-131-02		
主要研究者 Principal Investigator	金芝芝	承担科室 Responsible Department	儿童血液内科
审查类别 Category of Review	复审	审查方式 Type of Review	快速审查
审查日期 Date of Review	2023 年 1 月 13 日	审查地点 Location of Review	/
审查文件清单 Items Reviewed	1. 复审申请表 2. 试验方案（版本号：V2.0；版本日期：2022.12.10）		
审评意见 Evaluation	批准		
审查决定 Decision	委员会对该项目的审查决定为：☑批准 (Approval)		
主任委员签字 Chair Signature			
签发日期 Date of issue	2023 年 1 月 13 日		
医学伦理委员会 Stamp of EC	医学伦理委员会盖章		
批件有效期 Period of Validity	自本医学伦理委员会初始审查批准之日起一年内，本临床研究应在本院启动。逾期未启动的，本批件自动失效。		
年度/定期跟踪审查 Continue Review	审查频率为该研究批准之日起每 12 月一次，首次请于 2024 年 1 月 12 日前 1 个月递交研究进展报告。 医学伦理委员会有根据实际进展情况改变跟踪审查频率的权利。		
声明 Statement	本医学伦理委员会的职责、人员组成、操作程序及记录遵循《涉及人的生物医学研究伦理审查办法》、《涉及人的健康相关研究国际伦理准则》、《赫尔辛基宣言》、GCP 和 ICH-GCP 等国际伦理指南和国内相关法律法规。		

注意事项：

1. 请遵循我国相关法律、法规和规章中的伦理原则。
2. 请遵循经本医学伦理委员会批准的临床研究方案、知情同意书、招募材料等开展本研究，保护受试者的健康与权利。对研究方案、知情同意书和招募材料等的任何修改，均须得到本医学伦理委员会审查同意后方可实施。
3. 在本院发生的SAE/SUSAR以及研发期间安全性更新报告须按照NMPA/GCP最新要求及时递交本医学伦理委员会，国内外其它中心发生的SAE/SUSAR需定期汇总、评估后递交本医学伦理委员会。
4. 根据报告情况，本医学伦理委员会有权对其评估做出新的决定。
5. 自今日起，无论研究开始与否，请在跟踪审查日到期前1个月提交研究进展报告。
6. 申办方应当向组长单位医学伦理委员会提交中心研究进展报告汇总；当出现任何可能显著影响研究进行或增加受试者危险的情况时，请申请人及时向本医学伦理委员会提交书面报告。
7. 研究纳入了不符合纳入标准或符合排除标准的受试者，符合中止研究规定而未让受试者退出研究，给予错误治疗或剂量，给予方案禁止的合并用药等没有遵从方案开展研究的情况；或可能对受试者的权益或健康以及研究的科学性造成不良影响等违背GCP原则的情况，请申办方、监查员或研究者提交违背方案报告。
8. 申请人暂停或提前终止临床研究，请及时提交暂停或终止研究报告。
9. 完成临床研究，请申请人提交结题报告。
10. 凡涉及中国人类遗传资源采集标本、收集数据等研究项目，必须获得中国人类遗传资源管理办公室批准后方可在本中心开展研究。
11. 凡经本医学伦理委员会批准的研究项目在实施前，申请人应按相关规定在国家卫健委、药审中心等的临床研究登记备案信息系统平台登记研究项目相关信息。

APPENDIX C

Permission for using instruments



Re: ☆
发件人: **xclpsymd** <xclpsymd@gmail.com>
时　间: 2022年8月20日（星期六）下午5：28
收件人: **Zhizhi.Jin** <429096049@qq.com>
纯文本 |
邮件可翻译为中文 立即翻译

You are welcome to use it for your research.

Good luck,

Dr. Liu Xianchen

From: Zhizhi.Jin <429096049@qq.com>
Sent: Saturday, August 20, 2022 3:14 AM
To: xclpsymd <xclpsymd@gmail.com>
Subject:

尊敬的刘老师您好，
我是来自温州医科大学附属第二医院的儿童血液科的金芝芝，现正进行泰国东方大学的硕士研究生的毕业课题研究。我的研究名为青少年及年轻成年恶性肿瘤患者化疗期的疲乏及其影响因素，在研究中，我将使用汉化版的PSQI量表，由于您是国内首位对其进行汉化和信效度分析的学者，所以，在这里恳切的希望您能允许我使用汉化版PSQI进行研究，期待您的答复。

回复: ☆
发件人: **shihp** <shihp@vip.163.com>
时　间: 2022年8月20日（星期六）下午5：28
收件人: **Zhizhi.Jin** <429096049@qq.com>
纯文本 |

欢迎使用啊

发自我的手机

-------- 原始邮件 --------
发件人: "Zhizhi.Jin" <429096049@qq.com>
日期: Saturday, August 20, 2022 3:14 AM
收件人: shihp <shihp@vip.163.com>
主 题:

尊敬石汉平老师您好，
我是来自温州医科大学附属第二医院的儿童血液科的金芝芝，现正进行泰国东方大学的硕士研究生的毕业课题研究。我的研究名为青少年及年轻成年恶性肿瘤患者化疗期的疲乏及其影响因素，在研究中，我将使用汉化版的PG-SGA，由于您是国内首位对其进行汉化并规范的的学者，所以，在这里恳切的希望您能允许我在您的基础上，使用汉化版PG-SGA进行研究，期待您的答复。

Re: ☆
发件人: **winnieso** <winnieso@cuhk.edu.hk>
时　间: 2022年8月20日（星期六）下午5：28
收件人: **Zhizhi.Jin** <429096049@qq.com>
纯文本 |
邮件可翻译为中文 立即翻译

Sure. Good luck

From: Zhizhi.Jin <429096049@qq.com>
Sent: Saturday, August 20, 2022 3:14 AM
To: winnieso <winnieso@cuhk.edu.hk>
Subject:

Dear Professor Winnie,
I am Jin Zhizhi from the Department of Pediatric Hematology of the Second Affiliated Hospital of Wenzhou Medical University. Now I am doing my postgraduate research in Oriental University of Thailand. My research is called the fatigue and its influencing factors of adolescent and young adult patients with malignant tumor during chemotherapy. In this research, I will use the Chinese version of the piper Fatigue scale. Since you are the first scholar who has conducted the Chinese version of the piper fatigue scale and analyzed its reliability and validity in China, I sincerely hope that you can allow me to use the Chinese version of the Piper fatigue scale for research. Looking forward to your reply.

回复: ☆
发件人: **zhangyl69** <zhangyl69@vip.sina.com>
时　间: 2022年8月20日（星期六）下午5：28
收件人: **Zhizhi.Jin** <429096049@qq.com>
纯文本 |

可以的

-------- 原始邮件 --------
发件人: "Zhizhi.Jin" <429096049@qq.com>
日期: Saturday, August 20, 2022 3:14 AM
收件人: zhangyl69 <zhangyl69@vip.sina.com>
主 题:

尊敬张亚林老师您好，
我是来自温州医科大学附属第二医院的儿童血液科的金芝芝，现正进行泰国东方大学的硕士研究生的毕业课题研究。我的研究名为青少年及年轻成年恶性肿瘤患者化疗期的疲乏及其影响因素，在研究中，我将使用汉化版的HAMA焦虑表，由于您是国内首位对汉化版量表的因素结构进行的学者，所以，在这里恳切的希望您能允许我在您的基础上，使用汉化版HAMA进行研究，期待您的答复。

回复： ☆
发件人：**fanlv** <fanlv@chinaaids.cn>
时　间：2022年8月22日（星期一）上午9：01
收件人：**Zhizhi.Jin** <429096049@qq.com>
纯文本

当然可以，祝研究顺利

-------- 原始邮件 --------
发件人： "Zhizhi.Jin" <429096049@qq.com>
日期： Sunday, August 7, 2022 3:15 PM
收件人： fanlv <fanlv@chinaaids.cn>
主 题:

尊敬吕繁老师您好，
我是来自温州医科大学附属第二医院的儿童血液科的金芝芝，现正进行泰国东方大学的硕士研究生的毕业课题研究。我的研究名为青少年及年轻成年恶性肿瘤患者化疗期的疲乏及其影响因素，在研究中，我将使用汉化版的APGAR家庭功能量表，由于您是国内首位对其进行汉化并进行信效度检测的学者，所以，在这里恳切的希望您能允许我使用由您汉化的APGAR量表进行研究，期待您的答复。

BIOGRAPHY

NAME	Zhizhi Jin
DATE OF BIRTH	23 May 1993
PLACE OF BIRTH	Zhejiang, China
PRESENT ADDRESS	The Second Affiliated Hospital of Wenzhou Medical University, Wenzhou City, Zhejiang Province, China
POSITION HELD	Student/Nurse
EDUCATION	2011-2015 Bachelor of Nursing (B.S.N), Huzhou University,Huzhou, China 2020-2022 Master of Nursing Science (International Program) (M.N.S), Faculty of Nursing, Burapha University, Chonburi, Thailand