

**THE ASSOCIATION BETWEEN RISK OF MALNUTRITION, SERUM
ALBUMIN LEVEL AND PROTEIN INTAKE AMONG CANCER PATIENTS IN
HOSPITAL PAKAR UNIVERSITI SAINS MALAYSIA**

LENA CHRISTINE VICTOR

SCHOOL OF HEALTH SCIENCES

UNIVERSITI SAINS MALAYSIA

2025

**THE ASSOCIATION BETWEEN RISK OF MALNUTRITION, SERUM
ALBUMIN LEVEL AND PROTEIN INTAKE AMONG CANCER PATIENTS IN
HOSPITAL PAKAR UNIVERSITI SAINS MALAYSIA**

by

LENA CHRISTINE VICTOR

**Dissertation submitted in partial fulfillment of the requirements for the degree of
Bachelor of Health Science (Honours) (Dietetics)**

2025

DECLARATION

I hereby declare that this dissertation is the result of my own investigations, except where otherwise stated and duly acknowledged. I also declare that it has not been previously or concurrently submitted as a whole for any other degrees at Universiti Sains Malaysia or other institutions. I grant Universiti Sains Malaysia the right to use the dissertation for teaching, research and promotional purposes.



.....
Ms Lena Christine Victor

Date: 01-07-2025

ACKNOWLEDGEMENTS

First and foremost, I would like to express my heartfelt gratitude to God for His unwavering guidance, strength, and grace throughout this research journey. Without His constant presence, wisdom, and blessings, the successful completion of this thesis would not have been possible.

I am deeply grateful to my supervisor, Puan Nurzetty Sofia Bt Zainuddin, for her invaluable guidance, constant support, and encouragement throughout my research. Her expertise, feedback, and patience were instrumental in the successful completion of this thesis.

I would also like to extend my heartfelt thanks to my co-supervisor, Puan Ismajuliawati Binti Ismail, for her insightful suggestions and assistance during the research process. Her feedback greatly enriched my work and helped shape the direction of this study.

My sincere appreciation also goes to Dr. Wan Faizah Wan Yusoff, Program Coordinator of the Bachelor of Dietetics with Honours program, for her continuous support and for providing me the opportunity to conduct this research. I would like to express my gratitude to the School of Health Sciences, Health Campus, Universiti Sains Malaysia, for the academic training, resources, and support provided throughout my studies.

A special note of thanks goes to the doctors, nurses, and staff at the Oncology Clinic and Wards of Hospital Pakar Universiti Sains Malaysia for their cooperation and assistance during data collection. Their support was invaluable to this research. I am also truly grateful to the respondents who participated in this study. Your willingness to contribute made this research possible.

Finally, I would like to thank my father, mother, brother, family, and friends for their love, encouragement, and unwavering support throughout this journey. Your prayers, patience, and belief in me gave me the strength to persevere.

Thank you all for being a part of this important milestone in my academic journey.

TABLE OF CONTENT

CHAPTER 1 : INTRODUCTION.....	1
1.1 BACKGROUND OF THE STUDY.....	1
1.2 PROBLEM STATEMENT	5
1.3 STUDY RATIONALE	6
1.4 RESEARCH QUESTIONS.....	7
1.5 RESEARCH OBJECTIVE	8
1.6 RESEARCH HYPOTHESIS:	8
1.7 SIGNIFICANCE OF THE STUDY	9
1.8 OPERATIONAL DEFINITION	12
CHAPTER 2: LITERATURE REVIEW	14
2.1 MALNUTRITION AND PROTEIN INTAKE AMONG CANCER PATIENTS	14
2.2 DETERMINANTS OF MALNUTRITION RISK AND PROTEIN INTAKE	15
2.3 ASSOCIATION BETWEEN SERUM ALBUMIN LEVEL AND MALNUTRITION RISK AMONG CANCER PATIENTS	18
2.4 FACTORS RELATED TO MALNUTRITION AMONG CANCER PATIENTS	19
2.5 CONSEQUENCES RELATED TO MALNUTRITION IN CANCER PATIENTS.....	20
2.6 ASSOCIATION BETWEEN ALBUMIN LEVEL, PROTEIN INTAKE, AND MALNUTRITION RISK AMONG CANCER PATIENTS	21
2.7 CONCEPTUAL FRAMEWORK.....	24
CHAPTER 3 : METHODOLOGY	26
3.1 STUDY DESIGN	26
3.2 STUDY AREA.....	27
3.3 STUDY POPULATION	27
3.4 INCLUSION & EXCLUSION CRITERIA	28
3.5 SAMPLE SIZE ESTIMATION	28
3.6 SAMPLING METHOD AND SUBJECT RECRUITMENT	30
3.7 RESEARCH TOOLS.....	31
VISUAL GUIDE FOR HOUSEHOLD MEASUREMENTS	33
CHAPTER 4 : RESULTS	44
CHAPTER 5 : DISCUSSION	48
CHAPTER 6: CONCLUSION AND RECOMMENDATIONS	55
6.1 SUMMARY OF FINDINGS	56
6.2 LIMITATIONS	56
6.3 CONCLUSION	58
6.4 PRACTICAL RECOMMENDATIONS.....	61
6.5 SUGGESTIONS FOR FUTURE RESEARCH.....	62
REFERENCES	63

LIST OF TABLES

Table 1 Statistical Tests Used for Each Research Objective in the Study.....	43
Table 4.1 - Sociodemographic Characteristics of Participants (n = 91).....	44
Table 4.2 - Descriptive Statistics of SGA Classification.....	45
Table 4.3 - Descriptive Statistics for Albumin Level.....	45
Table 4.4 - Descriptive Statistics for Protein Intake (n = 91).....	46
Table 4.5 - Serum Albumin Across SGA Groups.....	46
Table 4.6 - Post Hoc Mann–Whitney U Test Results for Pairwise SGA Comparisons.....	47
Table 4.7 - Kruskal-Wallis Test for Protein Intake Across SGA Groups.....	47

LIST OF FIGURES

Figure 1 Conceptual framework of the association between risk of malnutrition, albumin levels, and protein intake among cancer patients in Hospital Pakar Universiti	24
Figure 2 Data Collection Procedure	41

LIST OF ABBREVIATIONS / SYMBOLS

1TD	: Timur Depan
1U	: Utara
2U	: Utara
3S	: Selatan
3U	: Utara
B40	: Bottom 40% (household income category)
BMI	: Body Mass Index
CRP	: C-Reactive Protein
ESPEN	: The European Society for Clinical Nutrition and Metabolism
GI	: Gastrointestinal
HUSM	: Hospital Universiti Sains Malaysia
HPUSM	: Hospital Pakar Universiti Sains Malaysia
JePeM	: Jawatankuasa Etika Penyelidikan Manusia
M40	: Middle 40% (household income category)
MST	: Malnutrition Screening Tool
NHLBI	: National Heart, Lung, and Blood Institute
PG-SGA	: Patient-Generated Subjective Global Assessment
SGA	: Subjective Global Assessment
SPSS	: Statistical Package for the Social Sciences
T20	: Top 20% (household income category)
USM	: Universiti Sains Malaysia

**HUBUNGAN ANTARA RISIKO KEKURANGAN NUTRISI, TAHAP SERUM
ALBUMIN DAN PENGAMBILAN PROTEIN DI KALANGAN PESAKIT
KANSER DI HOSPITAL PAKAR UNIVERSITI SAINS MALAYSIA**

ABSTRAK

Kekurangan zat makanan merupakan isu yang sering diabaikan dalam kalangan pesakit kanser, terutamanya disebabkan oleh kesan sampingan rawatan atau kemerosotan penyakit. Serum albumin adalah biomarker penting untuk memantau status pemakanan, dan pengambilan protein amat penting untuk mengekalkan jisim otot dan kekuatan sepanjang rawatan. Walaupun banyak kajian mengenai hubungan antara malnutrisi, tahap serum albumin, dan pengambilan protein, kajian ini memberi tumpuan kepada pesakit kanser di Hospital Pakar Universiti Sains Malaysia (HPUSM), yang masih terhad. Kajian ini bertujuan untuk menyiasat hubungan antara risiko malnutrisi, tahap serum albumin, dan pengambilan protein dalam kalangan pesakit kanser di HPUSM. Kajian keratan rentas ini melibatkan 91 orang pesakit kanser, di mana risiko malnutrisi dikenalpasti menggunakan Penilaian Global Subjektif (SGA), tahap serum albumin diperoleh daripada rekod perubatan, dan pengambilan protein dinilai melalui ingatan diet selama tiga hari. Analisis data dilakukan menggunakan statistik deskriptif, ujian Kruskal-Wallis, dan analisis korelasi Pearson. Dapatan menunjukkan 41.8% pesakit berisiko kekurangan zat makanan, dengan purata tahap serum albumin sebanyak 40.46 g/L, yang berada dalam julat normal (3.4-5.4 g/dL atau 34-54 g/L). Purata pengambilan protein harian adalah 46.13 gram. Terdapat hubungan positif signifikan antara pengambilan protein dan serum albumin ($r = 0.286$, $p = 0.006$), namun tiada hubungan signifikan ditemui antara pengambilan protein dan risiko malnutrisi. Kajian ini menekankan keperluan untuk melaksanakan saringan pemakanan awal yang lebih

terperinci, seperti penggunaan alat SGA, bagi mengenal pasti risiko malnutrisi dalam kalangan pesakit kanser. Selain itu, intervensi pemakanan yang bersesuaian, seperti pemberian suplemen protein dan perancangan diet yang dipersonalisasi, perlu dilaksanakan untuk meningkatkan status pemakanan, mengurangkan kesan sampingan rawatan, dan meningkatkan toleransi terhadap terapi kanser.

**THE ASSOCIATION BETWEEN RISK OF MALNUTRITION, SERUM
ALBUMIN LEVEL AND PROTEIN INTAKE AMONG CANCER PATIENTS IN
HOSPITAL PAKAR UNIVERSITI SAINS MALAYSIA**

ABSTRACT

Malnutrition is a common issue often overlooked in cancer patients, particularly due to treatment side effects or disease progression. Serum albumin is a key biomarker for assessing nutritional status, with protein intake being crucial for maintaining muscle mass and strength throughout treatment. Despite numerous studies on the link between malnutrition, serum albumin levels, and protein intake, there is limited research specifically on cancer patients at Hospital Pakar Universiti Sains Malaysia (HPUSM). This study aimed to investigate the relationship between malnutrition risk, serum albumin levels, and protein intake among cancer patients at HPUSM. A cross-sectional study was conducted with 91 cancer patients, where malnutrition risk was assessed using the Subjective Global Assessment (SGA), serum albumin levels were retrieved from medical records, and protein intake was measured using a 3-day dietary recall. Data were analyzed using descriptive statistics, Kruskal-Wallis test, and Pearson correlation analysis. The results showed that 41.8% of patients were at risk of malnutrition, with an average serum albumin level of 40.46 g/L, within the normal range (3.4-5.4 g/dL or 34-54 g/L). The average daily protein intake was 46.13 grams. A significant positive correlation was found between protein intake and serum albumin ($r = 0.286$, $p = 0.006$), though no significant correlation was found between protein intake and malnutrition risk. The study highlights the need for more comprehensive early nutritional screening, such as the use of the SGA, to identify malnutrition risks in cancer patients. Additionally, appropriate nutritional interventions, such as protein

supplementation and personalized diet planning, should be implemented to improve nutritional status, reduce treatment side effects, and enhance cancer therapy tolerance.

CHAPTER 1 : INTRODUCTION

1.1 BACKGROUND OF THE STUDY

Cancer is defined as the rapid formation of abnormal cells that grow beyond their usual boundaries, invade adjoining parts of the body, and spread to other organs. The latter process, known as metastasis, is the major cause of death in cancer (Brown et al., 2023). The risk factors for cancer include age, poor diet, family history, obesity, and hormonal influences. These factors can cause genetic damage to cells, leading to accelerated cell division and, ultimately, tumor formation. Cancer was the second leading cause of mortality worldwide (Nagai & Kim, 2017). In 2022, the National Cancer Institute (2024) reported nearly 20 million new cases and 9.7 million cancer-related deaths globally. According to the Global Cancer Observatory (GLOBOCAN, 2022), Malaysia reported 51,650 new cancer cases in 2022, with an age-standardized incidence rate (ASR) of

142.1 per 100,000 population. The three most common cancers among both sexes were breast cancer (16.2%), colorectal cancer (13.8%), and lung cancer (10.7%). These were followed by liver and prostate cancer, which were more common in the male population, each accounting for 4.6% of all cancer cases. Other cancer types made up 50.2% of all cancer cases. Cancer has remained a major public health concern, with cancer cases in Malaysia being more prevalent among females. From 2012 to 2016, there were 63,733 cases in females compared to 51,505 cases in males. Similarly, from 2017 to 2021, females continued to have a higher incidence, with 91,131 cases compared to 77,692 in males (National Cancer Registry, 2023).

Malnutrition is defined as deficiencies, excesses, or imbalances in an individual's intake of energy and/or nutrients (World Health Organization, 2024). It encompasses two broad categories of conditions. The first is undernutrition, which includes stunting (low height for age), wasting (low weight for height), underweight (low weight for age), and micronutrient deficiencies or insufficiencies (lack of important vitamins and minerals). The second category includes overweight, obesity, and diet-related noncommunicable diseases such as heart disease, stroke, diabetes, and cancer (World Health Organization, 2024). For the purpose of this research, 'malnutrition' specifically referred to undernutrition.

Malnutrition, anorexia, and weight loss often occurred among cancer patients, even during their initial visit to a medical oncology center (Muscaritoli et al., 2017). Malnutrition, as detected through various screening tools of differing complexity, is a common issue among cancer patients, with prevalence rates reported between 20% and 70% (Arends, 2024). Unexpected weight loss is recognized as a non-specific but important early indicator of cancer in primary care, potentially serving as a precursor to diagnosis (Nicholson et al., 2022). A study conducted in Brazil among 60 cancer patients undergoing chemotherapy treatment reported that the prevalence of malnutrition was 77% (Ferigollo et al., 2018). Another study by Nitichai et al. (2019) in Thailand reported that 39% of 195 cancer patients were well-nourished, 27% were moderately malnourished, and 34% were severely malnourished. However, the prevalence of malnutrition among cancer patients in Malaysia remained underexplored at the time of the study, despite its critical implications. According to Sing and Vanoh (2022), who conducted a study among 82 cancer patients receiving both outpatient and inpatient cancer treatment at Hospital Pakar Universiti Sains Malaysia (HPUSM), the prevalence of malnutrition was 69.5%.

Malnutrition often resulted from inadequate dietary intake. Cancer patients frequently experienced a decline in oral intake due to multiple factors, such as anorexia, cachexia, sarcopenia, appetite loss, mouth ulcers, diarrhea, vomiting, pain, intestinal obstructions, or malabsorption (Muscaritoli et al., 2017). Cachexia, a wasting syndrome characterized by muscle atrophy and loss of lean body mass, was commonly seen in advanced cancer stages and worsened prognosis. As a result, many cancer survivors experienced unintentional weight loss, which was a marker of undernutrition, and associated this weight loss with negative outcomes (Sing & Vanoh, 2022). Preoperative malnutrition has been linked to several adverse clinical outcomes, including lower quality of life, reduced treatment response, increased risk of chemotherapy-related toxicity, and decreased survival (Zheng et al., 2017). Additionally, there was a decrease in responses to chemotherapy, increased chemotherapy-induced toxicity, more frequent and severe complications, and shorter survival times (Nguyen et al., 2022). Psychiatric conditions such as depression and anxiety are common yet often overlooked among cancer patients. It is estimated that up to 20% of cancer patients experience depression and around 10% experience anxiety, regardless of treatment stage or prognosis (Pitman et al., 2018).

Hypoalbuminemia, a condition linked to cancer and other chronic disorders, was commonly considered a sign of malnutrition (McLean et al., 2020). According to Farrah et al. (2017), the four most common cancers associated with malnutrition or low serum albumin levels included nasopharyngeal carcinoma, lung cancer, breast cancer, and colorectal cancer. Serum albumin levels, a key indicator of nutritional status, could serve as a predictor of cancer survival (Tang, Li, & Sun, 2024), while lower albumin levels were correlated with increased cancer mortality risk (Kühn et al., 2017).

Protein intake played a crucial role in maintaining muscle function and overall health during cancer treatment. Muscle loss during treatment was often associated with protein intakes below 1.2 g/kg body weight, with muscle maintenance achievable only with intakes above 1.4 g/kg (Capitão et al., 2022). Higher protein intake has been linked to improved breast cancer survival in several prospective studies, including a large cohort of 1,982 women in the Nurses' Health Study (Holmes et al., 2017). Protein intake among cancer patients is highly variable, and many do not meet the minimum recommended levels (Ford et al., 2021). According to ESPEN guidelines, cancer patients are advised to consume at least 1.0 g of protein per kg of body weight per day, with a target intake of 1.2–2.0 g/kg/day, and even higher intakes (≥ 2.0 g/kg/day) are considered safe for those with normal kidney function (Arends et al., 2017). Nutritional supplementation alone could not address the catabolic state caused by cancer-related malnutrition, which was driven by tumor-induced inflammation and muscle breakdown (Baracos, 2018). Adequate protein intake was essential in preventing In this research, 3-day food records were used, as they had been selected as the method of assessment for the NHLBI Growth and Health Study. Crawford et al. (1994) indicated that the 3-day food record demonstrated better validity compared to other dietary assessment methods, such as the 24-hour recall and food frequency questionnaires. The 3-day food record showed lower reporting errors, with percentage absolute errors ranging between 12% and 22%, and a higher agreement between observed and reported intakes, with the proportion of missing foods being observed food items not reported and phantom foods being reported food items not observed, being 25% and 10%, respectively, making it the best overall choice.

The association between protein intake and malnutrition in cancer patients was important to understand, as thorough nutritional assessments and interventions could

enhance treatment outcomes. Poor protein intake not only increased the risk of malnutrition but also interrupted recovery and increased susceptibility to treatment side effects. Hence, this research aimed to identify the association between risk of malnutrition, serum albumin level and protein intake among cancer patients at Hospital Pakar Universiti Sains Malaysia (HPUSM).

1.2 PROBLEM STATEMENT

Cancer is a major public health concern, characterized by uncontrolled cell growth and tumor formation, with various risk factors such as age, poor diet, family history, obesity, and hormonal influences. In Malaysia, cancer is more prevalent among females, with 63,733 cases reported between 2012 and 2016 compared to 51,505 in males. This trend continued from 2017 to 2021, with 91,131 female cases and 77,692 male cases (National Cancer Registry, 2023).

An often overlooked issue in cancer care is malnutrition, affecting 20-70% of cancer patients depending on tumor type, disease stage, and clinical setting (Arends, 2024). Malnutrition is linked to both the cancer itself and its treatments, which impair appetite, digestion, and nutrient absorption. This leads to immune dysfunction, muscle wasting, and reduced treatment tolerance. Cachexia, a wasting syndrome, is common in advanced cancer and worsens prognosis.

Despite its significance, the role of serum albumin levels and protein intake in managing malnutrition among cancer patients in Malaysia is underexplored. Serum albumin is a key indicator of nutritional status, with low levels correlating with poorer outcomes and higher mortality (Kühn et al., 2017). Protein intake is crucial for maintaining muscle mass and overall health, yet many cancer patients do not meet the recommended levels,

exacerbating muscle loss and delaying recovery (Capitão et al., 2022).

This research focuses on addressing the knowledge gap surrounding malnutrition among cancer patients at Hospital Pakar Universiti Sains Malaysia (HPUSM). Previous studies, such as those by Sing and Vanoh (2022), found that 69.5% of cancer patients at HPUSM were malnourished but did not examine the specific impact of serum albumin levels and protein intake on recovery or survival. This gap in research limits the development of targeted nutritional interventions, which are crucial for improving cancer treatment outcomes.

Malnutrition in cancer patients is linked to weight loss, muscle wasting, and increased infection risks (Arends et al., 2017). It also affects treatment outcomes by increasing toxicity, reducing chemotherapy tolerance, and leading to treatment complications (Arends, 2024). In advanced stages, malnutrition significantly lowers survival rates, with the loss of muscle mass being a major contributor to poor prognosis (Vanoh & Sing, 2022). Given the limited research on this issue in Malaysia, particularly at HPUSM, this study aims to investigate the association between the risk of malnutrition, serum albumin levels, and protein intake among cancer patients to inform more effective nutritional strategies and improve patient care.

1.3 STUDY RATIONALE

The relationship between malnutrition risk, serum albumin levels, and protein intake in cancer patients has not been adequately investigated, particularly in Malaysia. Although a sufficient protein intake is essential for preventing muscle loss and improving treatment outcomes, and serum albumin is an important biomarker of nutritional status, it is challenging to evaluate nutritional status in a straightforward way due to the complex relationships between cancer-related inflammation and metabolic abnormalities. This study aims to investigate this relationship at Hospital Pakar

Universiti Sains Malaysia (HPUSM), where the rising number of cancer diagnoses each year highlights the urgent need to identify patients at risk of malnutrition early. By examining the prevalence of malnutrition risk and its correlation with serum albumin levels and protein intake, this study will help fill existing knowledge gaps and provide a deeper understanding of how malnutrition impacts cancer patients' health and prognosis. It is expected that the findings will guide towards the development of more individualised and successful nutritional therapy programs, ultimately leading to better patient outcomes. Additionally, by detecting early indicators of malnutrition and improving nutritional therapy, this research will raise survival rates. By highlighting the impact that nutrition plays in improving overall patient well-being and treatment tolerance, the study expects to increase awareness of the significance of nutrition in cancer care.

1.4 RESEARCH QUESTIONS

What is the prevalence of malnutrition among cancer patients in HPUSM?

What is the mean of serum albumin levels among cancer patients in HPUSM?

What is the mean of protein intake among cancer patients in HPUSM?

Is there a significant difference in serum albumin levels among cancer patients with different malnutrition risk categories in HPUSM?

Is there a significant difference in protein intake among cancer patients with different malnutrition risk categories in HPUSM?

Is there a relationship between serum albumin levels and protein intake in cancer patients in HPUSM?

1.5 RESEARCH OBJECTIVE

To investigate the association between albumin level, protein intake and risk of malnutrition among cancer patients in Hospital Pakar Universiti Sains Malaysia.

SPECIFIC OBJECTIVES :

To determine the prevalence of malnutrition risk among cancer patients at Hospital Pakar Universiti Sains Malaysia (HPUSM).

To determine the mean serum albumin levels among cancer patients at HPUSM.

To determine the mean protein intake among cancer patients at HPUSM.

To compare serum albumin levels across different malnutrition risk categories among cancer patients at HPUSM.

To compare protein intake across different malnutrition risk categories among cancer patients at HPUSM.

To investigate the relationship between serum albumin levels and protein intake in cancer patients at HPUSM.

1.6 RESEARCH HYPOTHESIS:

NULL HYPOTHESIS: (H₀):

There is no significant relationship between malnutrition risk, serum albumin levels, and protein intake among cancer patients at Hospital Pakar Universiti Sains Malaysia (HPUSM).

ALTERNATIVE HYPOTHESIS: (H₁):

There is a significant relationship between malnutrition risk, serum albumin levels, and protein intake among cancer patients at Hospital Pakar Universiti Sains Malaysia (HPUSM).

1.7 SIGNIFICANCE OF THE STUDY

This study has the potential to enhance our understanding of malnutrition, serum albumin levels, and protein intake in cancer patients in Malaysia, where the prevalence of cancer continues to rise annually. Recognizing patients at risk of malnutrition and understanding the complex interactions between nutritional factors is crucial for implementing effective nutritional interventions that enhance treatment tolerance and overall survival. By clarifying the prevalence of malnutrition and examining its correlation with serum albumin levels and protein intake, the study's findings will contribute to the development of more accurate nutritional assessments and personalized treatment approaches tailored to the needs of Malaysian cancer patients. The study aims to address existing knowledge gaps while educating healthcare personnel on the significance of proactive nutritional care. In doing so, it will advance the understanding of the critical role nutrition plays in cancer management. The outcomes of this study may guide the formulation of dietary standards and inform health policies relevant to cancer care, ultimately contributing to improvements in patients' quality of life and prognosis. Beyond academic contributions, this study holds practical implications for clinical practice and healthcare delivery in Malaysia and may also inform nutritional care strategies in similar healthcare settings. One key question addressed by this study is: what are the potential long- term benefits of early identification of malnutrition in cancer patients?

The long-term advantages include improved health outcomes, reduced morbidity and mortality, and shorter hospital stays. Early detection allows for timely nutritional interventions, which in turn optimize cancer treatment outcomes, minimize complications, and improve patients' quality of life. Early nutritional support also strengthens the immune system, aiding the body's defense against infections (Jamhuri et al., 2017).

In addition, early identification of malnourished cancer patients who would benefit from individualized nutritional intervention is a crucial part of a multidisciplinary approach to improve prognosis. Since nutritional screening and assessment should begin immediately upon hospitalization, effective early assessment methods can significantly facilitate subsequent treatment (Yin et al., 2021). Nutritional interventions, when initiated early, also improve treatment tolerance, reduce complications, and enhance survival rates. They help maintain functional capacity, especially in patients undergoing surgery, and can prevent or alleviate the effects of cachexia, a debilitating condition common in cancer patients. Moreover, proper nutritional management contributes to psychological well-being by reducing distress, which is vital for maintaining adherence to treatment and preserving quality of life (Arends, 2024).

The study is expected to raise awareness about the importance of adequate nutrition during cancer treatment. It encourages patients and their families to actively participate in nutritional care as an integral component of the treatment plan. By highlighting the association between nutrition, albumin levels, and malnutrition, this research reinforces the critical role of nutrition in improving treatment outcomes and motivates patients to prioritize dietary considerations in their care journey. Furthermore, the findings may guide future research on the effectiveness of specific nutritional interventions in cancer

care, expanding our understanding of how diet influences recovery, prognosis, and survival.

Insights from this study into serum albumin as a nutritional biomarker may also pave the way for future exploration of additional biomarkers or nutritional strategies to prevent malnutrition and cachexia among cancer patients. The research underscores the importance of a multidisciplinary approach in oncology, advocating for the collaboration of dietitians, oncologists, and other healthcare professionals to ensure comprehensive, holistic patient care. By emphasizing integrated nutritional and medical support, the study highlights the need for structured cancer nutrition education programs to better equip patients and their families with knowledge about the vital role of diet during treatment.

The final outcome of this research would provide valuable insights into the importance of protein intake, nutritional strategies, and lifestyle modifications that could inform public health strategies and clinical guidelines in reducing malnutrition risk, as well as improving cancer patients' care and outcomes. In addition, this research hoped to contribute to the growing body of evidence on the prevention of malnutrition and improve the nutritional health and quality of life of cancer patients in Kelantan and beyond by identifying key modifiable risk factors.

1.8 OPERATIONAL DEFINITION

MALNUTRITION

Malnutrition encompasses a range of conditions, including undernutrition, micronutrient deficiencies or excesses, and overweight or obesity, along with diet-related noncommunicable diseases such as heart disease, stroke, diabetes, and some cancers. It refers to imbalances in a person's intake of energy and/or nutrients, and is categorized into three broad groups which include undernutrition, micronutrient-related malnutrition, involving deficiencies or excesses of important vitamins and minerals, and overweight and obesity, which can lead to diet-related health issues (World Health Organization, 2024). To assess malnutrition in this study, the Subjective Global Assessment (SGA) tool was used. The SGA evaluated malnutrition through a comprehensive assessment that included the patient's weight history, food intake, symptoms that impacted nutrition, and a physical examination. The tool categorized malnutrition into three stages: well-nourished (Stage A), moderately malnourished (Stage B), and severely malnourished (Stage C). This classification helped in identifying the severity of malnutrition and guiding appropriate nutritional interventions (Henriksen et al., 2022).

ALBUMIN

Albumin is the most abundant circulating protein found in plasma. It represents half of the plasma's total protein content (3.5 g/dL to 5 g/dL) in healthy human patients. Liver hepatocytes synthesize albumin and rapidly excrete it into the bloodstream at about 10g to 15g per day (Moman, 2022). The normal range for serum albumin is 3.4 to 5.4 g/dL (34 to 54 g/L) (UCSF Health, 2023). Decreased blood albumin levels may occur when the body does not get or absorb enough nutrients, such as with weight-loss surgery,

Crohn's disease (inflammation of the digestive tract), or low-protein diets (UCSF Health, 2023).

CANCER

Cancer is a generic term for a large group of diseases that can affect any part of the body. Other terms used are malignant tumours and neoplasms. One defining feature of cancer is the rapid creation of abnormal cells that grow beyond their usual boundaries, and which can then invade adjoining parts of the body and spread to other organs, where the latter process is referred to as metastasis. Widespread metastases are the primary cause of death from cancer (World Health Organization, 2022).

CHAPTER 2: LITERATURE REVIEW

2.1 MALNUTRITION AND PROTEIN INTAKE AMONG CANCER PATIENTS

Malnutrition is associated with numerous negative consequences, such as prolonged hospitalization, depression, impaired physical function, and increased mortality (Mikkelsen et al., 2022). Cancer patients, especially those in advanced stages, are at high risk of developing malnutrition (Arends, 2023). Based on a previous study carried out among breast cancer patients at Hospital Tuanku Ja'afar Seremban, it was found that 51.7% of 89 patients diagnosed with cancer were malnourished, and one of the main reasons was low food consumption, reported in 42.7% of patients (Wong, 2022). This was identified using a seven-day diet history (Wong, 2022). The Subjective Global Assessment (SGA) is a structured questionnaire used as a screening tool to assess malnutrition in patients. The SGA form is easy to use and cost-effective. However, participant-related and questionnaire-related misunderstandings have been reported (Balstad et al., 2019). Explaining each aspect of the questionnaire to participants can help overcome this issue.

Sufficient protein intake is crucial for everyone, especially cancer patients undergoing treatments like chemotherapy and radiotherapy, where there is a significant risk of muscle loss and cachexia. Adequate protein intake helps prevent cachexia, a common condition in cancer patients, by preserving muscle mass. Protein also strengthens the immune response, which is vital since cancer patients often have weakened immune systems due to the disease or its treatments. Moreover, sufficient protein intake is essential even during the recovery stage. For instance, cancer patients recovering from

surgery benefit from protein as it provides overall strength and supports recovery. The European Society for Clinical Nutrition and Metabolism (ESPEN) recommends a protein intake of 1.0 to 1.5 g/kg/day for cancer patients to meet their nutritional needs (Dingemans et al., 2023).

2.2 DETERMINANTS OF MALNUTRITION RISK AND PROTEIN INTAKE

Malnutrition is a common issue among cancer patients, with a prevalence rate of 58.2%, in which it is more frequent among females (51.6%) compared to males (48.4%) (Gebremedhin et al., 2021). A significant proportion of patients also experience substantial weight loss, with 41.9% having moderate weight loss and 21.1% suffering from severe weight loss (Gebremedhin et al., 2021). The risk of malnutrition is higher in advanced cancer stages, particularly in stage IV, where the odds of malnutrition increase by 7.2 times (Gebremedhin et al., 2021). According to a study published in the Malaysian Journal of Public Health Medicine (2022), 69.5% of cancer patients in both inpatient and outpatient settings were found to be malnourished, based on the Patient-Generated Subjective Global Assessment (PG- SGA). The impact of cancer and its treatments on nutritional status is shown by this high prevalence of malnutrition. In these individuals, malnutrition is linked to decreased quality of life, immune system weakness, weight loss, and muscular atrophy. The problem is made worse by the fact that cancer treatments frequently result in adverse effects such altered taste and swallowing difficulties.

Norshariza et al. (2017) report significant findings regarding malnutrition among cancer patients. The study found that 43.5% of patients were classified as malnourished using the Subjective Global Assessment (SGA), while 61.9% were at risk of malnutrition based on the Malnutrition Screening Tool (MST). Notably, patients with Stage 4 cancer had a greater risk of malnutrition where 56.9% were at risk based on MST, and 69.7% were malnourished based on SGA. These results highlight the necessity for targeted nutritional interventions in this patient group and the high frequency of malnutrition, especially in late cancer stages.

Chemotherapy is a major contributing factor to malnutrition, as it is associated with side effects such as loss of appetite, nausea, vomiting, diarrhea, and anorexia. Nearly 80% of patients report a loss of appetite, 75% experience nausea, and almost 60% suffer from vomiting. Furthermore, many patients have difficulties with eating, including problems with chewing or pain while swallowing. In addition to treatment-related challenges, lifestyle factors such as alcohol consumption and smoking may also contribute to malnutrition. Socioeconomic factors, such as stress, also affect nutritional health, with 42.7% of patients experiencing mild to moderate stress, and 41.6% reporting severe stress (Gebremedhin et al., 2021). Additionally, many patients experience loss of subcutaneous fat and muscle weakness, further complicating their nutritional status. Certain cancers, including gastric, colorectal, and nasopharyngeal cancers, as well as pre-existing health conditions, put patients at greater risk of malnutrition.

Malnutrition has significant consequences, such as hindering treatment effectiveness, worsening side effects, extending hospital stays, and reducing both the quality of life and survival rates (Gebremedhin et al., 2021). Food insecurity is a critical factor influencing malnutrition, with socioeconomic issues like wealth index and food security

playing a substantial role (Muhamed et al., 2022). Poor appetite, vomiting, and diarrhea, common among cancer patients, significantly contribute to the worsening of their nutritional status. Malnutrition can lead to serious complications, including increased risks of infection, delayed wound healing, longer hospital stays, and higher healthcare costs (Muhamed et al., 2022).

Protein intake in cancer patients is influenced by several factors, including energy balance, protein quality, and the timing of intake. Amino acids can be grouped into essential and non-essential types. Non-essential amino acids are produced naturally by the human body, while essential ones must be obtained through dietary protein. The nine essential amino acids are leucine, isoleucine, valine, phenylalanine, threonine, tryptophan, methionine, lysine, and histidine. Among these, leucine, isoleucine, and valine are known as branched-chain amino acids because of their unique chemical structure that includes multiple carbon atoms in their side chains. These branched-chain amino acids make up around forty percent of the body's total amino acid needs and are important not only for building muscle proteins but also for regulating various biological and metabolic processes as signaling compounds (Xiao and Guo 2022).

When individuals fail to consume enough calories and protein, the body turns to its own nutrient reserves for energy, resulting in the breakdown of protein stores and additional weight loss (PDQ Supportive and Palliative Care Editorial Board, 2017). Moreover, the quality of dietary protein is crucial, as proteins must cover the requirements of each amino acid, especially for cancer patients with altered protein metabolism (Dardevet et al., 2021). Additionally, protein digestibility is a key factor influencing nutritional value, with animal proteins generally being digested more efficiently than plant proteins (Recommended Nutrient Intakes Malaysia, 2017). Cancer patients are particularly

vulnerable to anabolic resistance, where the stimulation of muscle protein synthesis after food intake remains insufficient, even with protein intake recommended for healthy adults (Dardevet et al., 2021). This makes it necessary to increase dietary protein intake above the current recommended daily allowance to overcome anabolic resistance (Dardevet et al., 2021). The timing of protein intake and its association with the desynchronized intake of energetic nutrients also play an important role in optimizing protein utilization (Dardevet et al., 2021). Muscle protein synthesis remains functional in individuals with cancer and is still responsive to amino acid intake. However, compared to young, healthy individuals, a slightly higher intake of amino acids or protein may be required to stimulate this process effectively. Despite this, there is limited research on the nutritional quality of protein specifically in cancer patients (Muscaritoli et al., 2021).

2.3 ASSOCIATION BETWEEN SERUM ALBUMIN LEVEL AND MALNUTRITION RISK AMONG CANCER PATIENTS

Albumin is the most abundant and well-known protein in human blood plasma. Unlike other serum proteins, it serves multiple physiological functions (Kajal & Pathania, 2021). Albumin plays a critical role in maintaining colloid osmotic pressure in the blood and also functions as a transport protein. It is highly sensitive to changes in the body's metabolic environment, and because it is among the first proteins affected by hyperglycemia and elevated levels of reactive oxygen species, modified albumin is considered a valuable diagnostic and prognostic marker in various diseases (Belinskaia et al., 2024). Based on previous studies, individuals with lower serum albumin levels (≤ 4.2 g/dL) have significantly lower survival rates compared to those with higher levels.

Serum albumin is a crucial nutritional biomarker, as low levels usually indicate a calorie deficit and insufficient protein intake. Serum albumin is also an indicator of inflammation, as prolonged inflammation reduces serum albumin production and increases its breakdown. Consequently, serum albumin levels are essential for evaluating cancer patients' nutritional status (Tang, Li, & Sun, 2024).

To monitor the nutritional status of cancer patients, it is essential to consider the relationship among malnutrition risk, and serum albumin levels. Low serum albumin levels indicate severe malnutrition and protein deficiency, while inadequate protein intake increases the risk of malnutrition (Wong et al., 2022). Hypoalbuminemia is frequently observed in cancer patients and is closely linked to the severity, progression, and prognosis of the disease (Nazha et al., 2015). Serum albumin synthesis is influenced by factors such as osmotic colloid pressure and inflammation (Nazha et al., 2015). A decrease of just 1 g/dL in serum albumin significantly increases mortality risk, signaling inadequate nutrition (Tang, Li, & Sun, 2024).

2.4 FACTORS RELATED TO MALNUTRITION AMONG CANCER PATIENTS

The development of malnutrition among cancer patients is influenced by multiple interrelated factors. Primarily, it arises from insufficient dietary intake (Arends, 2023). Patient-related factors include older age, female gender, smoking, alcohol use, and psychological conditions such as anxiety and depression. Disease-related factors like advanced cancer stage and side effects from chemotherapy or radiotherapy further worsen nutritional status. Many patients experience reduced food intake due to swallowing difficulties, taste changes, and treatment-related fatigue (Cao et al., 2021). Weight loss was more common in those with advanced-stage cancer. This can be

attributed to a wide range of nutrition-impact symptoms (Siemens et al., 2020), which may stem from the tumor's local effects, side effects associated with anticancer therapies, or complications such as infections occurring during disease progression. It is also important to note that, when metabolic abnormalities are absent, irregularities in how the body uses nutrients or expends energy are uncommon (Arends, 2023).

2.5 CONSEQUENCES RELATED TO MALNUTRITION IN CANCER PATIENTS

Malnutrition remains a significant concern among cancer patients, contributing to elevated rates of both morbidity and mortality. Studies have shown that the prevalence of malnutrition is notably high in individuals undergoing chemotherapy treatment. It has been estimated that approximately 20 percent of cancer-related deaths are attributed to malnutrition and its associated complications (World Health Organization, 2018). Malnutrition is a critical issue among cancer patients, with reported incidence rates ranging from 40% to 80%. At the time of diagnosis, malnutrition affects approximately 15% to 20% of patients, and this figure may rise to 80% to 90% in those with advanced-stage cancer (Silva et al., 2015). Malnutrition in cancer patients typically occurs due to the complex interaction between the disease and the host. This results in reduced nutrient intake, appetite loss, altered taste perception, food aversions, as well as psychological issues such as fear, anxiety, and depression. These factors collectively worsen treatment outcomes by increasing therapy-related side effects, interrupting treatment regimens, extending hospital stays, impairing physical performance, weakening immune function, reducing quality of life, and ultimately affecting survival status (Gebremedhin et al., 2021). Moreover, it contributes to an elevated risk of

treatment-related side effects, negative drug reactions, interruptions in therapy, postoperative complications, and increased hospital readmission rates.

2.6 ASSOCIATION BETWEEN ALBUMIN LEVEL, PROTEIN INTAKE, AND MALNUTRITION RISK AMONG CANCER PATIENTS

Albumin plays a crucial role in the maintenance of blood colloid osmotic pressure and in the transport of a wide range of both endogenous and exogenous substances, making it essential for homeostasis (Belinskaia et al., 2021). Based on previous studies, individuals with lower serum albumin levels (≤ 4.2 g/dL) have significantly lower survival rates compared to those with higher levels. A decline in albumin levels is consistently associated with increased cancer mortality across various cancer types. Serum albumin is a crucial nutritional biomarker, as low levels usually indicate a calorie deficit and insufficient protein intake. Furthermore, albumin is an indicator of inflammation. Prolonged inflammation in cancer reduces albumin production and increases its breakdown. Additionally, decreasing albumin levels are frequently correlated with cachexia cases, which involve systemic complications and worsening conditions. Because of this, serum albumin is an essential indicator for evaluating cancer patients' nutritional status (Tang, Li, & Sun, 2024). To monitor the nutritional status of cancer patients, it is essential to consider the relationship among malnutrition risk, serum albumin levels, and protein intake. Low albumin levels indicate severe malnutrition and protein deficiency, while inadequate protein intake increases the risk of malnutrition (Wong et al., 2022). Consequently, insufficient albumin levels are indicative of malnutrition. However, further studies are required to explore the relationship between malnutrition risk, serum albumin levels, and protein intake

among cancer patients to improve interventions and patient outcomes. Serum albumin levels have long been regarded as an indicator of nutritional status, and in cancer patients, hypoalbuminemia is frequently observed, closely linked to the severity, progression, and prognosis of the disease. Produced primarily in the liver, albumin plays an essential role in maintaining circulatory function, metabolism, and drug transport, with its synthesis influenced by factors such as osmotic colloid pressure and inflammation.

Recent studies have shown that systemic inflammation has a significant impact on albumin levels (Nazha et al., 2015). Low albumin levels and reduced albumin-to-globulin ratios (AGR) are indicative of a proinflammatory state, which can negatively affect cancer outcomes and survival, as cancer cachexia, linked to inflammation, is also associated with both hypoalbuminemia and malnutrition. Hypoalbuminemia, malnutrition, and cancer cachexia are interconnected consequences of the body's inflammatory response to malignancy, highlighting albumin's role as a key negative acute-phase reactant (Nazha et al., 2015). Furthermore, serum albumin levels are widely considered an important prognostic marker, with lower albumin levels indicating a higher risk of cancer-related death . A decrease of just 1 g/dL in albumin significantly increases mortality risk, signaling inadequate nutrition, which is vital for assessing patient outcomes. Therefore, albumin's importance in maintaining overall health and assessing the success of cancer treatment underscores its role in cancer prognosis (Tang, Li, & Sun, 2024).

Optimizing nutritional status early on and maintaining elevated protein intake are essential to prevent and reduce negative health effects, such as muscle loss, which is common in cancer patients. Proteins supply the vital amino acids necessary for muscle

health, and muscle loss can vary depending on the stage and type of cancer, as well as changes in body weight. This can result in serious clinical consequences, including reduced treatment tolerance and lower survival rates. A mix of animal and plant-based proteins is likely the most effective way to support muscle health and prevent malnutrition during cancer treatment. Animal proteins are more effective in promoting muscle growth compared to plant-based proteins. As such, it is recommended that cancer patients get at least 65% of their protein from animal sources to enhance muscle anabolism. Ongoing research is examining the protein requirements and the effects of increased protein or amino acid intake on muscle in cancer patients, as muscle weakness can occur even in the absence of muscle loss (Ford et al., 2022).

2.7 CONCEPTUAL FRAMEWORK

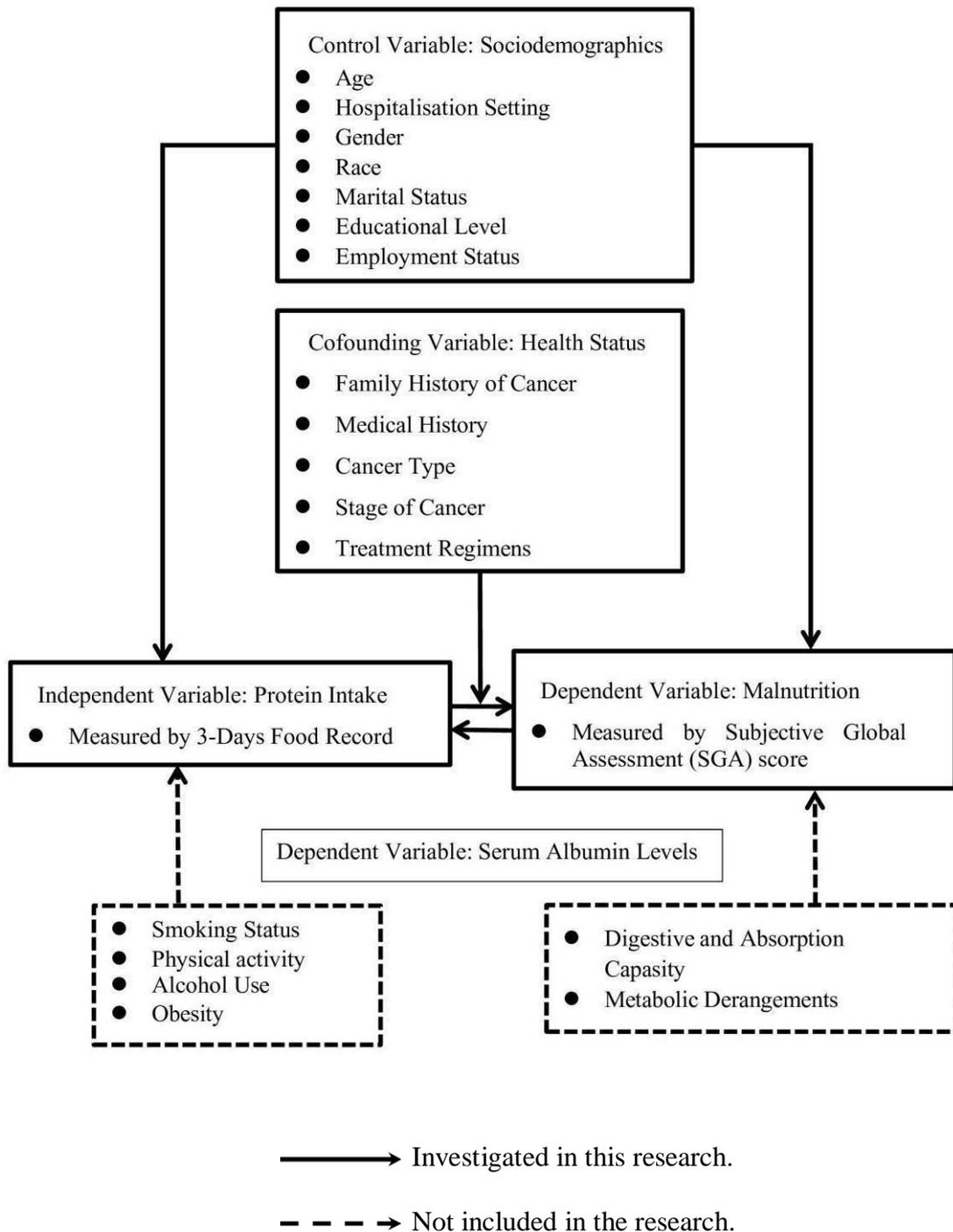


Figure 1 Conceptual framework of the association between risk of malnutrition, albumin levels, and protein intake among cancer patients in Hospital Pakar Universiti Sains Malaysia, Kelantan.