นิพนธ์ต้นฉบับ

ความชุกและปัจจัยเสี่ยงของภาวะทุพโภชนาการในผู้ป่วยมะเร็งผู้ใหญ่ในคลินิกผู้ป่วยนอกที่ศูนย์มะเร็ง: การศึกษาแบบตัดขวาง

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Prevalence and Risk Factors of Malnutrition Among Adult Cancer Patients in Outpatient Clinic at Cancer Center: A Cross-sectional Study

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(Received: 12 June, 2024; Revised: 12 September, 2024; Accepted: 8 January, 2025)

Abstract

Background: Cachexia is a common issue among cancer patients. Nutritional assessments and awareness of the risk factors for malnutrition should be prioritized. **Objectives:** This study aimed to investigate the prevalence of malnutrition among adult cancer patients in the cancer center using the validated Nutrition Alert Form (NAF). The secondary objective was to evaluate the risk factors of malnutrition among adult cancer patients. Moreover, the aim is to find correlations among NAF, laboratory findings, and anthropometric parameters. **Methods:** We conducted a cross-sectional study involving 272 outpatients with cancer at the Cancer Center, Khon Kaen Hospital, from October 2022 to August 2023. Nutritional status was assessed using the NAF, and risk factors including baseline characteristics, anthropometric indices, laboratory results, and cancer-related factors were evaluated. **Results:** Among the 272 patients, the median age was 59 years (IQR 51-67) and the median BMI was 21.7 kg/m² (IQR 19.2-24.8). The prevalence of moderate and severe malnutrition, according to NAF-B and NAF-C, was 43.8% and 11.8%, respectively. Patients with severe malnutrition experienced significant weight loss compared to those without malnutrition (% of weight change -12.77% vs. -2.13%, $p < .001$). Factors significantly associated with malnutrition included age ≥ 60 years old and BMI < 20 kg/m^2 (Adjusted odds ratio (adjOR) 2.17, (95%CI: 1.15, 4.12); and adjOR 3.97 (95%CI: 1.93, 8.17)) respectively. There was a highly significant correlation among NAF. **Conclusion:** The prevalence of malnutrition among outpatients with cancer is high. NAF can effectively evaluate nutritional status. Significant risk factors include low BMI and being elderly.

Keywords: Nutrition alert form, Cancer, Oral nutritional supplement, Immunonutrients, Malnutrition

บทคัดย่อ

ภูมิหลัง: ภาวะผอมหนังหุ้มกระดูกเป็นปัญหาที่พบบ่อยในผู้ป่วยโรคมะเร็ง **วัตถุประสงค์:** การศึกษานี้มีวัตถุประสงค์เพื่อศึกษาความชุกของภาวะทุพโภชนาการในผู้ป่วยมะเร็งผู้ใหญ่ในศูนย์มะเร็งโดยใช้แบบฟอร์มแจ้งเตือนโภชนาการ (Nutrition Alert Form; NAF) วัตถุประสงค์รองเพื่อหาปัจจัยเสี่ยงของภาวะทุพโภชนาการในผู้ป่วยมะเร็งผู้ใหญ่ นอกจากนี้ยังเพื่อหาความสัมพันธ์ระหว่าง NAF ผลทางห้องปฏิบัติการและสัดส่วนของร่างกายอีกด้วย **วิธีการ:** การศึกษานี้เป็นการวิจัยแบบตัดขวางที่รวบรวมผู้ป่วยมะเร็ง 272 ราย ที่ศูนย์มะเร็ง โรงพยาบาลขอนแก่น ตั้งแต่เดือนตุลาคม 2565 ถึงสิงหาคม 2566 โดยมีการประเมินภาวะโภชนาการโดยใช้ NAF และปัจจัยเสี่ยงซึ่งรวมถึงลักษณะพื้นฐาน สัดส่วนร่างกาย ผลการตรวจทางห้องปฏิบัติการ และปัจจัยที่เกี่ยวข้องกับมะเร็งอื่น ๆ **ผล:** ในผู้ป่วย 272 ราย มีค่ามัธยฐานของอายุที่ 59 ปี (IQR 51 - 67) และค่ามัธยฐานของดัชนีมวลกายอยู่ที่ 21.7 กิโลกรัม/เมตร^2 (IQR 19.2 - 24.8) ความชุกของภาวะทุพโภชนาการระดับปานกลางและรุนแรงตาม NAF อยู่ที่ร้อยละ 43.8 และ 11.8 ตามลำดับ ผู้ป่วยที่มีภาวะทุพโภชนาการรุนแรงมีน้ำหนักลดลงอย่างมีนัยสำคัญเมื่อเทียบกับผู้ป่วยที่ไม่มีภาวะทุพโภชนาการ (น้ำหนักที่เปลี่ยนแปลงคิดเป็นร้อยละ 12.77 เทียบกับร้อยละ 2.13, $p < .001$) ปัจจัยที่เกี่ยวข้องกับภาวะทุพโภชนาการอย่างมีนัยสำคัญ ได้แก่ อายุอย่างน้อย 60 ปี และดัชนีมวลกายที่น้อยกว่าหรือเท่ากับ 20 adjusted odds ratio (adjOR) 2.17 (95%CI: 1.15, 4.12); adjOR 3.97 (95%CI: 1.93, 8.17) ตามลำดับ นอกจากนี้พบความสัมพันธ์ระหว่างเครื่องมือ NAF อย่างมีนัยสำคัญทางสถิติ **สรุป:** ความชุกของภาวะทุพโภชนาการในผู้ป่วยนอกที่เป็นมะเร็งอยู่ในระดับสูง ดังนั้นควรใช้ NAF ในการประเมินภาวะโภชนาการ โดยเฉพาะอย่างยิ่งในผู้ป่วยมะเร็งที่มีดัชนีมวลกายน้อย และผู้สูงอายุ

คำสำคัญ: แบบแจ้งเตือนโภชนาการ, มะเร็ง, อาหารเสริมทางการแพทย์, สารอาหารภูมิคุ้มกัน, ภาวะทุพโภชนาการเลือดต่ำ

Introduction

Cancer cachexia is a common issue among cancer patients, arising from both the disease and its treatment.[1] The number of cancer diagnoses is increasing globally, with approximately 20 million new cases in 2022 compared to 17 million in 2018, according to the World Health Organization's global cancer burden report.[2, 3] Despite advancements in cancer diagnosis and treatment technologies, mortality rates remain high, making cancer the second leading cause of death worldwide. Cancer cachexia can exacerbate chemotherapy toxicity, diminish the quality of life, and reduce the effectiveness of cancer treatments. Cancer cachexia accounts for approximately 20% of cancer-related mortality.[4, 5, 6] Cancer patients face significant risks of malnutrition due to multiple factors, including insufficient food intake, their performance status, the specific types of cancer, and the direct and indirect side effects of treatments.[4, 6]

Recent systematic review and meta-analysis indicate that the prevalence of moderate to high-risk malnutrition ranges from 16% to 71.6%.[7] The Patient-Generated Subjective Global Assessment (PG-SGA) is the standard nutritional assessment for cancer patients, significantly correlating with worsened overall survival and increased postoperative complications.[7] The Nutrition Alert Form (NAF), recommended by the Society of Parenteral and Enteral Nutrition of Thailand (SPENT), is another nutritional assessment tool which is correlated with PG-SGA and has high sensitivity and specificity.[8, 9] However, there has been no prior study on the prevalence of malnutrition using NAF in outpatient clinics across different types of cancer patients.

This study aimed to determine the prevalence of malnutrition in an outpatient clinic at a cancer center and to evaluate the associated risk factors. We also seeked to examine the correlations between nutritional status assessed by NAF and various laboratory parameters (creatinine, serum albumin, blood urea nitrogen, white blood cell count, hemoglobin levels, total lymphocyte count, and absolute neutrophil count) as well as anthropometric indices.

Materials and methods Study design and Population Selection

This cross-sectional study was conducted in the outpatient department of the Cancer Center at Khon Kaen Hospital, Thailand. Patients diagnosed with cancer were included through random sampling from August 1, 2022 to November 30, 2023. The sample size was calculated using a formula[10] based on a proportion in the population of 22.9% from previous studies with an absolute error of .05, resulting in 272 participants.[11] The inclusion criteria encompassed patients older than 18 years who were diagnosed with any type of cancer based on histological and radiological methods. All participants provided informed consent before being included in the study. The exclusion criteria included patients with unstable hemodynamics, Eastern Cooperative Oncology Group (ECOG) performance status of 4, and pregnancy. The study received approval from the Khon Kaen Hospital Institute Review Board in Human Research, Thailand (approval code KEXP65057). Initially, 279 patients met the inclusion criteria; however, 7 were excluded, leaving 272 patients for analysis.

Nutrition Alert Form

All patients were assessed using the NAF as a single-step approach for nutritional assessment. The NAF score evaluates nutritional status based on the sum of eight items with either BMI, albumin, or TLC. The grading scores for each NAF are as follows: a score between 0 and 5 indicates normal nutritional status, a score between 6 and 10 indicates moderate malnutrition, and a score greater than 11 indicates severe malnutrition.

Statistical analysis

All analyses were performed using R version 4.1.2 [R Core Team (2021). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria].[12] Data normality was assessed using the Shapiro-Wilk test. Categorical variables are presented as numbers or percentages and were analyzed using the chi-square test, Fisher's exact test, or the McNemar test as appropriate. Descriptive statistics were presented as mean with standard deviation (SD) or median with interquartile range (IQR) for non-normally distributed continuous data, and as percentages for categorical data.

We employed univariate and multivariable analyses using a logistic regression model to assess the relationship between predictor variables and malnutrition. Crude and adjusted odds ratios, along with 95% confidence intervals (CI), were then calculated to evaluate the strength of these associations.[13] The Spearman rank correlation coefficient (ρ) was used to determine the correlation among the three types of NAF, laboratory findings, and anthropometric parameters.[14] Continuous variables were categorized according to their cut-off values for malnutrition. P-values less than .05 were considered statistically significant.

Results

Demographics and Clinical Characteristics stratified by NAF-BMI categories

All 272 patients met the inclusion criteria and were enrolled for analysis. The median age of the participants was 59 years (IQR 51-67), with 50% being male. The most common types of cancer among malnourished patients, as defined by NAF-B and NAF-C, were colorectal (30%), head and neck (28.5%), and breast cancer (18%). Approximately 60% of patients had advanced-stage cancer.

Significant differences in baseline characteristics, including ECOG performance status, cancer stage, TLC, serum albumin level, and hemoglobin level, were observed among different nutritional statuses. However, comorbidities did not differ significantly among cancer patients. Comorbid diseases included diabetes mellitus and chronic kidney disease (8.5%), while 15.5% of patients had hypertension,

dyslipidemia, thyroid disease, or heart disease. The remaining 76% of patients had no comorbid diseases. Other baseline characteristics of the study population are presented in Table 1.

Table 1 Baseline characteristics of the patients as stratified by NAF-BMI categories (N = 272)

Parameters	Overall (N = 272)	NAF A (N = 121)	NAF B (N = 119)	NAF C (N = 32)	p-value†
Age (years)‡	59 (51, 67)	57 (51, 66)	61 (52, 68)	61 (52, 69)	.20
Male (%)	135 (50%)	51 (42%)	68 (57%)	16 (50%)	.07
ECOG 0 (%)	81 (30%)	50 (41%)	30 (25%)	1 (3.1%)	<.001
ECOG 1 (%)	172 (63%)	66 (55%)	82 (69%)	24 (75%)	
ECOG 2 (%)	18 (6.6%)	5 (4.1%)	7 (5.9%)	6 (19%)	
ECOG 3 (%)	1 (0.4%)	0 (0%)	0 (0%)	1 (3.1%)	
Type of cancer (%)					NA
Breast cancer	49 (18%)	28 (23%)	17 (14%)	4 (12%)	
Upper GI	17 (6.2%)	8 (6.6%)	6 (5.0%)	3 (9.4%)	
Liver cancer	11 (4.0%)	7 (5.8%)	2 (1.7%)	2 (6.2%)	
Head and neck	55 (20%)	12 (9.9%)	29 (24%)	14 (44%)	
Lung cancer	44 (16%)	21 (17%)	20 (17%)	3 (9.4%)	
Genitourinary cancer	4 (1.5%)	1 (0.8%)	3 (2.5%)	0 (0%)	
Bone-soft tissue	4 (1.5%)	2 (1.7%)	2 (1.7%)	0 (0%)	
Lower GI	82 (30%)	40 (33%)	37 (31%)	5 (16%)	
Other	6 (2.2%)	2 (1.7%)	3 (2.5%)	1 (3.1%)	
Cancer stage 1 (%)	10 (4%)	3 (2.5%)	3 (2.5%)	4 (12%)	.01
Cancer stage 2 (%)	36 (13%)	11 (9.1%)	23 (19%)	2 (6.2%)	
Cancer stage 3 (%)	61 (23%)	23 (19%)	28 (24%)	10 (31%)	
Cancer stage 4 (%)	165 (60%)	84 (69%)	65 (54.6%)	16 (50%)	
Comorbidity (%)	65 (24%)	22 (18.1%)	32 (26.9%)	11 (34.3%)	.20
Chemotherapy	171 (63%)	76 (63%)	79 (66%)	16 (50%)	NA
Radiotherapy	21 (7.7%)	4 (3.3%)	13 (11%)	4 (12%)	
Chemoradiotherapy	18 (6.6%)	3 (2.5%)	9 (7.6%)	6 (19%)	
Targeted therapy	12 (4.4%)	7 (5.8%)	4 (3.4%)	1 (3.1%)	
Palliative care	14 (5.1%)	5 (4.1%)	5 (4.2%)	4 (12%)	
Hormonal therapy	15 (5.5%)	11 (9.1%)	4 (3.4%)	0 (0%)	
Other	21 (7.7%)	15 (12%)	5 (4.2%)	1 (3.1%)	
TLC($x10^3$cells/mm^3)‡	1.55 (0.98, 2.20)	1.81 (1.22, 2.41)	1.48 (0.84, 2.10)	0.88 (0.53, 1.63)	<.001
ANC($x10^3$cells/mm^3) ‡	3.55 (2.48, 5.36)	3.48 (2.47, 5.02)	3.47 (2.44, 5.26)	4.97 (2.81, 5.99)	.20
BUN (mg/dL) ‡	12.0 (9.0, 16.0)	12.0 (9.0, 16.0)	12.0 (9.0, 15.0)	10.5 (9.0, 16.0)	.80
Creatinine(mg/dL) ‡	0.77 (0.63, 0.94)	0.75 (0.61, 0.91)	0.80 (0.67, 0.95)	0.76 (0.60, 0.97)	.40
Albumin (g/dL) ‡	3.99 (3.50, 4.20)	4.00 (3.80, 4.30)	4.00 (3.50, 4.20)	3.15 (2.68, 3.80)	<.001
Hemoglobin (g/dl) ‡	11.3 (10.0, 12.5)	11.4 (10.2, 12.6)	11.3 (10.0, 12.6)	10.3 (9.3, 11.4)	.004

† Kruskal-Wallis rank sum test; Pearson's Chi-squared test; Fisher's exact test; ‡Median (IQR); significance is shown as p-value < .05
Abbreviations: GI: Gastrointestinal, TLC: Total lymphocyte counts, ANC: Absolute neutrophil counts, BUN: Blood urea nitrogen

Prevalence, Nutritional Status and Intervention of the Study Population Stratified by NAF-BMI Categories

Using the NAF as a one-step assessment tool, 43.8% of patients (N = 119) were classified as having moderate malnutrition (NAF B), and 11.8% (N = 32) were classified as having severe malnutrition (NAF C) out of a total of 272 patients. The nutritional status of the study population, stratified by NAF-BMI categories, are presented in Table 2. ABW and BMI decreased significantly with worsening nutritional status (p-value < 0.05). According to NAF A, B, and C categories, the BMI values were 22.9 kg/m² (IQR 20.6-25.3), 20.9 kg/m² (IQR 18.4-23.9), and 18.7 kg/m² (IQR 16.2-21.4), respectively.

Nutritional routes included oral nutrition (137 patients, 50%), oral nutritional supplements (ONS) with immunonutrients (80 patients, 29%), standard ONS (41 patients, 15%), and enteral nutrition (14 patients, 5.1%). Malnourished individuals were more likely to receive an oral diet with ONS containing immunonutrients and enteral nutrition compared to individuals without malnutrition. However, there was no statistically significant difference in the nutritional routes among different nutritional status categories.

Cancer patients with malnutrition experienced significantly more weight loss compared to those without malnutrition. The overall percentage of weight change was -3.85 % (IQR -9.89 to 0.18). For the NAF C group, the percentage of weight change was -12.77 % (IQR -17.80 to -6.32); for the NAF B group, it was -5.36 % (IQR -10.18 to 0.00); and for the NAF A group, it was -2.13 kg (IQR -6.15 to 1.09) (p < .05), as shown in Table 2.

Table 2: Nutrition status and interventions stratified by NAF-BMI categories.

Parameters	Overall N = 272	NAF A (44.4%) N = 121	NAF B (43.8%) N = 119	NAF C (11.8%) N = 32	p-value†
Actual BW (kg)	56 (50, 64)	60 (53, 65)	54 (48, 63)	48 (42, 55)	<.001
BMI (kg/m^2)	21.7 (19.2, 24.8)	22.9 (20.6, 25.3)	20.9 (18.4, 23.9)	18.7 (16.2, 21.4)	.029
ΔWeight (%)	–3.85 (–9.89, 0.18)	–2.13 (–6.15, 1.09)	–5.36 (–10.18, 0.00)	–12.77 (– 17.80, – 6.32)	<.001

†Kruskal-Wallis rank sum test and data are presented median (Interquartile range).

Correlation between NAF, anthropometric parameters and laboratory results

Among the three types of NAF scores, there was a statistically significant and very high correlation between NAF-BMI and both NAF-ALB (ρ = 0.96, p < .001) and NAF-TLC (ρ = 0.91, p < .001). Despite statistical significance, the correlation between NAF scores and either laboratory results or anthropometric indices was negligible or low.

Analysis of risk factors associated with malnutrition

Logistic regression analyses were conducted to identify risk factors associated with malnutrition. The analysis included sex, age, BMI, type of cancer, current cancer treatment, ECOG status, cancer stage, ANC level, TLC level, albumin level, and types of nutritional support. Compared to patients younger than 60 years old with a BMI greater than 20, the odds of malnutrition among cancer patients older than 60 years with a BMI of less than 20 were 2.17 times higher adjusted odds ratio (adjOR) 2.17, (95%CI: 1.15, 4.12) and 3.97 times higher (adjOR 3.97 (95%CI: 1.93, 8.17)).

Table 3 Risk factors associated with malnutrition among cancer patients

Variables	Outcome variables		Crude odds ratio (95%CI)	p-value	Adjusted odds ratio (95%CI)	p-value
	NAF B+C (N = 151)	NAF A (N = 121)				
Male	85	50	1.83 (1.13, 2.97)	.015	1.46 (0.76, 2.80)	.25
Female	66	71	Ref			
Age ≥ 60 years	83	48	1.86 (1.14, 3.01)	.012	2.17 (1.15, 4.12)	.017*
Age < 60 years	68	73	Ref	Ref	Ref	Ref
BMI ≤ 20 kg/m^2	70	21	4.12 (2.33, 7.27)	<.001	3.97 (1.93, 8.17)	<.001*
BMI > 20 kg/m^2	81	100	Ref	Ref	Ref	Ref
Type of cancer						
Breast	21	28	Ref	Ref	Ref	Ref
Upper GI	9	8	1.5 (0.5, 4.54)	.47	0.31 (0.67, 1.39)	.13
- HCC	4	7	0.76 (0.2, 2.95)	.69	0.26 (0.04, 1.60)	.15
- Head and neck	43	12	4.78 (2.03, 11.22)	<.001	0.86 (0.20, 3.61)	.84
- Lung	22	22	1.33 (0.59, 3.02)	.49	0.67 (0.21, 2.12)	.49
- Genitourinary	3	1	4.0 (0.39, 41.23)	.24	2.15 (0.16, 29.3)	.56
- Bone	2	2	1.33 (0.17, 10.25)	.78	0.57 (0.04, 7.52)	.67
- Colorectal	43	39	1.47 (0.72, 3.00)	.29	0.53 (0.18, 1.52)	.24
- Other	4	2	2.0 (0.306, 13.06)	.47	0.35 (0.04, 3.34)	.36
Current Treatment						
- Chemotherapy	95	76	3.13 (1.16, 8.44)	.025	3.21 (0.84, 2.33)	.09
- Radiotherapy	17	4	10.63 (2.51, 44.99)	.001	3.93 (0.57, 6.95)	.16
- CCRT	15	3	12.5 (2.63, 59.57)	.002	5.71 (0.87, 7.37)	.07
- Target	5	7	1.79 (0.40, 7.91)	.445	2.64 (0.43, 16.3)	.29
- Palliative	9	5	4.5 (1.06, 19.11)	.042	4.21 (0.7, 26.1)	.12
- Hormone	4	11	0.91 (0.21, 4.015)	.9	0.98 (0.14, 6.69)	.99
- Other	6	15	Ref	Ref	Ref	Ref
- ECOG 0	31	50	Ref	Ref	Ref	Ref
- ECOG 1	106	66	2.59 (1.51, 4.46)	<.01	1.41 (0.69, 2.87)	.34
- ECOG 2	13	5	4.19 (1.36, 12.91)	.012	2.37 (0.58, 9.61)	.23
- ECOG 3	1	0	NA	NA	NA	NA
- Cancer stage 1	7	3	Ref	Ref	Ref	Ref
- Cancer stage 2	25	11	0.97 (0.21, 4.49)	.97	0.49 (0.06, 4.23)	.52
- Cancer stage 3	38	23	0.71 (0.166, 3.01)	.64	0.28 (0.03, 2.26)	.23
- Cancer stage 4	81	84	0.41 (0.10, 1.65)	.21	0.19 (0.02, 1.46)	.11
ANC<1500 unit	12	10	0.96 (0.40, 2.30)	.92	0.72 (0.24, 2.18)	.55
ANC>1500 unit	139	111	Ref	Ref	Ref	Ref

Variables	Outcome variables		Crude odds ratio (95%CI)	p-value	Adjusted odds ratio (95%CI)	p-value
	NAF B+C (N = 151)	NAF A (N = 121)				
TLC <1500 unit	85	44	2.25 (1.38, 3.68)	.001	1.9 (0.99, 3.60)	.05
TLC >1500 unit	66	77	Ref	Ref	Ref	Ref
Albumin <2.8 g/dL	14	2	6.08 (1.35, 27.30)	.018	5.14 (0.82, 32.18)	.08
Albumin >2.8 g/dL	137	119	Ref	Ref	Ref	Ref
Nutritional support						
- Oral intake	64	73	Ref	Ref	Ref	Ref
- Enteral nutrition	13	1	14.83(1.89,116.51)	.01	2.46 (0.24, 25.0)	.45
- ONS (standard)	19	22	0.99 (0.49, 1.98)	.966	0.68 (0.28, 1.69)	.41
- ONS (add immunonutrients)	55	25	2.51 (1.41, 4.48)	.002	2.19 (1.0, 4.76)	.047*

Abbreviation: ANC (Absolute neutrophil count), BMI (Body Mass Index, ECOG (Eastern Cooperative Oncology Group performance status), CCRT (Concurrent chemoradiotherapy), TLC (Total lymphocyte count), ONS (oral nutritional support), *p-value < .05, unit = cells/mm³

Discussion

To the best of our knowledge, this study is the first to evaluate the prevalence of malnutrition among a variety of cancer patients in the outpatient department of the Cancer Center using the NAF. The prevalence of moderate malnutrition and severe malnutrition was found to be 43.8% and 11.8%, respectively, using NAF as a one-step approach assessment tool. Moreover, a high correlation was observed between NAF-BMI and other NAF parameters, including NAF-ALB and NAF-TLC. In settings where weight measurement is not feasible, the use of NAF-ALB and NAF-TLC were beneficial. Additionally, this study identified several risk factors associated with malnutrition, including BMI $\leqslant$ 20 kg/m^2, and age $\geqslant$ 60 years.

Cancer patients face a high risk of malnutrition due to inadequate intake, appetite loss, gastrointestinal dysfunction, therapeutic side effects, increased energy expenditure, and tumor-associated inflammation. Malnutrition is linked to higher mortality, postoperative complications, and prolonged hospital stays. Guidelines recommend risk screening and nutritional assessment for early detection, followed by interventions to correct reversible causes, provide multimodal nutritional support, and maintain or improve ECOG performance status, critical for treatment tolerance.[15, 16] The NAF, validated against PG-SGA, offers a simpler alternative for monitoring nutritional status without requiring complex examinations.[9] Our study highlighted a strong correlation between NAF using BMI and laboratory tests, enabling assessment in patients unable to undergo weight measurement.

The prevalence of malnutrition varies among cancer centers depending on the clinical setting and measurement tools used. In the Thai population, previous studies using NAF have revealed malnutrition prevalence rates of 40% in colorectal cancer patients, 91.8% in head and patients with locally advanced head and neck squamous cell carcinoma, and 89.8% in cancer patients receiving radiotherapy[9, 17, 18] Some center showed that 27% of patients were moderately malnourished, and 34% were severely malnourished according to the PG-SGA.[19] BMI has

limitations in detecting malnutrition among cancer patients. Conditions like edema caused by hypoalbuminemia and carcinomatosis peritonei can obscure changes in body weight. Therefore, validated screening and assessment tools should be used throughout the cancer treatment process.[20] Therefore, NAF can be considered a single-step assessment tool for outpatient clinics due to its higher sensitivity.

Cancer patients often face malnutrition due to disease-related mechanisms, making nutritional and immune support essential. Cancer cachexia, a complex wasting syndrome, is not fully addressed by conventional nutrition care. Early-stage interventions, including nutrition counseling, fortified foods, and oral nutritional supplements (ONS) with anti-inflammatory ingredients, are recommended for precachexia to address metabolic derangements. Immunonutrients like fish oil, arginine, nucleotides, and glutamine improve appetite, calorie intake, body weight, and postoperative outcomes, as supported by current guidelines.[15] Our cross-sectional study investigates malnutrition and nutrition routes, including enteral nutrition and ONS with immunonutrients. Reactive feeding correlated with higher malnutrition risk, while nasogastric feeding in head and neck cancer patients reduced complications and improved long-term oral intake.[21] However, the study design limits causal conclusions. In resource-limited settings, ONS with immunonutrients and prophylactic feeding may be prescribed after other interventions fail, showing significant outcomes.

Several factors contribute to malnutrition in cancer patients, with esophageal, gastroenteric, head and neck, and pancreatic cancers showing the highest prevalence. Patients with head and neck and upper gastrointestinal cancers are particularly vulnerable due to poor intake and treatment-related sequelae.[22] Our study did not identify specific cancer types and staging associated with malnutrition risk, consistent with previous research showing no link between disease stage and malnutrition risk.[23] Gender differences in treatment efficacy and toxicity may influence nutritional status, but our findings did not support earlier studies suggesting males are at higher risk.[24] While prior research connects malnutrition with poorer ECOG scores, our study found no significant risk, likely due to the exclusion of patients with ECOG status of 4[25] Treatments like chemotherapy, RT, and CCRT are associated with a higher risk of malnutrition, primarily due to severe radiation-induced oral mucositis, which reduces oral intake. Despite increasing treatment effectiveness, these combined modalities lead to more adverse effects.

This study's strength lies in being the first to utilize the NAF to determine the prevalence of malnutrition among various types of cancer outpatients at a referral center, including patients who received different kinds of therapy. This study also establishes the first correlation between NAF-Alb, NAF-TLC, and NAF-BMI in cancer patients. However, we acknowledge some limitations, such as the cross-sectional nature of the study, which recorded data at various points during treatment. For example, most of patients with malnutrition were given nutrition interventions, including enteral feeding and ONS with immunonutrients. Consequently, we were unable to establish a temporal relationship between nutritional status and certain risk factors, such as nutrition interventions. Further longitudinal studies are needed to detect malnutrition using NAF among cancer patients in outpatient departments and assess the improvement of nutritional status outcome after receiving nutrition interventions.

Conclusion

The prevalence of malnutrition among cancer outpatients is high, highlighting the importance of utilizing the NAF to evaluate nutritional status, particularly in patients with low BMI, and the elderly patients. Given the strong correlation between NAF-BMI, NAF-Alb, and NAF-TLC, all these tools can be employed to screen for malnutrition among outpatient cancer patients.

เอกสารอ้างอิง (References)

1. Muscaritoli M, Arends J, Bachmann P, Baracos V, Barthelemy N, Bertz H, et al. ESPEN practical guideline: clinical nutrition in cancer. Clin Nutr 2021;40(5):2898-913.
2. Bray F, Laversanne M, Sung H, Ferlay J, Siegel RL, Soerjomataram I, et al. Global cancer statistics 2022: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA Cancer J Clin 2024;74(3):229-63.
3. Gebremedhin TK, Cherie A, Tolera BD, Atinafu BT, Demelew TM. Prevalence and risk factors of malnutrition among adult cancer patients receiving chemotherapy treatment in cancer center, Ethiopia: cross-sectional study. Heliyon 2021;7(6):e07362.
4. Ni J, Zhang L. Cancer cachexia: definition, staging, and emerging treatments. Cancer Manag Res 2020;12:5597-605.
5. Lustberg MB. Management of neutropenia in cancer patients. Clin Adv Hematol Oncol 2012;10(12):825-6.
6. Donaldson SS, Lenon RA. Alterations of nutritional status: impact of chemotherapy and radiation therapy. Cancer 1979;43(5 Suppl):2036-52.
7. Zhang J, Xu W, Zhang H, Fan Y. Association between risk of malnutrition defined by patient-generated subjective global assessment and adverse outcomes in patients with cancer: a systematic review and meta-analysis. Public Health Nutr 2024;27(1):e105.
8. Komindrg S, Tangsermwong T, Janepanish P. Simplified malnutrition tool for Thai patients. Asia Pac J Clin Nutr 2013;22(4):516-21.
9. Taonam N, Ngamphaiboon N, Aiempradit S, Lepananon T, Sankaseam N, Komindr S, et al. Validation of a Nutrition Alert Form (NAF) against Patient-Generated Subjective Global assessment (PG-SGA) in Patients with locally advanced head and neck squamous cell carcinoma. J Nutr Assoc Thailand 2021;56(1):52-64.
10. Pourhoseingholi MA, Vahedi M, Rahimzadeh M. Sample size calculation in medical studies. Gastroenterol Hepatol Bed Bench 2013;6(1):14-7.
11. Saeteaw M, Mutthapha R, Polyiam S. The evaluation of malnutrition in cancer patients who treated with concurrent chemoradiotherapy at Ubonratchathani Cancer Hospital. Isan J Pharm Sci 2018;14(3):44-55.
12. Team RC. R: A language and environment for statistical computing Vienna. Austria: R Foundation for Statistical Computing; 2021.
13. Sperandei S. Understanding logistic regression analysis. Biochem Med (Zagreb) 2014;24(1):12-8.
14. McHugh ML. Interrater reliability: the kappa statistic. Biochem Med (Zagreb) 2012;22(3):276-82.
15. Arends J, Baracos V, Bertz H, Bozzetti F, Calder PC, Deutz NEP, et al. ESPEN expert group recommendations for action against cancer-related malnutrition. Clin Nutr 2017;36(5):1187-96.
16. Santarpia L, Contaldo F, Pasanisi F. Nutritional screening and early treatment of malnutrition in cancer patients. J Cachexia Sarcopenia Muscle 2011;2(1):27-35.
17. Raksawongsa W. Nutritional status and dietary perceptions in colorectal cancer patients undergoing adjuvant chemotherapy. [Thesis] Bangkok : Chulalongkorn University; 2019.
18. Tongyai A, Sutthiruk J, Wittayapun Y. Association of nutritional assessment in cancer patients receiving radiotherapy between Body Mass Index (BMI) and Nutrition Alert Form (NAF). J DMS 2017;42(5):101-8.
19. Nitichai N, Angkatavanich J, Somlaw N, Voravud N, Lertbutsayanukul C. Validation of the scored patient-generated subjective global assessment (PG-SGA) in Thai setting and association with nutritional parameters in cancer patients. Asian Pac J Cancer Prev 2019;20(4):1249-55.

เอกสารอ้างอิง (References)

20. Kadakia KC, Symanowski JT, Aktas A, Szafranski ML, Salo JC, Meadors PL, et al. Malnutrition risk at solid tumor diagnosis: the malnutrition screening tool in a large US cancer institute. Support Care Cancer. 2022;30(3):2237-44.
21. Sheth CH, Sharp S, Walters ER. Enteral feeding in head and neck cancer patients at a UK cancer centre. J Hum Nutr Diet 2013;26(5):421-28.
22. Reed WT, Jiang R, Ohnuma T, Kahmke RR, Pyati S, Krishnamoorthy V, et al. Malnutrition and adverse outcomes after surgery for head and neck cancer. JAMA Otolaryngol Head Neck Surg. 2024;150(1):14-21.
23. Bicakli DH, Uslu R, Güney SC, Coker A. The relationship between nutritional status, performance status, and survival among pancreatic cancer patients. Nutr Cancer 2020;72(2):202-8.
24. Karami K, Pourmahmoudi A, Akbartabar Toori M, Imani H, Hosseinikia M, Jounaghani M, et al. Malnutrition risk and related factors in cancer patients undergoing chemotherapy: a cross-sectional study. World Cancer Res J. 2021;8.
25. Sheth CH, Sharp S, Walters ER. Enteral feeding in head and neck cancer patients at a UK cancer centre. J Hum Nutr Diet 2013;26(5):421-28.