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Impact of Adjuvant Chemotherapy on Nutritional Status and Functional Capacity in Postoperative Stage III Colorectal Cancer Patients

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ABSTRACT:
Background: Colorectal cancer is one of the cancers with high prevalence in Indonesia. Management generally involves surgery and adjuvant chemotherapy. However, chemotherapy often causes side effects that can affect the nutritional status and functional capacity of patients. Nutritional status and Karnofsky index are important indicators in assessing the quality of life of post-chemotherapy patients.
Aims: This study aims to analyze the relationship between adjuvant chemotherapy with nutritional status and Karnofsky index in patients with stage III colorectal cancer after surgery.
Methods: This study used an analytic observational approach with a cross-sectional design. A total of 65 stage III colorectal cancer patients at Sultan Agung Islamic Hospital Semarang who met the inclusion and exclusion criteria were analyzed using medical record data. Nutritional status was assessed through body mass index (BMI), and Karnofsky index was classified into good and bad categories. Data analysis was performed using the Chi-Square test.
Results: Most patients had BMI in the normal category (58.5%) and Karnofsky index in the good category (64.6%). Statistical test results showed that there was no significant relationship between adjuvant chemotherapy and nutritional status ($p = 0.356$) or Karnofsky index ($p = 0.841$).
Conclusion: Adjuvant chemotherapy was not significantly associated with nutritional status and Karnofsky index in post-surgical stage III colorectal cancer patients. This study emphasizes the importance of a holistic care approach and nutritional support in maintaining patients' quality of life.

Keywords: Adjuvant chemotherapy, colorectal cancer, nutritional status, Karnofsky index, quality of life

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INTRODUCTION

Colorectal cancer is one of the most common types of cancer, with high incidence rates in both developed and developing countries, including Indonesia (Dwijayanthi et al., n.d.; Hossain et al., 2022; Prihantono et al., 2023) . According to data from the Global Cancer Observatory (2022), it ranks fourth in Indonesia, with 35,676 cases reported (Hardiati et al., 2022; Mulyadi & Sugiarto, 2020; Sugeng et al., 2022) . This disease progresses slowly and symptoms often only appear in advanced stages. The primary treatment for colorectal cancer involves surgical procedures, followed by additional therapies such as chemotherapy (M. Agung Rahmadi et al., 2024; Nugraha et al., 2023; Salmiah & Sayuti, 2024; I. W. W. Sari & Nurafriani, 2024) . Two important parameters in assessing the success of therapy and the patient's quality of life are nutritional status and the Karnofsky index (Larasari & Zulaikha, 2021; Malikhah et al., 2021; Novitasari et al., 2020) . Nutritional status reflects the balance between a patient's nutritional needs and intake, which is crucial for recovery, while the Karnofsky index assesses a patient's ability to perform daily activities independently. Together, these indicators are vital for determining how well a patient can endure treatment and recover.

In clinical practice, adjuvant chemotherapy that is, additional therapy administered after surgery still poses various problems that can lead to a decline in patients' quality of life (Darmawan et al., 2019; Mirfauddin et al., 2023; M. I. Sari et al., 2019) . The aim of chemotherapy is to eliminate microscopic cancer cells that are not clinically detectable (Nareswari et al., 2018; Samuel Frederik Tuhumury, n.d.) . However, this is often not achieved in practice due to significant side effects such as nausea, vomiting, loss of appetite, peripheral neuropathy and prolonged fatigue. These can disrupt nutrient intake, lead to weight loss and hinder daily activities (Abu El-Kass et al., 2021; Di Nardo et al., 2022; Eriyani et al., 2022) . The discrepancy between the intended and actual outcomes of chemotherapy underscores the importance of evaluating its impact on patients' nutritional status and physical function, particularly when the therapy has negative effects on other aspects of their health.

There are plenty of research opportunities in this field, particularly at hospitals that serve as cancer treatment centers, such as Sultan Agung Islamic Hospital. This research is important for identifying the extent to which adjuvant chemotherapy affects patients' nutritional status and physical function, thereby providing healthcare providers with a basis for evaluation. Furthermore, this research can inform the development of chemotherapy administration protocols that balance anticancer efficacy with its impact on patients' quality of life. Previous studies examining two key variables nutritional status and the Karnofsky index in stage III colorectal cancer patients simultaneously are limited.

The research gap in this study is clear. While many studies have examined the clinical effectiveness of chemotherapy, such as survival rates or tumor size reduction, few have investigated its impact on patients' overall physiological and functional condition. This study is unique because it seeks to assess quantitatively how nutritional status and the Karnofsky index two indicators of quality of life are affected by adjuvant chemotherapy. Using an analytical observational design and a cross-sectional approach, the study also aims to address the lack of literature in Indonesia discussing the impact of cancer therapy in Islamic hospitals.

The choice of adjuvant chemotherapy as the independent variable is not arbitrary. Chemotherapy is the primary postoperative treatment option for patients with stage III colorectal cancer. However, this therapy can have a wide range of side effects, which vary from person to person. These side effects are not only temporary, but can also affect the body's metabolic balance and physical performance in the long term.

This study makes a distinctive contribution in several ways. Firstly, it is conducted at an Islamic hospital in Indonesia, providing a unique socio-cultural and religious perspective on cancer care, an aspect that is rarely explored in similar studies. Secondly, unlike most previous research, which tends to focus on one or the other in isolation, this study simultaneously investigates two critical quality-of-life indicators: nutritional status and the Karnofsky index. Third, the study uses theoretical integration, incorporating perspectives from the biopsychosocial model, Maslow's hierarchy of needs and physiological homeostasis theory, to enrich the interpretation of the findings. Together, these elements highlight the novelty and importance of this research in achieving a comprehensive understanding of patient outcomes following adjuvant chemotherapy.

METHOD

Research design

This study employed an analytical observational design with a cross-sectional approach (Capili, 2021; Moradi et al., 2021; Ramji, 2022). The aim of the study was to determine the relationship between adjuvant chemotherapy (the independent variable) and nutritional status, as well as the Karnofsky index (the dependent variables), in patients with stage III colorectal cancer after surgery.

Participants and Data Collection

The study involved 65 stage III colorectal cancer patients treated at Sultan Agung Islamic Hospital, Semarang, from 2018 to 2023. Of these, 35 patients had received adjuvant chemotherapy, and 30 had not. Participants were aged between 19 and 64 years.

The target population was all stage III colorectal cancer patients undergoing treatment. The accessible population included those with complete and accessible medical records during the specified period. The sampling technique used was consecutive sampling, where subjects were selected based on inclusion and exclusion criteria until the required number of participants was reached.

1. Inclusion Criteria
    - Diagnosed with stage III colorectal cancer.
    - Complete medical records including height, weight, Karnofsky index, cancer staging, and CT scan results.
    - Age between 19 and 64 years.
2. Exclusion Criteria
    - Patients with severe comorbidities (e.g., stroke, infection, or other cancers).
    - Patients with congenital disorders or severe disabilities affecting daily functioning.
    - Patients who did not complete 12 cycles of chemotherapy.
3. Data were collected from hospital medical records, which included
    - Nutritional status (BMI based on height and weight).
    - Karnofsky index (evaluated through physician assessments).
    - Chemotherapy administration status (adjuvant chemotherapy received or not after 12 cycles).

All medical records used in this study followed standardized documentation procedures based on clinical hospital guidelines, ensuring consistency, reliability, and validity of the recorded data. Because the instruments were extracted from routine medical records, additional psychometric testing was not performed

Procedures and If Relevant, the Time Frame

Research stages:

- Prepare and approve the proposal.
- Submission of ethical clearance to the Faculty of Medicine at UNISSULA.
- Data collection through patient medical records (2018-2023 period).
- Participants will be selected based on inclusion and exclusion criteria.
- Data processing using SPSS software, version 27.

Implementation period: July 2024**.**

Analysis Plan

The collected data were analyzed descriptively and inferentially. Descriptive analysis was used to summarize the participants' characteristics (age, gender, nutritional status and Karnofsky index) in terms of frequencies, percentages and means. Next, inferential analysis was conducted to test the hypothesis regarding the relationship between the independent variable (adjuvant chemotherapy: yes/no) and the dependent variable.

- The Chi-Square test was used if the data met the cell frequency distribution requirement of >5.
- If the data distribution did not meet the Chi-Square requirement, a Fisher's Exact test was used instead.
- The Mann-Whitney test was used if the data were ordinal and not normally distributed.

RESULTS AND DISCUSSION

Results

1. The relationship between adjuvant chemotherapy and nutritional status (BMI).
   Test used: Chi-square

   Table 4.2 shows the distribution of nutritional status based on the administration of adjuvant chemotherapy.

Adjuvant chemotherapy	Very thin	Thin	Normal	Fat	Obese	Total	p-value
Yes (n=35)	7 (20.0%)	6 (17.1%)	17 (48.6%)	2 (5.7%)	3 (8.6%)	100%	0,356
No (n=30)	3 (10.0%)	3 (10.0%)	21 (70.0%)	2 (6.7%)	1 (3.3%)	100%	
Total (n = 65)	10 (15.4%)	9 (13.8%)	38 (58.5%)	4 (6.2%)	4 (6.2%)	100%	

   Interpretation: There was no significant association between adjuvant chemotherapy and nutritional status of colorectal cancer patients (p = 0.356).

2. Relationship between adjuvant chemotherapy and Karnofsky Index
   Test used: Chi-Square

Adjuvant Chemotherapy	Poor (<80%)	Good (≥80%)	Total	p-value
Yes (n=35)	12 (34.3%)	23 (65.7%)	100%	0,841
No (n = 30)	11 (36.7%)	19 (63.3%)	100%	

Total (n = 65)	23 (35.4%)	42 (64.6%)	100%	

Interpretation: There was no significant association between adjuvant chemotherapy and Karnofsky index in stage III colorectal cancer patients after surgery (p = 0.841).

Discussion

The results of this study showed that adjuvant chemotherapy was not significantly associated with nutritional status (p = 0.356) or Karnofsky index (p = 0.841) in stage III colorectal cancer patients after surgery. These results suggest that, although chemotherapy is often associated with severe side effects such as nausea, loss of appetite and fatigue, these adverse effects do not necessarily result in a deterioration in nutritional or functional status, particularly when patients receive comprehensive clinical care. (Hutagaol et al., 2023; Ruhyanudin et al., 2022; Tumina & Yona, 2020) . In the perspective of homeostasis theory, the human body has an adaptive ability to maintain physiological balance despite facing stressors such as cytotoxic therapy (Bakar & Negara, 2024; Humairah et al., 2024; Isfandiary et al., 2021) . If hospital support systems such as nutritional monitoring, side effect control, and patient education are optimal, the balance can be maintained so that nutritional status remains in the normal category and functional abilities remain good.

From a theoretical perspective, these results can be explained by the homeostasis theory. This theory states that the human body has intrinsic adaptive mechanisms that maintain physiological balance in the face of stressors, such as cytotoxic therapies. (Rahmi et al., 2022; Wijaya et al., 2022) . In this context, patients who receive appropriate nutritional monitoring, symptom management and psychosocial support may be able to maintain their physical functioning and nutritional health despite undergoing chemotherapy. The Karnofsky index used to measure the patient's ability to perform daily activities is also influenced by the body's adaptive capacity and energy reserves, not solely by the type of therapy undergone (Ishaq et al., 2021; Simanjuntak et al., 2022; Xu et al., 2021) . This is in line with the biopsychosocial model that places the individual as a system influenced by the interaction of biological, psychological, and social factors (Alexsander et al., 2023; Hidayat, 2022; Ismail et al., 2024) . Therefore, while the results show no statistically significant differences, they emphasise the importance of contextualised care models, such as those practised in Islamic hospitals, in mitigating the potential negative effects of chemotherapy. The findings emphasise that institutional protocols based on a holistic approach to care can protect patient well-being.

The theoretical contribution of this study lies in reinforcing the understanding that medical interventions such as chemotherapy need to be evaluated not only from a clinical perspective (e.g. reduction in tumor size), but also from the impact on patients' quality of life. This study proves that a comprehensive treatment approach can mitigate side effects that could theoretically be detrimental to the patient's physical condition. On the other hand, this study also has limitations. The use of retrospective data from medical records limits control of factors such as the type of chemotherapy drugs, actual diet, psychological support, and patient comorbidities. In fact, Hans Selye's stress theory explains that the body's response to stress is strongly influenced by the duration and intensity of exposure, as well as the adaptive capacity of each individual (Adiningsih & Zahro', 2023; Brahmana, 2024; Rochette et al., 2023; Szabo, 2023) . Without taking these factors into account in detail, the results of statistical analysis may miss important mediating variables.

For this reason, future studies are recommended to use a longitudinal design so that the dynamics of changes in nutritional status and Karnofsky index can be monitored more accurately over time. Roy's adaptation theory-based approach can be used as a framework to assess how patients adapt to chemotherapy in the long term, both physiologically and psychosocially. In addition, the integration of stress coping theory and basic needs theory can enrich the analysis of the role of internal and external factors in maintaining patients' quality of life. At the practice level, hospitals

need to develop monitoring protocols that not only focus on tumor response, but also include nutritional indicators and daily activity function as part of a comprehensive evaluation of therapeutic success.

CONCLUSION

Based on the results of statistical analysis and research findings, it can be concluded that adjuvant chemotherapy has no significant relationship with nutritional status ($p = 0.356$) or Karnofsky index ($p = 0.841$) in stage III colorectal cancer patients after surgery at Sultan Agung Islamic Hospital. Although chemotherapy is known to have side effects that can affect patients' physical and functional conditions, in the context of this study, most patients were able to maintain normal nutritional status and a good level of independence.

These results indicate that the implementation of adjuvant chemotherapy in these hospitals is likely to have been accompanied by good management, including nutritional support and side effect control. These findings make an important contribution to the development of postoperative care protocols that focus not only on survival, but also on patients' quality of life. However, further research is needed with a more comprehensive approach and considering additional variables that may affect the nutritional status and functional capacity of patients more thoroughly.

AUTHOR CONTRIBUTION STATEMENT

MDA played a role in designing the research design, developing instruments, collecting and analyzing data, and preparing the first draft of the manuscript. VM contributed to theoretical review, interpretation of results, writing the discussion and conclusion sections, and final editing of the manuscript for publication.

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