Journal of Neonatal Surgery
ISSN(Online): 2226-0439
Vol. 14, Issue 31s (2025)
https://www.jneonatalsurg.com

OPEN ACCESS

The Effect Of High Protein and Calories Milk On Nutrition Status And Blood Parameters In Ovarian Cancer Patients Treating Chemotherapy

Tiara Pasomba[1,2*], Sharvianty A. Arifuddin[1,2], Sriwijaya[1,2], Isharyah Sunarno[1,2], Syahrul Rauf[1,2], Ajardiana[1,2]

[1]Department of Obstetrics and Gynaecology, Faculty of Medicine, Hasanuddin University, Makassar, Indonesia.

[2]RSUP Dr. Wahidin Sudirohusodo, Makassar, Indonesia

[*]**Corresponding author:**

Tiara Pasomba

Department of Obstetrics and Gynaecology, Faculty of Medicine, Hasanuddin University, Makassar, Indonesia - Jl. Perintis kemerdekaan, Km.10 (90245)

Email ID: tiarapasomba@yahoo.com

Cite this paper as: Tiara Pasomba, Sharvianty A. Arifuddin, Sriwijaya, Isharyah Sunarno, Syahrul Rauf, Ajardiana, (2025) The Effect Of High Protein and Calories Milk On Nutrition Status And Blood Parameters In Ovarian Cancer Patients Treating Chemotherapy. *Journal of Neonatal Surgery*, 14 (31s), 429-437.

ABSTRACT

Objective: To assess the comparative effect of high protein milk feeding on routine blood parameters and nutritional status in ovarian cancer patients undergoing chemotherapy

Method: This study was a single-blind randomized controlled clinical trial involving 96 samples divided into 2 groups, including interventional group (n = 48) and control group (n = 48). The intervention group patients received additional nutrition in the form of high-protein and high-calorie milk and vitamin B complex supplementation.

Result: In the control group, there was a significant decrease in BMI (p=<0.001),karnofsky scale (p<0.001), platelets (p=0.003), and hemoglobin (p=0.030) and an increase in PG-SGA (p=<0.001) and NLR (p=<0.001). In the nutritional intervention group, there was a significant increase in karnofsky score (p<0.001) and decrease in PG-SGA (p=0.001), BMI (P<0.001) and platelet (p=0.018) values after undergoing chemotherapy. Comparison between groups showed that the nutritional intervention group had significantly lower values of PG-SGA, leukocytes, platelets, NLR, and PLR and significantly higher BMI and karnofsky score than the control group after undergoing a series of chemotherapy.

Conclusion: The high protein milk intervention can improve nutritional status and inflammatory parameters in ovarian cancer patients undergoing chemotherapy.

Keywords: *Protein, Supplementation, Ovarian cancer, chemotherapy*

1. INTRODUCTION

Treatment for ovarian cancer depends on the stage and histology of the disease. Treatment may include surgery, chemotherapy, or a combination of both. Chemotherapy is often given after surgery in the early stages to ensure that no cancer cells remain, but in the advanced stages (III/IV), it is not curative and only delays death [1–3]. The side effects of chemotherapy are varied. They include fatigue, nausea, vomiting, pain, insomnia, anorexia, constipation, diarrhea, alopecia, and the risk of myelodepression, mucositis, and nutritional disturbances [2,4].

Chemotherapy-induced myelosuppression affects routine blood parameters and is a prognostic factor in ovarian cancer patients. The platelet-to-lymphocyte ratio has predictive value in advanced cancer and is a better prognostic indicator than thrombocytosis in epithelial ovarian cancer. Previous research shows that platelet levels are higher in stage III/IV, but decrease during chemotherapy. In addition, hemoglobin levels before and during chemotherapy correlate with survival, with hemoglobin concentration being a prognostic factor in oral squamous cell carcinoma and ovarian cancer. Higher erythrocyte, hematocrit, and hemoglobin levels are associated with early stage borderline ovarian tumors, while lower hemoglobin levels are found in stage III/IV [5].

Malnutrition is common in cancer patients and is a major cause of morbidity and mortality. Patients with good nutritional status are better able to withstand medical treatment, which is very important in cancer treatment. Weight loss during chemotherapy can reduce the effectiveness of therapy and exacerbate nutritional deficiencies, which have negative effects on the immune system, including decreased lymphocyte responses to mitogens, impaired cellular immunity, phagocytosis dysfunction, impaired inflammatory response, and weakened cytotoxic T-cell activity [6]. Malnutrition in cancer patients arises from multiple factors and is frequently overlooked by clinicians. Studies estimate that up to 85% of cancer patients suffer from clinical malnutrition, which can negatively impact treatment effectiveness, increase the likelihood of side effects, and reduce overall survival rates [6].

Research by Qin et al. (2021) shows that nutritional intervention with milk in ovarian cancer patients can improve chemical parameters such as leukocytes, lymphocytes, hemoglobin, albumin, and total protein [7]. In contrast, a systematic review by de van der Schueren et al. (2018) reported that nutritional supplementation had no effect on gastrointestinal status or hematologic toxicity [8]. Research in Mexico by Sánchez-Lara et al. (2014) also found no significant effect of high protein and n-3 PUFA intake on cancer survival [9]. Although nutritional interventions with high-energy supplements containing high protein and n-3 PUFA may increase body weight during chemotherapy compared to isocaloric diets, metabolic changes due to disease and treatment, such as systemic inflammation that increases catabolism, make adequate nutrient intake alone insufficient to prevent deterioration in nutritional status [8]. Given the debate about the effectiveness of nutritional interventions and the limited data on ovarian cancer patients undergoing chemotherapy, this study aims to investigate the effect of high-protein milk administration on routine blood parameters and nutritional status of ovarian cancer patients during chemotherapy.

2. MATERIAL AND METHODS

Study Design: This study used a single-blind randomized controlled clinical trial design. involving 96 samples divided into 2 groups, including interventional group (n = 48) and control group (n = 48*).* This study carried out at several hospitals in Makassar, Indonesia. Random allocation sequence using drawing lots methods.

Participants: a total 96 ovarian cancer patients divided into 2 groups, including interventional group (n = 48) and control group (n = 48*).* The inclusion criteria were ovarian cancer patients who were undergoing chemotherapy, aged >18 years and had never received chemotherapy before. Patients with a history of active oral supplementation, severe dysphagia, cognitive impairment, and sleep disorders were excluded from the study. Patients who had received a blood transfusion during chemotherapy or did not complete chemotherapy for 3 months were dropped out of the study.

Intervention procedure: In the intervention group, patients received additional nutrition in the form of high-protein and high-calorie milk and vitamin B complex supplementation. Each serving of milk contains 350 kcal and 18 grams of protein, which is taken 3 times a day. In the control and intervention groups, each patient received standard chemotherapy therapy and also received vitamin B complex supplementation (containing B1, B2, B3, B5, B6, B7, B9 and B12), given 1 capsule/day.

Data Measurement and Data Analysis: Measurements of demographic data, nutritional status (PG-SGA score, body mass index and Karnofsky score) and blood parameters (hemoglobin, leukocytes, platelets, neutrophil-lymphocyte ratio, and platelet-lymphocyte ratio) were performed before intervention and after chemotherapy in months 1, 2 and 3. Data analysis was performed using SPSS software. A p-value of <0.05 was considered statistically significant.

Table 1. Sample characteristics

Characteristics	Control Group n (%)	Interventional Group n (%)	*p*-value
Age			
<45 years	16 (33.3%)	21 (43.7%)	0.402[a]
≥45 years	32 (66.7%)	27 (56.3%)	
Parity			
Nullipara	3 (6.3%)	5 (10.4%)	
Primipara	15 (31.3%)	8 (16.7%)	0.221[b]
Multipara	30 (62.5%)	35 (72.9%)	
Education level			

Low	34 (70.8%)	33 (68.8%)	1.000[a]
Hig	14 (29.2%)	15 (31.2%)	
Occupational status			
Inactive	32 (66.7%)	29 (60.9%)	0.672[a]
active	16 (33.3%)	19 (39.6%)	
Grade			
Early stage	20 (41.7%)	14 (29.2%)	0.286[a]
Advance stage	28 (58.3%)	34 (70.8%)	

(a) Fisher exact test; (b) Chi-square test

3. RESULTS

In the control group, there was a significant increase in PG-SGA ($p<0.001$) and NLR ($p<0.001$). There was also a significant decrease in Karnofsky score ($p<0.001$), hemoglobin level ($p<0.001$), platelet level ($p=0.030$), and BMI ($p<0.001$). There was no significant change in PLR and leukocyte levels. In the intervention group, there was a significant increase in Karnofsky score ($p <0.001$) and BMI ($p <0.001$). There was also a significant decrease in the PG-SGA score ($p = 0.001$) and platelet count ($p = 0.018$). There were no significant changes in hemoglobin, leukocyte, NLR, and PLR levels (Table 2).

Table 2. Comparison of nutritional and hematological parameters in the control group and the intervention group

Variable	Control Group (n=48)	Interventional Group (n=48)	*p*-value
PG-SGA Score			
Pre-chemotherapy	1.08 ± 0.96	1.42 ± 1.00	0.105[c]
Post-chemotherapy first month	2.58 ± 0.89	1.17 ± 0.98	**<0.001[c]**
Post-chemotherapy second month	3.48 ± 0.68	1.10 ± 0.90	**<0.001[c]**
Post-chemotherapy third month	3.85 ± 0.97	0.83 ± 0.78	**<0.001[c]**
p-value	**<0.001[a]**	**0.001[a]**	
Karnofsky score			
Pre-chemotherapy	86.46 ± 7.58	82.29 ± 9.94	**0.026[c]**
Post-chemotherapy first month	78.96 ± 5.92	85.21 ± 8.99	**<0.001[c]**
Post-chemotherapy second month	73.33 ± 5.19	90.83 ± 9.64	**<0.001[c]**
Post-chemotherapy third month	65.42 ± 6.83	93.75 ± 8.90	**<0.001[c]**
p-value	**<0.001[a]**	**<0.001[a]**	
Body mass index (kg/m^2)			
Pre-chemotherapy	22.25 ± 2.58	20.39 ± 4.04	**0.003[c]**
Post-chemotherapy first month	21.74 ± 2.22	21.41 ± 4.06	0.369[c]
Post-chemotherapy second month	20.91 ± 2.47	22.54 ± 4.54	**0.028[c]**
Post-chemotherapy third month	20.40 ± 2.68	23.45 ± 4.35	**<0.001[c]**
p-value	**<0.001[a]**	**<0.001[a]**	

Haemoglobin (gr/dL)			
Pre-chemotherapy	11.64 ± 1.26	11.37 ± 1.08	0.259[d]
Post-chemotherapy first month	11.34 ± 1.760	11.33 ± 1.42	0.486[c]
Post-chemotherapy second month	10.93 ± 1.80	11.46 ± 1.02	0.077[d]
Post-chemotherapy third month	11.27 ± 1.36	11.42 ± 1.08	0.546[d]
p-value	**0.030[a]**	0.970[a]	
Leukocyte (cell/µl)			
Pre-chemotherapy	9.81 ± 5.31	7.65 ± 3.31	**0.021[c]**
Post-chemotherapy first month	9.92 ± 4.24	6.50 ± 3.01	**<0.001[c]**
Post-chemotherapy second month	10.12 ± 4.81	7.29 ± 4.31	**0.001[c]**
Post-chemotherapy third month	10.29 ± 3.70	8.57 ± 6.48	**0.001[c]**
p-value	0.177[a]	0.416[a]	
Platelet (x 10^3 cell/µl)			
Pre-chemotherapy	351.52 ± 153.98	296.83 ± 118.42	**0.050[c]**
Post-chemotherapy first month	340.08 ± 159.26	286.21 ± 134.46	0.135[d]
Post-chemotherapy second month	295.29 ± 135.03	279.58 ± 103.79	0.524[d]
Post-chemotherapy third month	284.92 ± 102.58	245.29 ± 74.72	**0.033[d]**
p-value	**0.003[b]**	**0.018[a]**	
NLR			
Pre-chemotherapy	6.45 ± 9.60	4.09 ± 5.21	**0.007[c]**
Post-chemotherapy first month	7.11 ± 6.15	2.11 ± 1.62	**<0.001[c]**
Post-chemotherapy second month	7.94 ± 8.04	3.57 ± 5.87	**<0.001[c]**
Post-chemotherapy third month	8.35 ± 4.59	3.37 ± 4.15	**<0.001[c]**
p-value	**<0.001[a]**	0.552[a]	
PLR			
Pre-chemotherapy	33.27 ± 42.95	15.26 ± 14.96	**0.001[c]**
Post-chemotherapy first month	43.28 ± 87.91	11.24 ± 8.12	**<0.001[c]**
Post-chemotherapy second month	36.20 ± 50.03	12.05 ± 9.08	**0.003[c]**
Post-chemotherapy third month	28.29 ± 19.67	11.86 ± 12.90	**<0.001[c]**
p-value	0.139[a]	0.199[a]	

(a) Friedman test; (b) Repeated anova test; (c) Mann-whitney test; (d) Independent T-test

In this study, we found that the intervention group had a significantly better nutritional profile characterized by a lower PG-SG score, a higher Kanofsky score, and a higher BMI value. According to the hematological profile, the intervention group had significantly lower levels of leukocytes, platelets, NLR, and PLR compared to the control group. There was no significant difference in hemoglobin levels between the two treatment groups.

4. DISCUSSION

The findings in this study show that there was an improvement in the nutritional status of patients and their functional status after undergoing nutritional intervention. The group that received nutritional intervention had a satisfactory nutritional status outcome compared to the control group.

Similar results were also found in a meta-analysis study by Van Der (2018) of cancer patients undergoing chemo-radio-therapy which found that nutritional interventions with high-energy oral nutritional supplementation containing high levels of protein and n-3 PUFA led to increased body weight during chemotherapy compared to an isocaloric diet control (+1.89 kg, 95%CI 0.51-3. 27, P=0.02; Q=3.1 P=0.37) [8]. On the other hand, Qin et al. (2021) also reported that the administration of oral nutritional intervention in the form of a 250 mL liquid supplement (1.06 kcal/ml + 0.0356 grams of protein/mL) three times a day in ovarian cancer patients undergoing chemotherapy was found to significantly reduce PG-SGA scores after 15 weeks of intervention. The same study also reported that the group that received nutritional intervention had significantly lower PG-SGA scores than the control group from weeks 3 to 15 of chemotherapy [7].

Chemotherapy can significantly impact nutrition status by some symptoms such as nausea, vomiting, diarrhea, anorexia, and weight loss. On the other hand, Malnutrition in cancer patients can result from several factors, including cancer-related anorexia, tumor-driven metabolic breakdown, disrupted nutrient metabolism, and mechanical obstructions in the gastrointestinal tract caused by tumors. Poor nutritional status negatively affects the immune system by weakening the body's natural defense mechanisms, altering cellular and humoral immunity, and impairing macrophage function [10,11].

The weight loss observed during chemotherapy primarily results from the loss of skeletal muscle mass, driven by an imbalance in protein synthesis and degradation, insufficient protein intake, and heightened pro-inflammatory activity. Ensuring adequate protein consumption is crucial for preserving muscle mass and compensating for the decline in muscle protein synthesis. Higher protein intake has been linked to improvements in muscle quantity, fat-free mass, and skeletal muscle mass [11].

Data on protein intake in cancer patients remains limited. However, experts generally recommend increasing protein intake from 0.8 g/kg/day, the standard for healthy individuals, to 1.2-1.5 g/kg/day for cancer patients [12–14]. The rationale for higher protein intakes in these patients is mechanistically compelling. Adequate protein intake activates mTORC1 (mammalian target of rapamycin complex 1), which plays a key role in stimulating muscle protein synthesis (MPS) [15]. In addition, a high-protein diet can improve immune system function, which can help fight tumor cells. However, while this strategy may benefit patients, it may also promote tumor growth. Increased protein intake supports protein synthesis in tumors, potentially accelerating their progression through the same mTOR signaling pathway. In contrast, a low-protein diet may help slow tumor growth by enhancing tumor immune surveillance. However, the implementation of such a dietary approach carries risks, as it may further compromise the patient's nutritional status and exacerbate cancer-related cachexia [16].

The most recent results of an in vivo study reported by Boutiere (2023) in rats with colon cancer found no effect of protein intake on tumor growth. Furthermore, the study results show that high cumulative protein intake can improve nutritional status in rodents undergoing chemotherapy. Based on these findings, it can be concluded that a high-protein diet in ovarian cancer patients has the potential to provide satisfactory clinical outcomes for patients [16].

Weight gain in ovarian cancer patients has been linked to improved survival rates. A study by Mardas (2017) reported that a weight loss exceeding 5% can negatively impact progression-free survival (PFS) and overall survival (OS) in patients with advanced epithelial ovarian cancer, whereas a weight gain of more than 5% was associated with improved PFS and OS outcomes [17]. Regarding protein intake and survival, Johnston (2023) found that higher consumption of dairy products had a positive effect on overall survival, though the mechanisms behind this relationship remain unclear. Previous studies have shown that animal protein has a stronger anabolic effect on muscle protein synthesis than plant protein, primarily due to its higher leucine content. Leucine, an essential amino acid, plays a crucial role in stimulating postprandial muscle protein synthesis. Among all animal protein sources, dairy products contain the highest leucine concentration, accounting for more than 10% of their total protein content [18].

This study found no significant difference in hemoglobin levels between the two groups after chemotherapy. Qin et al. (2021) also reported significant improvements in other blood parameters, including increased hemoglobin after 15 weeks of nutritional intervention compared to the control group [7]. Cancer chemotherapy-related anemia (CRA) affects approximately 30–90% of cancer patients depending on tumor location, with the lowest levels observed in ovarian cancer patients, suggesting that individuals with gynecological cancers may be more susceptible to CRA [19].

Anemia in cancer patients can result from various factors, including metabolic and nutritional imbalances, chronic illnesses, kidney dysfunction, blood loss, bone marrow suppression, peripheral damage caused by autoimmune disorders, drug-induced red blood cell aplasia, and chemotherapy-related anemia. Chemotherapy contributes to anemia by suppressing normal hematopoiesis and altering cytokine activity. Some chemotherapy agents disrupt the production of red blood cell precursors in the bone marrow, leading to anemia. Additionally, the nephrotoxic effects of cytotoxic drugs, especially platinum-based

treatments, can reduce erythropoietin production, further exacerbating anemia [20]. CRA can cause ischemia-hypoxia in multiple organs, weaken immune function, accelerate disease progression, negatively impact prognosis, and significantly reduce patients' quality of life [7].

The application of nutritional intervention in this study was found to suppress leukocyte reactivity and production. In this study, it was found that the nutritional intervention group had significantly lower leukocyte levels than the control group after chemotherapy. The control group had leukocyte levels of more than 10,000 in chemotherapy months 1 to 3. An increase in leukocytes is an inflammatory marker that is very important for tumor development. Leukocytes are secreted in large quantities due to the release of inflammatory mediators such as cytokines and chemokines. Inflammation plays a role in carcinogenesis and the development of cancer. Inflammation contributes to cancer's ability to maintain proliferation, angiogenesis, epithelial-mesenchymal transition activation, invasion, metastasis, and inhibition of cancer cell death[21]. Based on this, lower leukocyte levels in the nutritional intervention group indirectly indicate that the nutritional intervention was able to suppress inflammation in ovarian cancer patients.

This study found significantly lower platelet levels in the nutritional intervention group, highlighting the role of platelets in ovarian cancer prognosis. Previous research has shown that thrombocytosis at diagnosis and a platelet count reduction of less than 25% after initial therapy are associated with worse median progression-free survival (FPS) and median overall survival (OS) in recurrent epithelial ovarian cancer [22]. The ruduction in platelet levels in the nutritional intervention group suggests that targeted nutritional support may contribute to improved clinical outcomes in ovarian cancer patients.

Evidence several studies indicates that platelets promote ovarian cancer progression by activating multiple signaling pathways, including interleukin-6 (IL-6), nuclear factor kappa B, and the vascular endothelial growth factor (VEGF) pathway, thereby enhancing tumor angiogenesis [23]. Cancer cells interact with platelets during hematogenous metastasis, inducing platelet aggregation. This aggregation benefits cancer cells by forming a protective coating of platelets and fibrinogen around them, shielding them from direct contact with natural killer (NK) cells. This mechanism facilitates tumor invasion, extravasation, and metastasis by preventing tumor cell lysis by NK cells and allowing them to be trapped in target tissues. In addition, high platelet levels have been associated with chemoresistance in recurrent ovarian cancer [22].

In addition to the above routine blood parameters, in this study, it was found that the NLR and PLR values in the nutritional intervention group had significantly lower values than the control group. The control group experienced a significant increase in NLR values after undergoing chemotherapy. As reported in a meta-analysis study conducted by Rosaudyn (2023), which found that a high NLR value (median cut-off = 3.6) is associated with poorer overall survival and progression-free survival in ovarian cancer patients [24]. Other studies have also reported that a high PLR value is also an independent indicator for predicting poor clinical outcomes in ovarian cancer patients [25]. Based on this, the findings of this study show that nutritional interventions have the potential to produce better clinical outcomes than the control group.

Neutrophils and platelets play a significant role in promoting tumor growth and metastasis. Neutrophils contribute to inflammation, tumor vascularization, and immune suppression by releasing TNF, interleukin-1, and interleukin-6. They also enhance tumor proliferation through MMP9 and neutrophil elastase. In ovarian cancer, neutrophils exhibit increased ROS production and adhesion ability, facilitating early tumor spread to the omentum before detectable metastasis. Similarly, platelets support tumor progression by secreting growth factors such as PDGF and VEGF, which promote angiogenesis and tumor cell migration. They also facilitate metastasis through P2Y2 receptor-mediated mechanisms [25–27]. Conversely, lymphocytes play a vital role in immune surveillance, inducing cytotoxic cell death and inhibiting tumor proliferation. Higher lymphocyte infiltration into tumor tissue is linked to improved survival outcomes, as reflected in lower NLR and PLR ratios [25].

Despite the interesting findings we have discovered, this study still has shortcomings. This study did not assess tumor size and tumor markers after chemotherapy. Then, this study did not make comparisons of ovarian tumor types. So the effect between tumor types on nutritional intervention cannot be assessed. In conclusion, this study shows that nutritional intervention in the form of high-protein milk can improve nutritional status and routine blood tests in ovarian cancer patients

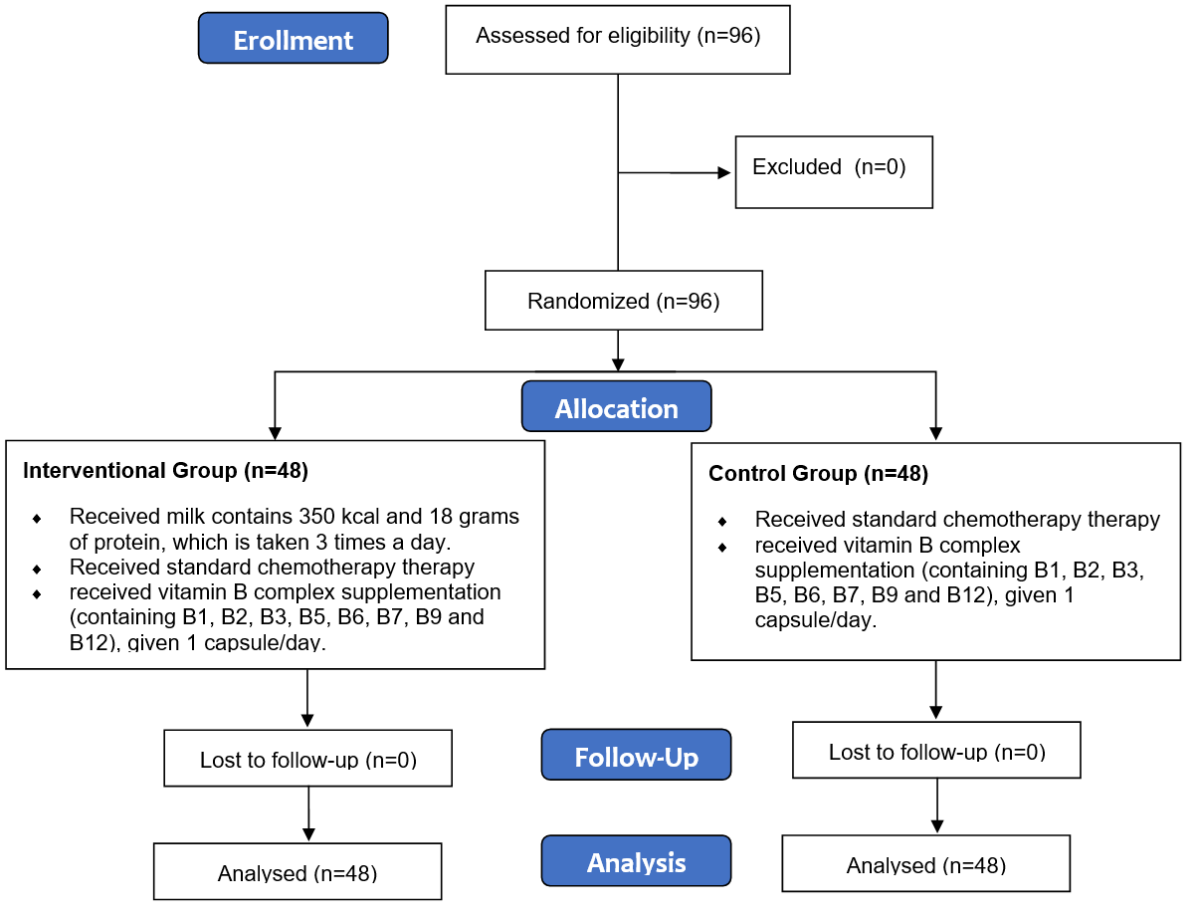

Figure 1. CONSORT Flow Chart

5. CONCLUSION

This study found that the provision of nutritional interventions in ovarian cancer patients was able to improve nutritional status, which also had an impact on inflammatory modulation in cancer patients. When compared to previous research reports, the condition in the nutritional intervention group has the potential to achieve good clinical outcomes.

REFERENCES

[1] Coleman RL, Fleming GF, Brady MF, Swisher EM, Steffensen KD, Friedlander M, et al. Veliparib with First-Line Chemotherapy and as Maintenance Therapy in Ovarian Cancer. New England Journal of Medicine 2019;381. https://doi.org/10.1056/nejmoa1909707.

[2] Chi DS, Berchuck A, Dizon DS, Yashar C. Principles and Practice of Gynecologic Oncology, 7e. Lippincott Williams & Wilkins, a Wolters Kluwer bu; 2017.

[3] Lorusso D, Daniele G. First line ovarian cancer treatment: Scanning the horizon. Crit Rev Oncol Hematol 2021;160. https://doi.org/10.1016/j.critrevonc.2021.103297.

[4] Bhugwandass CS, Pijnenborg JMA, Pijlman B, Ezendam NPM. Effect of chemotherapy on health-related quality of life among early-stage ovarian cancer survivors: A study from the population-based PROFILES registry. Current Oncology 2016;23. https://doi.org/10.3747/co.23.3243.

[5] Nomelini RS, De Carvalho Oliveira LJ, Tavares-Murta BM, Murta EFC. Parameters of blood count and tumor markers: A retrospective analysis and relation to prognostic factors in ovarian cancer. Eur J Gynaecol Oncol 2017;38. https://doi.org/10.12892/ejgo3503.2017.

[6] Gupta D, Lis CG, Vashi PG, Lammersfeld CA. Impact of improved nutritional status on survival in ovarian cancer. Supportive Care in Cancer 2010;18. https://doi.org/10.1007/s00520-009-0670-y.

[7] Qin N, Jiang G, Zhang X, Sun D, Liu M. The Effect of Nutrition Intervention With Oral Nutritional Supplements on Ovarian Cancer Patients Undergoing Chemotherapy. Front Nutr 2021;8.

https://doi.org/10.3389/fnut.2021.685967.

[8] de van der Schueren MAE, Laviano A, Blanchard H, Jourdan M, Arends J, Baracos VE. Systematic review and meta-analysis of the evidence for oral nutritional intervention on nutritional and clinical outcomes during chemo(radio)therapy: Current evidence and guidance for design of future trials. Annals of Oncology 2018;29:1141–53. https://doi.org/10.1093/annonc/mdy114.

[9] Sánchez-Lara K, Turcott JG, Juárez-Hernández E, Nuñez-Valencia C, Villanueva G, Guevara P, et al. Effects of an oral nutritional supplement containing eicosapentaenoic acid on nutritional and clinical outcomes in patients with advanced non-small cell lung cancer: RANDOMISED trial. Clinical Nutrition 2014;33. https://doi.org/10.1016/j.clnu.2014.03.006.

[10] Wu Y, Mu J, Cao J, Li D, Dai Y. Research Status and Progress of Nutritional Support Therapy for Ovarian Cancer. Nutr Cancer 2022;74:1519–26. https://doi.org/10.1080/01635581.2021.1957132.

[11] Manikam NRM, Andrijono A, Witjaksono F, Kekalih A, Sunaryo J, Widya AS, et al. Dynamic Changes in Body Composition and Protein Intake in Epithelial Ovarian Cancer Patients Undergoing Chemotherapy: A Preliminary Study. Asian Pacific Journal of Cancer Prevention 2024;25:555–62. https://doi.org/10.31557/APJCP.2024.25.2.555.

[12] Arends J, Baracos V, Bertz H, Bozzetti F, Calder PC, Deutz NEP, et al. ESPEN expert group recommendations for action against cancer-related malnutrition. Clinical Nutrition 2017;36. https://doi.org/10.1016/j.clnu.2017.06.017.

[13] Prado CM, Purcell SA, Laviano A. Nutrition interventions to treat low muscle mass in cancer. J Cachexia Sarcopenia Muscle 2020;11. https://doi.org/10.1002/jcsm.12525.

[14] van de Worp WRPH, Schols AMWJ, Theys J, van Helvoort A, Langen RCJ. Nutritional Interventions in Cancer Cachexia: Evidence and Perspectives From Experimental Models. Front Nutr 2020;7. https://doi.org/10.3389/fnut.2020.601329.

[15] Mirzoev TM, Shenkman BS. Regulation of Protein Synthesis in Inactivated Skeletal Muscle: Signal Inputs, Protein Kinase Cascades, and Ribosome Biogenesis. Biochemistry (Moscow) 2018;83. https://doi.org/10.1134/S0006297918110020.

[16] Boutière M, Cottet-Rousselle C, Coppard C, Couturier K, Féart C, Couchet M, et al. Protein intake in cancer: Does it improve nutritional status and/or modify tumour response to chemotherapy? J Cachexia Sarcopenia Muscle 2023;14:2003–15. https://doi.org/10.1002/jcsm.13276.

[17] Mardas M, Stelmach-Mardas M, Madry R. Body weight changes in patients undergoing chemotherapy for ovarian cancer influence progression-free and overall survival. Supportive Care in Cancer 2017;25:795–800. https://doi.org/10.1007/s00520-016-3462-1.

[18] Johnston EA, Ibiebele TI, Friedlander ML, Grant PT, van der Pols JC, Webb PM. Association of Protein Intake with Recurrence and Survival Following Primary Treatment of Ovarian Cancer. American Journal of Clinical Nutrition 2023;118:50–8. https://doi.org/10.1016/j.ajcnut.2023.05.002.

[19] Macciò A, Madeddu C, Gramignano G, Mulas C, Tanca L, Cherchi MC, et al. The role of inflammation, Iron, And nutritional status in cancer-related anemia: Results of a large, Prospective, Observational study. Haematologica 2015;100. https://doi.org/10.3324/haematol.2014.112813.

[20] Widhiarta KD, Askandar B. The correlation of nutritional status with hematology toxicity of adjuvant chemotherapy in ovarian cancer. Majalah Obstetri & Ginekologi 2021;29:57. https://doi.org/10.20473/mog.v29i22021.57-62.

[21] Winata J, Laihad BJ, M Wagey FM. Preoperative Platelet-Lymphocyte Ratio as a Prognostic Factor of Epithelial Ovarian Cancer Rasio Trombosit-Limfosit Pra Operasi sebagai Faktor Prognostik Epitel Kanker ovarium. Indones J Obstet Gynecol 2023;11.

[22] Hu Q, Hada A, Han L. Platelet count as a biomarker for monitoring treatment response and disease recurrence in recurrent epithelial ovarian cancer. J Ovarian Res 2020;13. https://doi.org/10.1186/s13048-020-00682-z.

[23] Isingizwe ZR, Meelheim BA, Benbrook DM. Elevated Platelet Aggregation in Patients with Ovarian Cancer: More than Just Increased Platelet Count. Cancers (Basel) 2024;16. https://doi.org/10.3390/cancers16213583.

[24] Rosaudyn R, Mutiani F, Yuliati I, Indraprasta BR. Prognostic value of neutrophil-to-lymphocyte ratio and fibrinogen levels in ovarian cancer. Medical Journal of Indonesia 2023;32:86–97. https://doi.org/10.13181/mji.oa.236880.

[25] Zhang C long, Jiang X chen, Li Y, Pan X, Gao M qi, Chen Y, et al. Independent predictive value of blood inflammatory composite markers in ovarian cancer: recent clinical evidence and perspective focusing on NLR

and PLR. J Ovarian Res 2023;16. https://doi.org/10.1186/s13048-023-01116-2.

[26] Liontos M, Andrikopoulou A, Koutsoukos K, Markellos C, Skafida E, Fiste O, et al. Neutrophil-to-lymphocyte ratio and chemotherapy response score as prognostic markers in ovarian cancer patients treated with neoadjuvant chemotherapy. J Ovarian Res 2021;14. https://doi.org/10.1186/s13048-021-00902-0.

[27] Xu W, Wang W, Yang M, Song L, Xiong J, Lin J, et al. Prognostic significance of the platelet-to-lymphocyte ratio in ovarian cancer: A meta-analysis. Transl Cancer Res 2018;7:552–60. https://doi.org/10.21037/tcr.2018.05.13.