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Abstract

Epithelial ovarian cancer (EOC) is a leading cause of gynecological cancer mortality and is often diagnosed at an advanced stage, resulting in poor survival outcomes. Access to specialized gynecological oncology services has been associated with improved prognosis; however, data on its impact in Indonesia remain limited. This study aimed to evaluate the association between gynecologic oncologist (GO) services and disease-free survival (DFS) in patients with EOC. This retrospective cohort study included 76 patients with EOC who were treated at a national cancer hospital in Jakarta between 2015 and 2018. Patient data were obtained from medical records and followed for three years after the primary treatment. Survival outcomes were analyzed using the Kaplan-Meier curve and Cox proportional hazards model. The overall 3-year DFS rate was 41.6%. Patients treated by GO specialists had a higher DFS rate (54.3%) than those treated in hospitals without GO services (24.5%). Multivariate analysis showed a higher recurrence risk in patients treated without GO services (HR 2.75; 95% CI: 1.32 - 5.74). This study's findings highlight the potential clinical benefits of facilitating early access to specialized GO care for patients with EOC.

Keywords: disease-free survival, epithelial ovarian cancer, gynecologic oncology specialist, prognostic factors

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Introduction

Ovarian cancer is a major global health concern, ranking seventh among the most common cancers, and sixth in cancer-related deaths among women worldwide in 2018.[1,2] The Global Cancer Observatory (GLOBOCAN) reported 324,603 new cases and 206,956 deaths in 2022 in 2022.[3] Alarmingly, International Agency for Research on Cancer (IARC) estimates that global incidence will increase by 96% in new cases and 100% in deaths by 2040, underscoring the urgent need for awareness, early detection, and effective treatment strategies.[3]

In Indonesia, ovarian cancer is a leading cause of cancer-related deaths among women, with 15,130 new cases and 9,673 deaths reported in 2022.[3] Notably, ovarian cancer is the third most prevalent malignancy in Indonesia.[1] Furthermore, ovarian cancer is the second leading cause of gynecologic cancer deaths worldwide, after cervical cancer, emphasizing the need for improved prevention, detection, and timely access to appropriate treatment.[3]

The lack of effective population-based screening methods for ovarian cancer poses a global epidemiological challenge.[4] Current tools, such as CA-125 or transvaginal ultrasound, are not recommended for the general population due to insufficient sensitivity and specificity for early-stage detection. Early symptoms, such as bloating, gastrointestinal disturbances, and abdominal distension, are also vague and non-specific, often leading to oversight. Together, these factors contribute to frequent late diagnoses, which is a key reason why ovarian cancer continues to have a high mortality rate, with most patients presenting at an advanced stage.[4]

Epidemiologic studies identify high-risk populations, such as women with genetic risk factors (e.g., BRCA1/BRCA2 mutations, strong family history) or age >50 years, parity, specific reproductive history, obesity, smoking, and high-fat diets, who may benefit from targeted surveillance rather than general screening.[5] Public health strategies, therefore, emphasize risk-based approaches, including genetic counseling and focused monitoring.[5]

Modifiable lifestyle factors, including obesity, physical inactivity, smoking, and dietary patterns, also contribute to ovarian cancer risk.[6,7] Higher health literacy and education levels are associated with better recognition of symptoms and risk factors, thereby promoting earlier help-seeking.[6,7] Public health further supports primary prevention, equitable treatment access, and survivorship care to improve outcomes. A critical barrier to early detection is delayed diagnosis caused by the disease's non-specific symptoms, limited public awareness, and restricted healthcare access.[3,4] The anatomical location of the ovary, deep within the pelvic cavity among various visceral organs, complicates direct tissue sampling.[8] Consequently, approximately 65-75% of ovarian cancer cases are diagnosed at advanced stages, which significantly impacts treatment outcomes and survival rates.[9] However, specialized management by a gynecologic oncology specialist, utilizing a combination of surgery, chemotherapy, and maintenance therapy, is associated with improved survival outcomes and quality of life.[10,11]

Gynecologic oncologists (GO) are pivotal in improving the outcomes of patients with ovarian cancer, particularly disease-free survival (DFS) and overall survival. GO are trained to manage gynecologic malignancies through a multidisciplinary approach that integrates advanced surgical techniques, chemotherapy, and maintenance therapies.[10,11] Several studies consistently showed that patients treated by GO are more likely to receive optimal cytoreductive surgery (residual tumor ≤1 cm), comprehensive surgical staging, and guideline-concordant chemotherapy regimens.[11,12] Specifically, women with advanced-stage ovarian cancer treated by GO had a 5-year survival rate of 72%, compared to 64% for those treated by non-specialists.[12] This survival advantage is largely attributed to their expertise in achieving complete tumor resection, which is a key prognostic factor. Studies have shown that women treated with GO are five times more likely to undergo complete tumor resection.[13,14]

Despite these benefits, access to gynecological oncology care in Indonesia is limited. As of 2020, only 109 GO are available nationwide, with the most concentrated on Java Island.[11] This shortage exacerbates healthcare disparities, particularly in rural and underserved regions, and contributes to suboptimal surgical outcomes.[8] Globally, when treated by non-specialists, up to 80% of patients with ovarian cancer may receive inadequate surgical debulking and staging.[9–11,15]

Recurrence remains a significant concern in ovarian cancer, affecting approximately 70% of patients, particularly those diagnosed at an advanced stage. GO involvement in post-treatment surveillance and recurrence management is crucial. Their expertise enables early detection of relapse, personalization of second-line therapies, management of platinum-resistant disease, and optimal timing of secondary surgery or maintenance therapies.[16–18]

This study investigated the effect of GO care on DFS in patients with epithelial ovarian cancer (EOC) in Jakarta, Indonesia. By analyzing pretreatment assessments and treatment pathways in hospitals equipped with GO services, this study provides evidence-based insights into how specialized care influences prognosis. These findings were expected to inform national strategies to improve ovarian cancer management, expand access to specialist care, and ultimately enhance patient outcomes across Indonesia.[2]

Method

This retrospective cohort study evaluated the impact of having a GO as the first attending physician on DFS in patients with EOC and identified the demographic and clinical factors associated with recurrence. Data were collected from the medical records of patients treated at the National Cancer Hospital in Jakarta between 2015 and 2018, with a three-year follow-up period selected to capture the peak recurrence risk while aligning with data availability. The Institutional Review Board approved the study, and patient data were anonymized.

A total of 76 patients were included in the study: 24 received full treatment at the National Cancer Hospital in Jakarta, and 52 were referred from other hospitals. Referred patients were those who had undergone an initial diagnostic workup or partial treatment at non-specialist facilities before being transferred to the National Cancer Hospital for continued management, most commonly due to suspected advanced disease or the need for specialized oncologic care. The inclusion criteria were histopathologically confirmed EOC, specifically serous carcinoma, mucinous carcinoma, endometrioid carcinoma, and clear cell carcinoma. Patients with significant comorbidities (e.g., diabetes mellitus, cardiovascular disease, and severe psychiatric disorders), immunodeficiency (e.g., HIV), or double primary malignancies were excluded.

Primary exposure was defined as the presence of GO at the first attending physician during the initial diagnosis and treatment planning. A GO was defined as a physician who completed formal subspecialty training in gynecologic oncology. The first attending physician was a specialist who first evaluated the patient after diagnosis and made the initial treatment decisions. The patients were classified into GO–led and non–GO–non–GO–led groups.

Covariates were included in the analysis to control for confounding factors, including sociodemographic characteristics (e.g., age, education, employment status, and parity), clinical features (e.g., histopathological subtype, stage, differentiation, and metastases), and treatment-related factors (e.g., surgery and chemotherapy completion). Education level was categorized as low (elementary or junior high school) or high (senior high school or higher education). Parity was categorized as nullipara (no prior births), primipara (1 prior birth), or multipara (≥2 prior births). Metastatic status was categorized as no metastasis, regional, or distant metastasis, based on the International Federation of Gynecology and Obstetrics (FIGO) ovarian cancer staging.[19] Regional metastasis refers to tumor spread to the pelvic or para-aortic lymph nodes, while distant metastasis includes spread to non-regional lymph nodes or distant organs outside the pelvis,[19] as documented in medical records.

Cell differentiation (grade) was determined by histopathological assessment of cellular morphology. Well-differentiated (good-grade) tumors closely resembled normal ovarian epithelial cells; moderately differentiated tumors showed intermediate features; and poorly differentiated tumors exhibited a marked loss of normal cellular features and a resemblance to the tissue of origin. The DFS was defined as the time from completion of the primary treatment (surgery, chemotherapy, or a combination of both) to the first documented recurrence or the last disease-free follow-up. Recurrence (event) was determined based on clinical evaluation, imaging examinations (primarily CT scans), and/or rising tumor markers (e.g., CA-125), as documented in medical records. Patients without recurrence were censored on their last disease-free date.

All the statistical analyses were performed using SPSS version 26 (IBM Corp., Armonk, NY, USA). Kaplan-Meier survival analysis was performed, with the log-rank test used to compare DFS between groups. The median DFS was calculated for the overall cohort and relevant subgroups to provide a summary measure of the survival distribution's central tendency. Cox proportional hazards regression was used to identify independent predictors of recurrence, with the results reported as hazard ratios (HRs) and 95% confidence intervals (CIs). Variables with a p-value of <0.25 in bivariate analysis were included in the multivariate model. The assumptions of the Cox proportional hazards model were assessed prior to the final analysis, and missing data were handled by case-wise deletion.

Results

This study included 76 women who underwent cancer treatment. Table 1 shows that patients with EOC were predominantly aged ≥50 years (52.6%), highly educated (67.1%), and unemployed (73.7%). Multiparity was the most common form of parity (46.1 %). Serous carcinoma (38.2%) was the most common histological subtype, followed by clear-cell carcinoma (30.3%). Most patients (48.7%) presented with stage I cancer. However, most patients with serous carcinoma had stage III (65.5%). The GOs treated 53.9% of patients, with the highest involvement in the endometrioid group (63.6%) and the lowest in the mucinous group (46.2%).

Debulking surgery was performed in 63.2% of the patients, most commonly in the serous group (82.8%). Complete chemotherapy was administered to 42.1% of patients, but 39.5% received no therapy. Poor cell differentiation was observed in 52.6% of patients, particularly in clear cell carcinomas (82.6%). Metastasis was absent in 55.3% of patients and was distant in 35.5%; the remaining cases were reported as unknown or not recorded. The most common year of diagnosis was 2014-2015 (38.2%).

The survival analysis results showed that 33 patients (43.4%) experienced recurrence during the study period, with an overall 3-year DFS rate of 41.6% (Figure 1a). Kaplan-Meier analysis showed that patients with EOC treated with GO had a significantly higher 3-year DFS probability (54.3% vs. 24.5%; p=0.038) and longer median survival time (Figure 1b). Among the demographic factors (Table 2, Figure 2), only parity (Figure 2d) was associated with DFS (p=0.024), with nulliparous patients having the highest 3-year DFS probability (58.7%), and primiparous patients having the lowest probability (14.1%). Among the clinicopathological factors, advanced stage (III) was associated with a lower 3-year DFS probability (12.8%) than early stage disease (I=58.9%, II=42.9%, p=0.001; Figure 3a). Complete surgery was also associated with DFS (56.5% vs. 31.7% for debulking, p=0.025; Figure 3b). Patients who underwent a complete cycle of adjuvant chemotherapy had a lower DFS rate than those who did not complete the cycle or received no therapy; however, these associations were not statistically significant (Figure 3c). No association with tumor grade was found; however, patients with poor cell differentiation had a lower DFS than those with good or moderate cell differentiation (Figure 3d). The histological subtype was associated with DFS (p=0.011); endometrioid carcinoma had the highest 3-year DFS probability (87.5%), and serous carcinoma had the lowest (23.7%; Figure 3e).

Table 1. Distribution of Demographic, Clinical, and Clinicopathological Variables Among Women with Epithelial Ovarian Cancer by Histologic Subtype (N = 76)

Variable	Category	Total (N = 76)	Clear-Cell (N = 23)	Endometrioid (N = 11)	Mucinous (N = 13)	Serous (N = 29)
Treated by GO	Yes	41 (53.9)	13 (56.5)	7 (63.6)	6 (46.2)	15 (51.7)
	No	35 (46.1)	10 (43.5)	4 (36.4)	7 (53.8)	14 (48.3)
3 Years of DFS	Event	33 (43.4)	11 (47.8)	1 (9.1)	5 (38.5)	16 (55.2)
	Censored	43 (56.6)	12 (52.2)	10 (90.9)	8 (61.5)	13 (44.8)
Demographics						
Age	<50 years	36 (47.4)	12 (52.2)	3 (27.3)	7 (53.8)	14 (48.3)
	≥50 years	40 (52.6)	11 (47.8)	8 (72.7)	6 (46.2)	15 (51.7)
Education	Low*	25 (32.9)	5 (21.7)	4 (36.4)	6 (46.2)	10 (34.5)
	High*	51 (67.1)	18 (78.3)	7 (63.6)	7 (53.8)	19 (65.5)
Employment Status	Employed	20 (26.3)	6 (26.1)	2 (18.2)	4 (30.8)	8 (27.6)
	Unemployed	56 (73.7)	17 (73.9)	9 (81.8)	9 (69.2)	21 (72.4)
Parity	Nulliparity	21 (27.6)	5 (21.7)	5 (45.5)	3 (23.1)	8 (27.6)
	Multiparity	35 (46.1)	8 (34.8)	4 (36.4)	6 (46.2)	17 (58.6)
	Primiparity	20 (26.3)	10 (43.5)	2 (18.2)	4 (30.8)	4 (13.8)
Clinicohistopathology						
Stage	I	37 (48.7)	15 (65.2)	8 (72.7)	8 (61.5)	6 (20.7)
	II	9 (11.8)	2 (8.7)	2 (18.2)	1 (7.7)	4 (13.8)
	III	30 (39.5)	6 (26.1)	1 (9.1)	4 (30.8)	19 (65.5)
Surgery	Complete	28 (36.8)	13 (56.5)	5 (45.5)	5 (38.5)	5 (17.2)
	Debulking	48 (63.2)	10 (43.5)	6 (54.5)	8 (61.5)	24 (82.8)
Adjuvant Chemotherapy	Complete	32 (42.1)	10 (43.5)	4 (36.4)	3 (23.1)	15 (51.7)
	Incomplete	14 (18.4)	4 (17.4)	3 (27.3)	2 (15.4)	5 (17.2)
	No therapy	30 (39.5)	9 (39.1)	4 (36.4)	8 (61.5)	9 (31)
Cell Differentiation (Grade)	Good	15 (19.7)	1 (4.3)	4 (36.4)	6 (46.2)	4 (13.8)
	Moderate	10 (13.2)	3 (13)	3 (27.3)	2 (15.4)	2 (6.9)
	Poor	40 (52.6)	19 (82.6)	3 (27.3)	0	18 (62.1)
	Unknown	11 (14.5)	0	1 (9.1)	5 (38.5)	5 (17.2)
Metastases	No	42 (55.3)	15 (65.2)	9 (81.8)	9 (69.2)	9 (31)
	Regional	7 (9.2)	2 (8.7)	2 (18.2)	0	3 (10.3)
	Distant	27 (35.5)	6 (26.1)	0	4 (30.8)	17 (58.6)
Year of Diagnosis	2014-2015	29 (38.2)	9 (39.1)	4 (36.4)	5 (38.5)	11 (37.9)
	2016	13 (17.1)	3 (13)	2 (18.2)	2 (15.4)	6 (20.7)
	2017	18 (23.7)	7 (30.4)	2 (18.2)	3 (23.1)	6 (20.7)
	2018	16 (21.1)	4 (17.4)	3 (27.3)	3 (23.1)	6 (20.7)

Notes: GO = gynecologic oncologists, DFS = disease-free survival, Low education = elementary and junior high school, High education = senior high school and higher education

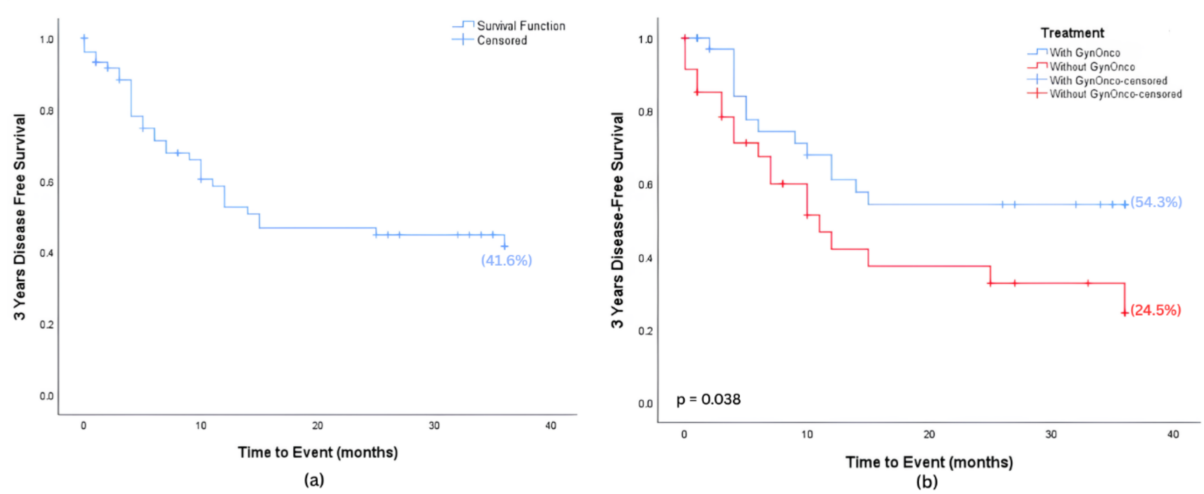

Figure 1. Kaplan–Meier Curves of 3-Year Disease-Free Survival Among Women with Epithelial Ovarian Cancer
(a) Overall 3-Year Disease-Free Survival for the Entire Cohort
(b) Comparison of 3-Year Disease-Free Survival Between Patients Treated with and Without Gynecologic Oncologist Involvement

Table 2. Gynecology Oncologist and Other Characteristics' 3-Year Disease-Free Survival Probability

Variable	3-Year Disease-Free Survival Event n (%)	Censored n (%)	3-Year Disease-Free Survival Probability	Median Survival Time (Months)[a]	Log-Rank (p-value)
Treated by GO					
Yes	14 (34.1)	27 (65.9)	54.3%	.[a]	0.038*
No	19 (54.3)	16 (45.7)	24.5%	11	
Age					
<50 years	17 (47.2)	19 (52.8)	38.3%	12	0.768
≥50 years	16 (40)	24 (60)	45.2%	15	
Education					
Low	10 (40)	15 (60)	39.2%	10	0.254
High	23 (45.1)	28 (54.9)	43.1%	15	
Employment Status					
Employed	22 (30.3)	34 (60.7)	32.3%	14	0.503
Unemployed	11 (55)	9 (45)	45.5%	36	
Parity					
Nulliparity	7 (33.3)	14 (66.7)	58.7%	.[a]	
Multiparity	13 (65)	7 (35)	14.1%	9	0.024*
Primiparity	13 (37.1)	22 (62.9)	45.3%	15	
Stage					
I	12 (32.4)	25 (67.6)	58.9%	.[a]	
II	4 (44.4)	5 (55.6)	42.9%	10	0.001*
III	17 (56.7)	13 (43.3)	12.8%	5	
Surgery					
Complete	9 (32.1)	19 (67.9)	56.5%	.[a]	0.025*
Debulking	24 (50)	24 (50)	31.7%	10	
Adjuvant Chemotherapy					
Complete	18 (56.2)	14 (43.8)	37.5%	14	
Incomplete	5 (35.7)	9 (64.3)	52.1%	.[a]	0.846
No Therapy	10 (33.3)	20 (66.7)	42.8%	15	
Cell Differentiation (Grade)					
Good	3 (20)	12 (80)	70%	.[a]	
Moderate	4 (40)	6 (60)	44.4%	12	0.236
Poor	21 (52.5)	19 (47.5)	26.3%	10	
Unknown	5 (43.4)	6 (56.6)	51.9%	.[a]	
Histology					
Endometrioid	1 (8.1)	10 (90.9)	87.5%	.[a]	
Serous	16 (55.2)	13 (44.8)	23.7%	6	0.011*
Mucinous	5 (38.5)	8 (61.5)	46.2%	15	
Clear cell	11 (47.8)	12 (52.2)	39.6%	25	
Year of Diagnosis					
2014-2015	13 (44.8)	16 (55.2)	35.4%	10	
2016	7 (53.8)	6 (46.2)	30.8%	4	0.231
2017	8 (44.4)	10 (55.6)	46.7%	25	
2018	5 (31.2)	11 (68.8)	58%	.[a]	

Notes: GO = gynecologic oncologists, *Statistically significant at an alpha value of 0.05

[a] Median survival time was not reached if more than half (>50%) of the patients in these subgroups remained free of disease recurrence at the end of the follow-up period

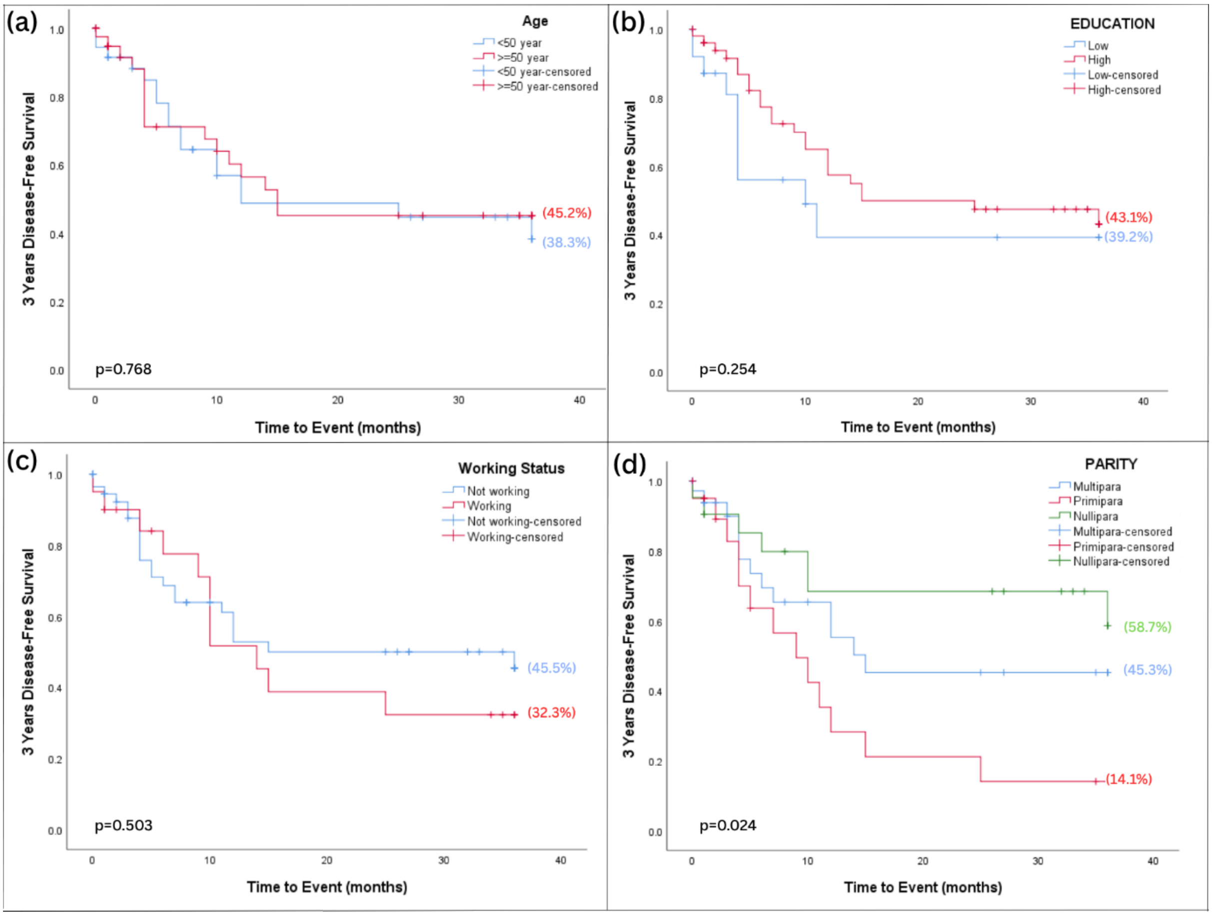

Figure. 2. Kaplan-Meier Curves for Patients' Demographic Variables: (a) Age, (b) Education, (c) Employment Status, (d) Parity

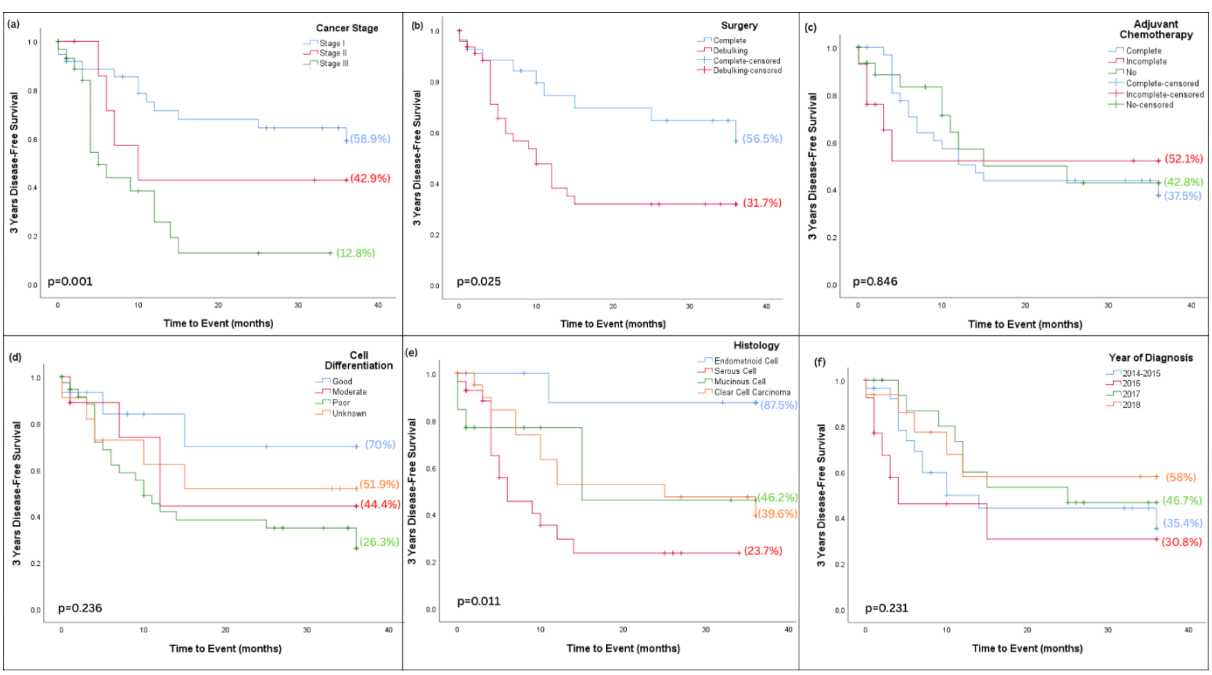

Figure 3. Kaplan-Meier Curves for Patients' Clinico-Histopathological Variables: (a) Cancer Stage, (b) Surgery, (c) Adjuvant Chemotherapy, (d) Cell Differentiation (grade), (e) Histology, (f) Year of Diagnosis

Table 3 presents the results of bivariate and multivariate Cox regression analyses. In bivariate analysis, absence of GO involvement (cHR = 2.02, 95% CI: 1.01–4.05, p-value = 0.04), primiparity (cHR = 3.22, 95% CI: 1.27–8.16, p-value = 0.01), advanced stage (Stage II/III: cHR = 3.08, 95% CI: 1.49–6.38, p-value = 0.002), and serous histology (cHR = 13.22, 95% CI: 1.72–101.5, p-value = 0.01) were associated with a higher hazard of recurrence. After multivariable adjustment for relevant covariates, absence of GO involvement (aHR = 2.75, 95% CI: 1.32–5.74, p-value = 0.007), advanced stage (aHR = 4.00, 95% CI: 1.84–8.69, p-value <0.001), and primiparity (aHR = 2.65, 95% CI: 1.01–6.95, p-value = 0.047) remained independent risk factors. Serous histology and debulking surgery were not statistically significant after adjustment.

Table 3. Crude and adjusted Cox Regression Analysis for 3-Year Disease-Free Survival in Epithelial Ovarian Cancer

Variable	3-Year Disease-Free Survival			
	Crude HR (95% CI)	p-value	Adjusted HR (95% CI)	p-value
Treated by GO				
Yes	Ref.		Ref.	
No	2.02 (1.01-4.05)	0.040*	2.75 (1.32-5.74)	0.007*
Age				
<50 years	Ref.			
≥50 years	0.90 (0.45-1.79)	0.770		
Education				
Low	Ref.			
High	0.65 (0.31-1.38)	0.270		
Working Status				
Yes	Ref.			
No	1.27 (0.62-2.63)	0.510		
Parity				
Nulliparity	Ref.		Ref.	
Primiparity	3.22 (1.27-8.16)	0.010*	2.65 (1.01-6.95)	0.047*
Multiparity	1.62 (0.643-4.062)	0.310	1.13 (0.43-2.96)	0.790
Stage				
I	Ref.		Ref.	
II & III	3.08 (1.49-6.38)	0.002*	4.00 (1.84-8.69)	<0.001*
Surgery				
Complete	Ref.		Ref.	
Debuking	2.32 (1.07-5.02)	0.030*	1.43 (0.35-5.91)	0.620
Chemotherapy				
Complete	Ref.			
Incomplete	1.15 (0.42-3.12)	0.780		
No Therapy	0.86 (0.39-1.86)	0.690		
Cell Differentiation (Grade)				
Good	Ref.			
Moderate	2.06 (0.46-9.21)	0.340		
Poor	3.03 (0.90-10.19)	0.070		
Unknown	1.89 (0.45-7.92)	0.380		
Histology				
Endometrioid carcinoma	Ref.		Ref.	
Serous carcinoma	13.22 (1.72-101.5)	0.010*	7.30 (0.89-59.95)	0.060
Mucinous carcinoma	6.88 (0.80-59.15)	0.080	5.38 (0.59-48.65)	0.130
Clear cell carcinoma	6.56 (0.85-50.95)	0.070	5.81 (0.71-47.62)	0.100

Notes: GO = gynecologic oncologists, *Statistically significant at an alpha value of 0.05

Discussion

This study highlighted several key factors associated with DFS in EOC. The findings reinforced the importance of specialized care, early-stage diagnosis, tumor biology (grade and histological subtypes), and parity in improving survival outcomes, and showed a survival benefit associated with GO involvement; patients treated by GO had significantly higher 3-year DFS and longer median survival, even after adjusting for confounders. These findings aligned with the established evidence that GO-led care improves adherence to treatment guidelines, optimal cytoreduction, and prognosis.

Stage at diagnosis was the strongest predictor of DFS. Patients diagnosed at early stages had significantly better outcomes, consistent with Surveillance, Epidemiology, and End Results (SEER) data showing a 5-year survival rate of over 90% for localized disease compared to only 32% for distant-stage disease.[20] A FIGO stage greater than I was identified as an independent predictor of recurrence in patients with EOC. Individuals with stage II and III EOC in this study had a fourfold higher risk of recurrence than those with stage I disease. This finding was consistent with those of previous studies demonstrating improved DFS with earlier-stage diagnosis, supporting the prognostic significance of FIGO staging, as reflected in our statistically significant results.[20,21] However, early-stage diagnosis is difficult, largely owing to the absence of an effective population-based screening method. Both the US Preventive Services Task Force (USPSTF) and American College of Obstetricians and Gynecologists (ACOG) conclude that no screening test (including CA-125 and transvaginal ultrasound) is recommended for average-risk women because available tests lack sufficient sensitivity and specificity to detect early disease.[22] Consequently, most patients present with advanced disease following vague, non-specific symptoms. The current ACOG guidelines therefore emphasize risk-based strategies, including genetic counseling and targeted surveillance for high-risk groups (e.g., BRCA carriers, strong family history), age >50 years, nulliparity, endometriosis, and certain lifestyle factors (e.g., obesity and smoking), rather than universal screening.[5,23] Targeting these groups was particularly valuable in low-resource settings where a limited oncologic workforce and delayed presentation may further worsen outcomes.

Histological subtype also played a critical role. Endometrioid carcinoma was associated with the most favorable DFS, whereas serous carcinoma had the poorest prognosis. These findings were consistent with population-based studies showing that patients with endometrioid and mucinous subtypes generally have better long-term survival than those with high-grade serous tumors.[24] However, after adjusting for stage and metastasis, the prognostic value of histology diminished, suggesting that its impact may be mediated through other clinical variables. Poorly differentiated tumors showed a trend toward poorer outcomes, although this association was not statistically significant. Previous studies have identified tumor grade as a prognostic factor, particularly in early-stage disease,[21,25] but its role may be less pronounced when other high-risk features are present.

Parity has emerged as an interesting factor. Multivariate analysis revealed that nulliparous women had the highest 3-year DFS, whereas primiparous women had the poorest DFS. This finding diverged from that of previous population-based studies, which generally found that parity (particularly multiparity) was associated with improved survival. Previous studies suggested that higher parity may protect against ovarian cancer development and progression.[26,27] A possible explanation was that the nulliparous women in this study may have been diagnosed at earlier stages or had a more favorable tumor biology. Alternatively, the primiparous group might represent a biologically distinct population with a delayed reproductive history or incomplete hormonal modulation. However, the relationship between reproductive history and survival remains complex and may be influenced by hormonal, genetic, and tumor-related factors.

In this study, completion of chemotherapy was not associated with DFS. This finding contrasted with the established role of platinum-based chemotherapy in improving survival, particularly in advanced-stage disease.[28] In this study, chemotherapy completion was notably higher among patients with FIGO Stage II–III disease than among those with Stage I, which may reflect a risk-adapted approach in clinical practice, reflecting the clinical judgment to reserve adjuvant platinum-based regimens for those at greater risk of recurrence.[28] Early-stage, low-grade tumors often achieve excellent disease-free survival with surgery alone. Hence, withholding chemotherapy in this group represents a risk-adapted approach rather than a failure of treatment adherence.[21,29] Conversely, although most advanced-stage patients receive and complete chemotherapy, their intrinsically higher tumor burden and aggressive biology maintain an elevated baseline risk of relapse. When early- and advanced-stage patients were combined, the chemotherapy DFS benefit may have been diluted and may reflect strong baseline differences in prognosis across stages, rather than a lack of treatment effects.

In addition to tumor- and treatment-related prognostic factors, modifiable lifestyle behaviors may influence ovarian cancer survival through both biological and behavioral mechanisms. Unhealthy lifestyle patterns (particularly obesity, physical inactivity, smoking, poor dietary habits, and metabolic syndrome) are associated with increased estrogen exposure, chronic inflammation, and immune dysregulation, which may contribute to disease progression and recurrence.[6,7] Conversely, evidence from gynecologic cancer survivorship studies suggests that maintaining a healthy body weight, engaging in regular physical activity, adopting healthier dietary patterns, and smoking cessation are associated with a reduced risk of recurrence, improved survival, and better quality of life. Furthermore, higher health literacy may improve the recognition of ovarian cancer risk factors and early symptoms, supporting earlier care seeking. Lower educational levels and smoking were associated with poor awareness. Although lifestyle factors were not directly evaluated in this cohort, incorporating lifestyle modifications and health education into survivorship care represents a feasible public health approach that may complement oncological treatment and support sustained DFS.[6,7]

This study's findings supported the critical role of specialized oncological care, early detection, histological subtype, and parity in determining survival outcomes in EOC. They also highlighted the importance of individualized treatment strategies that consider both clinical and pathological features. From a public health perspective, the absence of an effective screening strategy and predominance of non-specific early symptoms remain major contributors to delayed diagnosis and high mortality. Strengthening access to gynecological oncology services and implementing risk-targeted detection strategies for women with hereditary or high-risk clinical features may improve outcomes and reduce the burden of ovarian cancer. Future research should explore the mechanisms underlying parity-related differences in prognosis and evaluate strategies to improve outcomes in patients with high-risk histological subtypes.

This study had several limitations. First, the relatively small sample size (N=76) limited statistical power, particularly in subgroup analyses, resulting in wide confidence intervals for some estimates. Second, as this was a single-center study, the findings might not be generalizable to other institutions or populations, especially given the diverse healthcare settings in Indonesia and Asia. Third, the retrospective design introduced the risks of selection and information bias, missing data, and residual confounding factors, and key clinical variables (such as performance status, comorbidities, and breast cancer gene status) were unavailable. Fourth, the study lacked a detailed reproductive history (e.g., age at menarche, contraceptive use, and breastfeeding), which might have influenced survival. Finally, temporal trends in treatment and access to care were not assessed, limiting the insights into potential improvements over time. Despite these limitations, this study provided important insights into the factors associated with disease-free survival in EOC, highlighting the relevance of specialized care, early detection, and histological subtypes.

Conclusion

This study highlights that DFS in women with EOC is associated with multiple clinical and biological factors. Care from a GO, early-stage diagnosis, and complete surgical resection are associated with better DFS, whereas serous histology is associated with poorer survival. After adjustment, parity and histological subtype were no longer statistically significant, suggesting potential confounding factors according to stage. Chemotherapy completion was not associated with DFS, suggesting the need for further investigation of patient-specific factors influencing treatment responses. Overall, these findings underscore the importance of early detection, access to specialist care, and individualized treatment planning to optimize outcomes for patients with EOC.

Abbreviations

GO: Gynecology Oncologist; DFS: Disease Free Survival; EOC: Epithelial Ovarian Cancer; FIGO: International Federation of Gynecology and Obstetrics; HR: hazard ratio; CI: confidence interval; ACOG: American College of Obstetricians and Gynecologists.

Ethics Approval and Consent to Participate

Ethical approval for this study was obtained from the Ethics Committee of Dharmais National Cancer Hospital (reference number DP.04.03/11.5/174/2024).

Competing Interest

All the authors declare that there are no conflicts of interest.

Availability of Data and Materials

The data is not open for public.

Authors' Contribution

WLHH contributed to the study's conceptualization, methodology, validation, formal analysis, investigation, resources, data curation, writing of the original draft, review and editing, supervision, project administration, and funding acquisition. BD contributed to the conceptualization, methodology, validation, resources, data curation, writing of the original draft, review and editing, and supervision. ACA contributed to the conceptualization, methodology, validation, formal analysis, investigation, resources, data curation, writing of the original draft, review and editing, and supervision. YER contributed to the methodology, software, validation, formal analysis, investigation, resources, data curation, writing of the original draft, review and editing, and visualization. ASL contributed to the investigation, resources, data curation, the original draft, and the review and editing of the manuscript. OPR contributed to the methodology, software, formal analysis, investigation, resources, data curation, writing of the original draft, visualization, and project administration. JGA contributed to writing the original draft, visualization, and project administration.

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Declaration on the Use of Artificial Intelligence

The authors declare that artificial intelligence (AI) tools were utilized solely for language editing and grammatical refinement to improve the clarity and readability of the manuscript. The specific AI tools used are DeepL and QuillBot. AI was not involved in content generation, data analysis, interpretation, or any decision-making processes. All scientific content, interpretations, conclusions, and responsibilities related to the manuscript rest solely with the authors.

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