RESEARCH ARTICLE

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Incidence, Mortality and Survival Analysis of Epithelial Ovarian Cancer in Brunei Darussalam

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Abstract

Background: This study provides population-based study of cancer incidence, mortality and survival rates for women diagnosed with epithelial ovarian cancer (EOC), and evaluate the prognostic factors of EOC patients survival in Brunei Darussalam. **Methods:** This is a retrospective study of patients diagnosed with EOC between 1st January 2007 and 31st December 2017 in Brunei Darussalam. Crude, age-specific, age-standardized incidence and mortality rates per 100,000 women were calculated. Kaplan-Meier method was used to determine the overall 5-years survival rate. Log-rank test was used to examine the differences in survival between groups. The multivariable Cox Proportional Hazard regression models were used to estimate the hazard ratio for overall survival and to identify the prognostic factors. **Results:** A total of 207 patients were included in the study. The crude incidence and mortality rates were 9.7 and 3.6 per 100,000 respectively while the age-standardized incidence and mortality rates were 11.3 (95% CI: 9.7,12.9) and 4.5 (95% CI: 3.4,5.6) per 100,000 respectively in the period 2007-2017. The overall mean age at diagnosis was 48.4 (standard deviation=15.3) years. The overall survival rates at 1, 3, and 5 years for EOC patients were 79.7%, 69.7%, and 61.4% respectively. Age at diagnosis, cancer stage, and histology were significant prognostic factors for patients' survival. Older age at diagnosis (≥70 years vs <40 years), regional or advanced stage (vs localized stage) and having undifferentiated or other epithelial ovarian (vs serous carcinoma) were associated with having higher hazard of death. **Conclusion:** Early detection of disease should be emphasized through public education and raising awareness to improve survival rates of patients with EOC.

Keywords: Epithelial ovarian cancer- incidence- mortality- survival- Brunei Darussalam- prognostic factors

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Introduction

Ovarian cancer (OC) is the eighth most commonly diagnosed cancer in female and the eighteenth most common cancer worldwide (Sung et al., 2021; WHO, 2020a). It is one of the most common gynecologic cancers that ranks third after cervical and uterine cancer (Sung et al., 2021; Bray et al., 2018) and is associated with having the worst prognosis and the highest mortality rate (Coburn et al., 2017). Epithelial ovarian cancer (EOC) is the most lethal gynecologic cancer affecting women globally (Ferlay et al., 2015; Kurosaki et al., 2016) and accounts for 90% of all ovarian malignancies (Torre et al., 2018).

Globally, there were 313,959 new cases of OC and 207,252 death cases in year 2020. More than half of the new cases were from Asia (54.4%), followed by Europe (21.2%), Northern America (8.5%), Africa (7.7%), Latin America and the Carribean (7.5%), and Oceania (0.7%). Asia also recorded highest mortality from OC in year 2020 (54.4%) while Europe came second with 21.3% (WHO, 2020a). In Brunei Darussalam, OC was the fifth most common cancer among females (DPP, 2018). Like many cancers, the incidence of OC varies across the world. GLOBOCAN 2020 estimates of age-standardized (world) incidence rates and mortality rates of OC in Brunei Darussalam were 17.4 per 100,000 and 7.4 per 100,000 respectively (WHO, 2020b).

Brunei Darussalam has an estimated population of 453,600 in 2020. The population consists of Malay (65.8%), Chinese (10.2%) and other ethnicities (24.0%). There are four districts namely Brunei Muara (69.7%), Tutong (11.4%), Belait (16.5%) and Temburong (2.5%) (DEPS, 2019). Health services are highly accessible and provided free to citizens and permanent residents of the country, including provision for overseas specialized medical care not available in the country. The country implemented an electronic medical record system since September 2012. It provides an efficient, effective

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healthcare information and management system, and enhance the accuracy, timeliness, and completeness of the country's national cancer registry (Leong et al., 2019).

This study aims to provide population-based cancer incidence, mortality and survival rates for women diagnosed with EOC in 2007-2017, and evaluate the prognostic factors of EOC patients survival in Brunei Darussalam.

Materials and Methods

This is a retrospective population-based study using de-identified data extracted from the Brunei Darussalam Cancer Registry (BDCR) of Ministry of Health, Brunei Darussalam. Female citizens and permanent residents who were diagnosed with EOC between 1 January 2007 and 31 December 2017 were included in the study. All cases were followed until 31 December 2018. Age at diagnosis was classified as <40, 40-49, 50-59, 60-69, ≥ 70 years old, and ethnicity was stratified into Malay, Chinese and Others. District was classified as Brunei Muara, Tutong, Belait and Temburong. Cancer staging information at time of diagnosis reported in BDCR was based on the Surveilance, Epidemiology, and End Results (SEER) summary staging, which categorizes OC spread from its origin into localized (SEER stage 1 equivalent to TNM Stage I and IIa: T1-T3/N0/M0), regional (SEER Stage 2-5 equivalent to TNM Stage IIa and IIb and III: T3-T4/AnyN/AnyT/N1,2/M0) and distant (SEER stage 7 equivalent to TNM Stage IV: AnyT/AnyM/M1) (Young et al., 2001).

Histology types were categorized according to the third revision of the International Classification of Diseases for Oncology (ICD-O-3) histology codes (Fritz et al., 2000). Only cases of EOC (ICD-0-3 C56) diagnosed between 2007 and 2017 were included in the analysis whereas non-epithelial (e.g. germ cell, sex cord-stromal) were excluded from the analysis. Histological subtypes were categorized as serous carcinoma (8050, 8441, 8450, 8460, 8461), mucinous carcinoma (8470, 8471, 8480, 8490), endometroid carcinoma (8380, 8560), clear cell carcinoma (8310), and undifferentiated or other epithelial (8010, 8020, 8070, 8140, 8141, 8246, 8260, 8440, 8500, 8510, 8980) whereas all patients with borderline tumours (8442) were excluded.

Crude rate and age-specific rate were calculated using the number of new cases/deaths divided by Brunei female population during the same period (DOS, 2020). The annual age-standardized incidence rates (ASIR) and mortality rates (ASMR) were standardized by the direct method using the World Health Organization (WHO) world standard population distribution (Ahmad et al., 2000). Patients were categorized into two time-periods, 2007-2011 and 2012-2017, to compare the change in the crude, age-specific and age-standardized incidence and mortality rates over time.

Descriptive statistics analyses were conducted to evaluate the distribution of each variable, followed by the Fisher's Exact test to analyze associations between cancer stages and other variables. Kaplan-Meier survival analysis method was used to determine the overall 5-years survival rate and the median survival time of EOC patients. Overall survival was defined as the period of time from diagnosis to death or end of follow-up, due to any cause. Patients who were still alive or lost to follow-up at the end of the study period were right-censored. Log-rank test was used to examine the differences in survival between groups. Multivariable Cox Proportional Hazard (PH) regression models were used to estimate the hazard ratio (HRs) for overall survival and to identify the prognostic factor of EOC patients. We evaluated the PH assumption over time for these models using Schoenfeld residuals. Adjusted HRs and 95% confidence intervals (CI) were generated. All statistical analyses were performed using the R statistical software (Version 4.0.2).

Ethical approval for this study was obtained from Pengiran Anak Puteri Rashidah Sa'adatul Bolkiah Institute of Health Sciences Research and Ethics Committee, the Medical and Health Research Ethics Committee of Ministry of Health, Brunei Darussalam [Ref: UBD/PAPRSBIHSREC/2018/149].

Results

A total of 207 patients diagnosed with EOC were included in this study. The highest number of cases were recorded in year 2013 and 2014 (n=24 cases, 11.6%) while the lowest was in year 2007 (n=9 cases, 4.3%), with an average of 18 cases per year. There were 77 deaths in total during the study period and a total of 73 cases had died within 5 years of diagnosis.

The crude incidence rate of EOC was 9.7 per 100,000 per year while crude mortality rate was 3.6 per 100,000 in the period 2007 to 2017 (Table 1). Crude incidence rate was 8.7 per 100,000 in the first period (2007-2011) and increased to 10.5 per 100,000 in the second period (2012-2017). However, crude mortality rate was more than double in the second period (4.9 per 100,000) as compared to the first period (1.8 per 100,000).

By age group, the age-specific incidence rate was lowest in patients below 40 years old (3.8 per 100,000) and highest at 34.4 per 100,000 for 70 years and above age group (Figure 1). The same trend can be seen for the age-specific mortality rates where patients below 40 years old recorded the lowest rate (0.3 per 100,000), followed by 40-49 age group (5.2 per 100,000), 60-69 years (13.1 per 100,000), 50-59 years (17.5 per 100,000) and 70 years and above (19.9 per 100,000).

The ASIR for EOC was 11.3 (95% CI: 9.7,12.9) per 100,000 while the ASMR was 4.5 (95% CI: 3.4,5.6) per 100,000 in the period 2007-2017 (Table 1). The ASIR was higher in the first period with 11.6 (95% CI: 8.9,14.3) per 100,000 compared to the second period with 11.1 (95% CI: 9.1,13.1) per 100,000. However, the ASMR increased in the second period with 5.6 (95% CI: 3.1, 8.1) per 100,000 from 3.0 (95% CI: 1.5,4.5) per 100,000 in the first period.

Patients' demographic and clinical characteristics are presented in Table 2. The overall mean age at diagnosis was 48.4 (standard deviation=15.3) years, with the majority of the patients in the 50-59 age group (29.0%), followed by less than 40 years (27.5%), 40-49 years old (22.2%), 60-69 years old (12.1%) and 70 years old and above (9.2%). Majority of the patients were of Malay

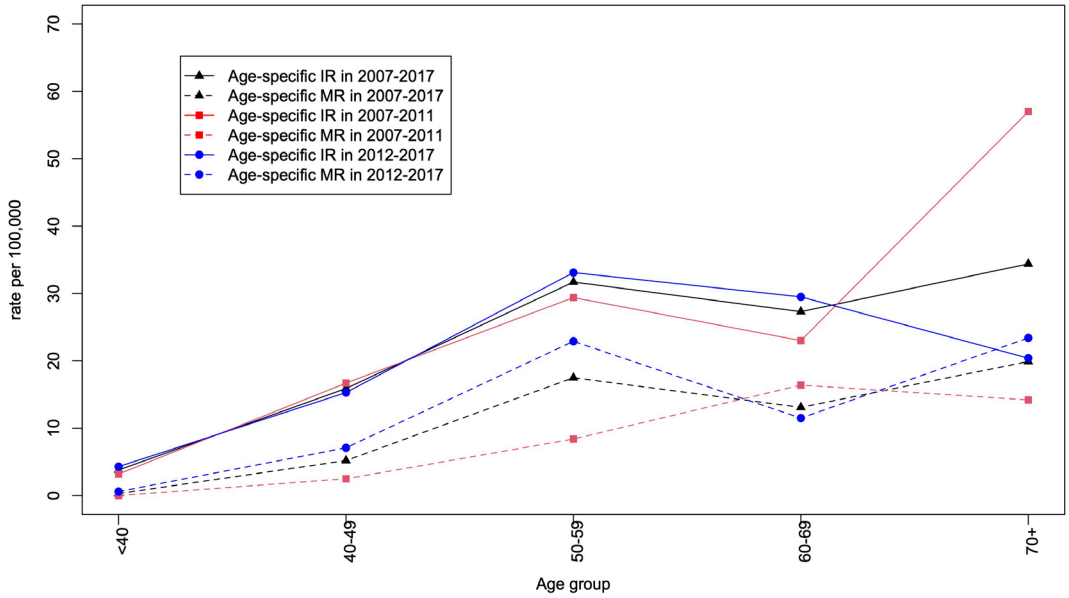

Figure 1. Age-Specific Incidence Rate and Mortality Rates (per 100,000) by Age Group in 2007-2017, 2007-2011 and 2012-2017

Table 1. Number, Crude, Age-Standardized Incidence Rate, and Age-Standardized Mortality Rate in 2007-2017, 2007-2011, and 2012-2017.

Period	Incidence			Mortality		
	No. of cases	Crude rate (per 100,000)	ASIR (95% CI) per 100,000	No. of deaths	Crude rate (per 100,000)	ASMR (95% CI) per 100,000
2007-2017	207	9.7	11.3 (9.7-12.9)	76	3.6	4.5 (3.4-5.6)
2007-2011	82	8.7	11.6 (8.9-14.3)	17	1.8	3.0 (1.5-4.5)
2012-2017	125	10.5	11.1 (9.1-13.1)	59	4.9	5.6 (3.1-8.1)

ASIR, age-standardized incidence rate; ASMR, age-standardized mortality rate; CI, Confidence Interval

ethnicity (83.6%) while 10.6% and 5.8% were of Chinese and other ethnicities respectively. Most EOC patients resided in Brunei Muara district (68.2%), followed by Tutong (16.2%), Belait (13.6%) and Temburong (2.0%). Majority of the patients were diagnosed at localized stage (38.9%), followed by distant (33.7%), and regional stages (27.4%). The most common histological type was mucinous carcinoma (30.9%), serous carcinoma (28.0%), undifferentiated or other epithelial (25.1%), endometrioid carcinoma (10.6%) and clear cell carcinoma (5.3%).

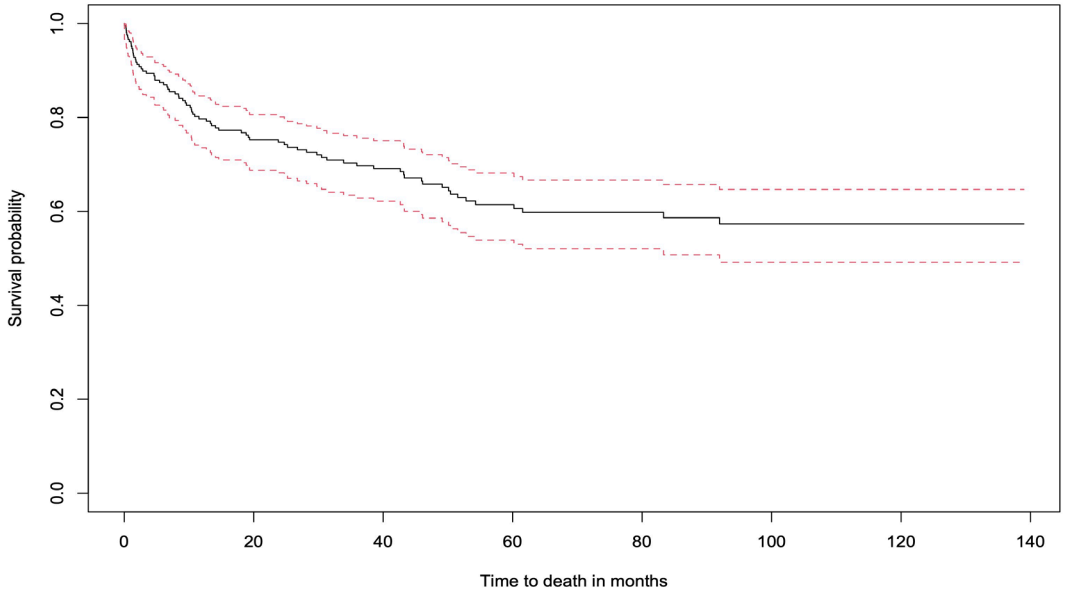

Figure 2. Kaplan-Meier Overall Survival Curve of EOC Patients

Table 2. Number of Cases, 5-Year Overall Survival Rate of EOC Patients, and p-values of log-rank Tests

Variable	No. of cases, n (%)	5-SR (95% CI)	p-value[a]
Age at diagnosis (years)			<0.001*
< 40	57 (27.5)	92.6 (81.3-97.2)	
40–49	46 (22.2)	66.6 (49.7-79.0)	
50–59	60 (29.0)	40.4 (26.7-53.6)	
60–69	25 (12.1)	43.9 (19.3-66.2)	
≥70	19 (9.2)	40.5 (18.7-61.5)	
District			0.229
Brunei Muara	135 (68.2)	57.8 (48.4-66.1)	
Tutong	32 (16.2)	60.6 (39.2-76.5)	
Belait	27 (13.6)	76.2 (54.1-88.6)	
Temburong	4 (2.0)	100	
Ethnicity			0.241
Malay	173 (83.6)	58.9 (50.7-66.3)	
Chinese	22 (10.6)	81.8 (58.5-92.8)	
Others	12 (5.8)	64.8 (25.3-87.2)	
Stage			<0.001*
Localized	74 (38.9)	94.1 (85.0-97.8)	
Regional	52 (27.4)	46.4 (31.7-59.8)	
Distant	64 (33.7)	38.0 (25.2-50.7)	
Histology			<0.001*
Serous carcinoma	58 (28.0)	62.3 (48.1-73.7)	
Mucinous carcinoma	64 (30.9)	78.5 (64.9-87.3)	
Endometrioid carcinoma	22 (10.6)	55.8 (27.4-76.9)	
Clear cell carcinoma	11 (5.3)	68.2 (28.6-88.9)	
Undifferentiated or other-epithelial	52 (25.1)	39.6 (25.7-53.2)	

5-SR, 5-year overall survival rate; CI, confidence interval; [a]p-value for Log Rank Test; *, statistically significant (p<0.05)

Table 3 shows the number of cases for EOC patients according to cancer stage. No significant differences in the proportion of districts (p=0.350) and ethnicities (p=0.443) were found between stages. More than half of the women aged 70 and above were diagnosed at distant stage (52.9%) while only 11.8% were diagnosed at localized stage. Approximately 62.5% of women aged 60-69 years were diagnosed at distant stage. However, most of the women aged 40 and below were diagnosed at localized stage (69.8%), followed by regional (17.0%)

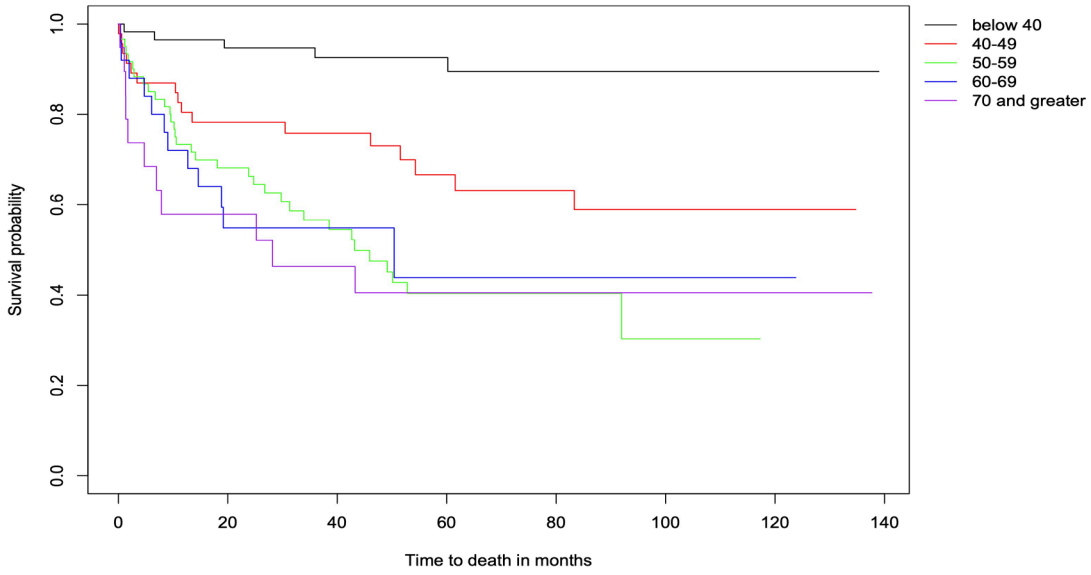

Figure 3. Kaplan-Meier Overall Survival Curves for EOC Patients by Aage Group

Table 3. Number of Cases for EOC Patients According to Cancer Stage

Variable	Stage			p-value[a]
	Localized n (%)	Regional n (%)	Distant n (%)	
Age at diagnosis (years)				<0.001*
<40	37 (69.8)	9 (17.0)	7 (13.2)	
40–49	14 (32.6)	11 (25.6)	18 (41.9)	
50–59	14 (26.4)	24 (45.3)	15 (28.3)	
60–69	7 (29.2)	2 (8.3)	15 (62.5)	
≥70	2 (11.8)	6 (35.3)	9 (52.9)	
District				0.350
Brunei Muara	46 (37.1)	33 (26.6)	45(36.3)	
Tutong	12 (42.9)	9 (32.1)	7 (25.0)	
Belait	14 (53.8)	5 (19.2)	7 (26.9)	
Temburong	0 (0.0)	2 (50.0)	2 (50.0)	
Ethnicity				0.443
Malay	60 (37.3)	44 (27.3)	57 (35.4)	
Chinese	10 (50.0)	4 (20.0)	6 (30.0)	
Others	4 (44.4)	4 (44.4)	1 (11.1)	
Histology				<0.001*
Serous carcinoma	11 (21.6)	15 (29.4)	25 (49.0)	
Mucinous carcinoma	42 (68.9)	10 (16.4)	9 (14.8)	
Endometrioid carcinoma	8 (38.1)	9 (42.9)	4 (19.0)	
Clear cell carcinoma	6 (54.5)	3 (27.3)	2 (18.2)	
Undifferentiated or other-epithelial	7 (15.2)	15 (32.6)	24 (52.2)	

[a]Fisher's Exact test (comparing cancer stages); *statistically significant (p<0.05)

and distant stage (13.2%). Almost half of the total women with serous carcinoma histology were diagnosed at distant stage (49.0%), followed by regional (29.4%) and localized (21.6%). However, patients with mucinous carcinoma and clear cell carcinoma reported majority of them were diagnosed at localized stage.

The overall survival rates at 1, 3, and 5 years for EOC patients in Brunei Darussalam were 79.7% (95% C.I.: 73.6,84.6), 69.7% (95% C.I.: 62.8,75.6), and 61.4% (95% C.I.: 53.9,68.1) respectively (Figure 2). However, the median survival time was not available as the estimated survival were above 0.5. Table 2 presents the 5-year survival rates and p-values of the log-rank test for each covariate. This study found significant differences in EOC

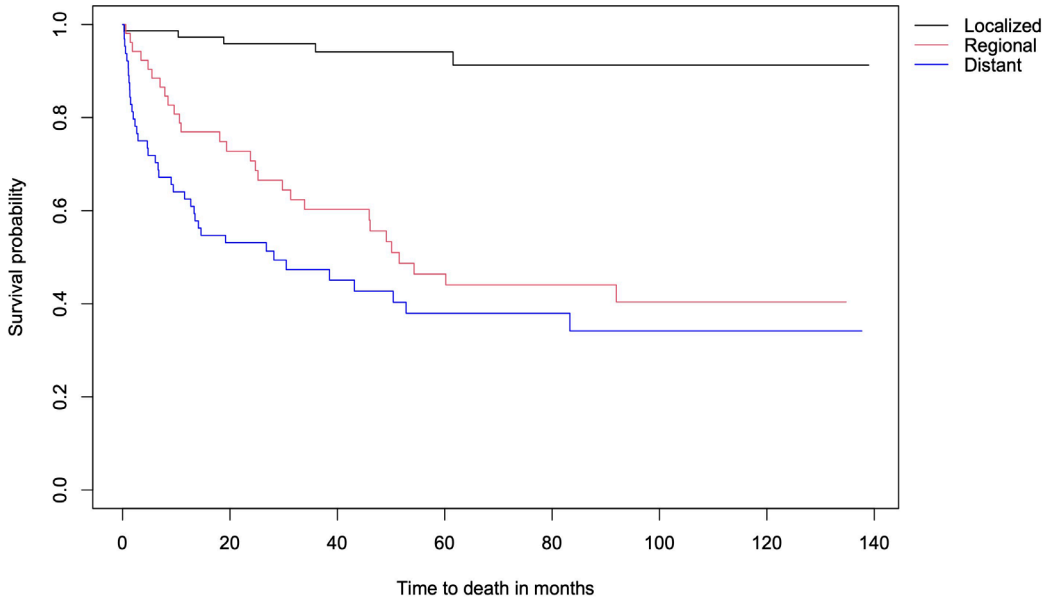

Figure 4. Kaplan-Meier Overall Survival Curves for EOC Patients by Cancer Stage

Table 4. Hazard Ratio, Adjusted Hazard Ratio, and 95% Confidence Intervals of the Variables Using Univariate and Multivariable Cox PH Regression.

Variable	HR (95% CI)	p-value[a]	Adj. HR (95% CI)	p-value[b]
Age at diagnosis				
<40[r]	1.00	-	1.00	-
40-49	4.50 (1.65-12.3)	0.003*	2.04 (0.69-5.99)	0.193
50-59	8.62 (3.36-22.1)	<0.001*	4.97 (1.87-13.22)	0.001*
60-69	8.65 (3.04-24.67)	<0.001*	3.05 (0.99-9.39)	0.052
≥70	9.62 (3.34-27.72)	<0.001*	4.06 (1.30-12.64)	0.016*
District				
Brunei Muara[r]	1.00	-		
Tutong	0.86 (0.46-1.61)	0.636		
Belait	0.48 (0.21-1.11)	0.084		
Temburong	0.00 (0.00-∞)	0.995		
Ethnicity				
Malay[r]	1.00	-		
Chinese	0.43 (0.16-1.18)	0.101		
Others	0.68 (0.25-1.87)	0.460		
Stage				
Localized[r]	1.00	-	1.00	-
Regional	9.51 (3.67-24.63)	<0.001*	6.60 (2.43-17.92)	<0.001*
Distant	13.72 (5.39-34.92)	<0.001*	10.80 (4.03-28.94)	<0.001*
Histology				
Serous carcinoma[r]	1.00	-	1.00	-
Mucinous carcinoma	0.51 (0.26-1.00)	0.051	1.66 (0.79-3.49)	0.182
Endometrioid carcinoma	0.96 (0.43-2.16)	0.925	1.35 (0.58-3.17)	0.490
Clear cell carcinoma	0.70 (0.21-2.35)	0.568	0.97 (0.28-3.39)	0.963
Undifferentiated or other-epithelial	1.99 (1.15-3.46)	0.015*	2.10 (1.14-3.87)	0.017*

HR, Hazard Ratios; CI, confidence interval; Adj: Adjusted; [a]p-value from Univariate Cox PH regression; [b]p-value from multivariable Cox PH regression; [r]reference level; *statistically significant (p<0.05)

patients' survival between age groups (p<0.001), cancer stage (p<0.001) and histology (p<0.001). The 5-year survival rate was highest for age group 40 years and below (92.6%), followed by 40-49 years (66.6%), 60-69 years (43.9%), 70 years and above (40.5%) and 50-59 years (40.4%) (Figure 3).

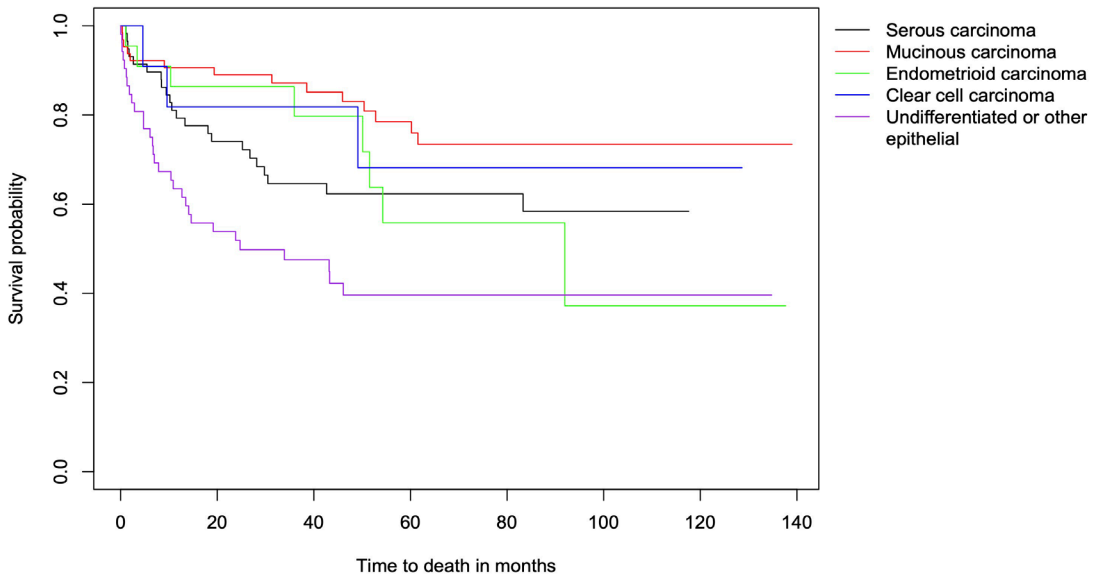

Figure 5. Kaplan-Meier Overall Survival Curves for EOC Patients by Histology Types

This study found no significant difference in survival between the four districts (p=0.229) and ethnicities (p=0.241). The 5-year survival rates for cancer stages were 94.1%, 46.4% and 38.0% for localized, regional, and distant stages respectively (Figure 4). For histological subtypes, mucinous carcinoma had the highest 5-year survival rate (78.5%), followed by clear cell carcinoma (68.2%), serous carcinoma (62.3%), endometroid carcinoma (55.8%), and undifferentiated or other epithelial (39.6%) (Figure 5).

Multivariable Cox PH regression analyses found that age at diagnosis, cancer stage and histology were the significant prognostic factors for EOC patients' survival ($p<0.05$), shown in Table 4. No evidence of significant violations of proportional hazard assumptions were observed.

As compared to a patient below 40 years old, the expected hazard of death was highest for EOC patient in the oldest age group (≥70 years) [Adj.HR=7.21; p=0.001], followed by 50-59 years [Adj.HR=5.29; p=0.001] whereas the expected hazard of patients in the 40-49 and 60-69 age groups were found to be comparable to those below 40 years old ($p>0.05$). Patients with distant stage have significantly higher hazard [Adj.HR=11.99; $p<0.001$] compared to patients with localized stage. This trend is also observed in patients with regional stage [Adj. HR=6.12; $p<0.001$]. Patients with undifferentiated or other epithelial have significantly higher hazard of death [Adj.HR=3.12; p=0.001] compared to patients with serous carcinoma.

Discussion

Global ASIR of OC in year 2012, 2018 and 2020 were 6.1, 6.6 and 6.6 per 100,000 women respectively (Sung et al., 2021; Bray et al., 2018; Ferlay et al., 2015). Brunei Darussalam recorded the third highest standardized incidence rate of OC (8.8 per 100,000) among Asian countries in year 2012 (Razi et al., 2016). Adjusting crude EOC incidence rate (9.7 per 100,000) for WHO world standard population in this study revealed an ASIR of 11.3 per 100,000. Our rates were considerably higher compared to the world's average ASIR of all ovarian cancers. Past study has found a significant positive correlation between the Human Development Index (HDI) and the standardized incidence rate of OC, which means that incidence was higher among high HDI countries (Razi et al., 2016). Brunei Darussalam's HDI was 0.838 in year 2019 which put the country in the very high human development country (UNDP, 2020). OC incidence pattern may be explained by changes in risk factors related to lifestyle, population growth, tube ligation, decreased pregnancy, lactation, obesity, and diet (Razi et al., 2016; Rohani-Rasaf et al., 2013). Increasing spread of western diet and lifestyle in this country might also be the cause of the rapid increase in the burden of the disease.

The world's average ASMR of OC in 2012 was 3.8 (per 100,000) and the rate increased to 3.9 (per 100,000) in 2018 and 4.2 (per 100,000) in 2020 (Sung et al., 2021; Bray et al., 2018; Ferlay et al., 2012). In this study, our crude EOC mortality was 3.6 (per 100,000) but ASMR was 4.5 (per 100,000), when standardized using WHO world standard population. Our study showed a decrease in ASIR trend of EOC between the two time periods (11.6 vs 11.1 per 100,000). Comparison of the age-specific incidence rates between the two time periods showed incidence in women aged 70 years and above was much higher in the first period (57.0 vs 20.4 per 100,000), which might have contributed to the drop in ASIR in the second period. However, the ASMR was higher in the second period (5.6 vs 3.0 per 100,000). The high mortality rate observed in the second period was due to the higher age-specific mortality rates for all the age-groups, except for women aged 60 to 69 years, as compared to the first period.

This is the first study looking at the overall survival rates and prognostic factors of EOC in Brunei Darussalam. The overall survival rates at 1-, 3- and 5-year for EOC patients in Brunei Darussalam were 79.7%, 69.7%, and 61.4% respectively. Studies from other Asian countries reported 5-year overall survival rates among OC patients of 51.2% in Malaysia (NCR, 2018), 54.8% in Indonesia (Aziz, 2009) and 42.7% in Singapore (NRDO, 2021).

It is commonly reported that the risk of EOC is strongly related to age, highest in older females. Younger patients had better 5-year survival than older patients, consistent with other large population-based studies (Chan et al., 2006; Cabanes et al., 2009). 5-year survival in this study was 92.6% for women aged below 40 years at diagnosis, while survival ranged from 40.4% to 43.9% for women aged 50 and above at diagnosis. Better survival in younger women may be related to the fact that older women are more likely to have other health problems. In addition, OC may be diagnosed earlier in pre-menopausal women than in post-menopausal women, because one major symptom used to identify OC is a change in menstruation (Akhtar-Danesh et al., 2011).

Cancer stage, a prognostic factor recognized by previous studies (Lokman et al., 2017; Lee et al., 2018), was found to be significantly associated with survival of EOC patients in this study. About 33.7% of the total cases were diagnosed at distant stage. This study found patients with distant stage have significantly higher hazard compared to patients with localized and regional stages, consistent with previous studies (Lee et al., 2018; Liu et al., 2020; Chang et al., 2018). More than half of the women aged 70 and above (52.9%), and approximately 62.5% of women aged between 60 to 69 were diagnosed at distant stage. In most cases, OC is not diagnosed until it has progressed to an advanced stage and the cancer has spread beyond the ovaries which explains the lower survival from OC (Permuth-Wey and Sellers, 2009). OC symptoms in the early stage tend to be not noticeable (Verheijen and Zweemer, 2016).

Histological type is another prognostic factor for EOC patients in this study. While serous carcinoma is reported to be the most common histological type (Ishioka et al., 2004; Kurman et al., 2014), our study found that 30.9% were diagnosed with mucinous carcinoma, followed by serous carcinoma (28.0%). Our data showed the 5-year survival of patients with mucinuous carcinoma or clear cell carcinoma was better than those of serous carcinoma, endometroid carcinoma, and undifferentiated or other

epithelial. Although the current managements for epithelial ovarian carcinoma were similar regardless different histological types (Chiang et al., 2013), the modification of the treatments based on the histological types is necessary especially for patients with undifferentiated carcinoma or other epithelial because of their poorer outcome.

EOC, although less common compared to the other gynecological cancers, is the most deadly. We found that the 5-year survival rate of OC patients is 61.4%, lower as compared to the other gynecologic cancer in Brunei Darussalam such as cervical cancer with 5-year survival rate of 68.6% (Madli et al., 2019). Treatments for OC have improved over time, such as the development of adjuvant therapy with platinum-based drugs, tumor cytoreductive surgery, taxane-based chemotherapy, and intraperitoneal delivery of chemotherapy (Cristea et al., 2010; Raja et al., 2012).

There are several limitations in our study. First, data were collected retrospectively and were based on the inherent accuracy of patient records. Therefore, our study may have biases especially with incomplete data collection. Second, cancer treatment, which is an important prognostic factor for ovarian tumours (Lee et al., 2018; Chang et al., 2018), is not available for this study. Other potential prognostic factors that have been reported in other studies such as BMI at diagnosis, CA125 levels, first-degree family history of cancer, grade of cancer, gene expression and marital status are also not available (Liu et al., 2020; Goode et al., 2020). Future studies should include these potential prognostic factors which would be useful for examining the impact of early diagnosis of survival and could contribute to understanding some of the variation observed between countries.

Despite these limitations, the findings of the present study provide policy makers, and health professionals with key data to call for increasing awareness among women about early symptoms of OC. Early detection of disease should be emphasized through public education and raising awareness to improve survival rates of patients with EOC.

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