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A Three-Decade Overview of Female-Specific Cancers in Malaysia: A Thorough Examination

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ABSTRACT

The purpose of this research is to analyze the epidemiological trends of female-specific cancers in Malaysia. The review included studies from various sources, including the Asian Pacific Journal for Cancer Prevention, as well as databases like PubMed, Medline, Wiley Online Library, and ProQuest Central. The selected studies were published in various languages and covered all types of trials on patients of any age, between 1980 and 2016. The findings highlighted that Chinese women had the highest incidence of breast cancer, with a relative difference (RD) of 0.42 (CI = 0.41-0.43). Malay women showed a 22% higher likelihood of developing breast cancer compared to Indian women (RD = 0.22, CI = 0.21, 0.22), but 20% lower compared to Chinese women (RD = -0.20, CI = -0.21, -0.19). Cervical cancer held the second spot, with an average age-standardized rate (ASR) of 17.3. Indian women had the least risk of cervical cancer in comparison to Malays (RD = 0.22, CI = 0.18, 0.26) and Chinese women (RD = 0.46, CI = 0.41, 0.51). Ovarian cancer ranked fourth in frequency, with an ASR of 7.3. Indian women exhibited a lower risk of ovarian cancer than Chinese (RD = 0.29, CI = 0.27, 0.31) and Malay women (RD = 0.36, CI = 0.34, 0.38). By 2008, endometrial cancer ranked sixth among female cancers with an ASR of 6.5. Malay women had a slightly reduced risk of endometrial carcinoma compared to Chinese women (RD = -0.06, CI = -0.09, -0.03) but had a higher risk than Indian women (RD = 0.25, CI = 0.23, 0.28). The age group of 50-59 years saw the highest incidence for both breast and cervical cancers. Endometrial cancer was most common in women aged 60-69 years, while the risk of ovarian cancer began to rise significantly after the age of 40 years.

Keywords: Malaysia, Breast cancer, Cervical cancer, Ovarian cancer, Endometrial cancer

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Introduction

Cancer is one of the leading global causes of mortality, with 8.2 million deaths attributed to the disease in 2012 [1]. Lung, breast, colorectal, stomach, and prostate cancers were the primary contributors to these deaths [2]. In the realm of gender-specific cancers, various types affect women, including breast, cervical, uterine, ovarian, vaginal, vulvar, and fallopian tube cancers. Europe and the Americas report the highest incidence rates of breast cancer, with these figures almost double those seen in other regions. For cervical cancer, the highest rates are observed in Africa, followed by Southeast Asia, while the Eastern Mediterranean region shows the lowest incidence rates [2].

GLOBOCAN 2012 data suggests that overall cancer incidence and mortality rates are lower in Asia compared to developed regions such as North America, Oceania (Australia, New Zealand), and Europe for both genders [1]. According to the World Health Organization's 2012 rankings, breast and cervical cancers are the leading female-specific cancers globally, with breast cancer being the deadliest, accounting for 521,000 deaths that year [3]. Southeast Asia ranks second in both incidence and mortality rates for breast cancer within Asia [1]. Epidemiological research is instrumental in identifying high-risk populations and understanding the genetic and environmental factors that contribute to cancer. This knowledge is essential for reducing the cancer burden through early detection, public health initiatives, medical care, and diagnostics. Interventions may include raising awareness, identifying hereditary cancer risks, and offering support for individuals at high risk [4]. Early detection is crucial for improving cancer survival rates, as treatments are far more effective when cancers are caught in the early stages [3, 4].

In Malaysia, a middle-income country in Southeast Asia, the cancer trends differ from those in high-income countries such as the United States and Europe. However, similar trends to other upper-middle-income countries in Asia and Europe are observed, where lung and breast cancers remain the most prevalent among both men and women [5]. Malaysia, with a population of 28.3 million in 2010, is a multi-ethnic nation, with 67.4% Bumiputera, 24.6% Chinese, 7.3% Indians, and 0.7% other ethnic groups. The Malays are the predominant ethnic group in Peninsular Malaysia, while the Iban and Kadazan/Dusun dominate in Sarawak and Sabah, respectively [6]. Among Malaysian women, breast cancer is the most commonly diagnosed, aligning with patterns seen across Asia [1, 5]. Given the country's diverse ethnic composition, it is vital to examine ethnic differences in cancer patterns to target preventive measures effectively, such as screening and educational campaigns aimed at high-risk groups. Overall, cancer rates are higher among Malaysian women compared to men, with breast cancer accounting for 30-31% of all reported cases in two consecutive National Cancer Registries. Chinese women report the highest cancer rates, followed by Malays and Indians. The highest incidence of female-specific cancers occurs in the 30-50-year age group [7, 8].

The purpose of this research is to analyze the epidemiological trends of female-specific cancers in Malaysia. The goals of this investigation are:

1. To examine the patterns of female-specific cancers within the country.
2. To identify specific population groups (based on factors such as age, ethnicity, etc.) that are more susceptible to developing female-specific cancers.

Materials and Methods

Study approach

This research involves a comprehensive review of published literature from January 1980 to May 31, 2016, focused on female-specific cancers in Malaysia.

Search methodology

The review included studies from various sources, including the Asian Pacific Journal for Cancer Prevention, as well as databases like PubMed, Medline, Wiley Online Library, and ProQuest Central. The selected studies were published in various languages and covered all types of trials on patients of any age, between 1980 and 2016, as shown in the PRISMA Flow Diagram.

Keywords used

To search, the following keywords were used on PubMed: ((((((((((((breast cancer) AND Malaysia)) OR ((cervical cancer AND Malaysia)) OR ((uterine cervix cancer) AND Malaysia)) OR ((endometrial cancer) AND Malaysia)) OR ((ovarian cancer) AND Malaysia)) OR ((vagina cancer) AND Malaysia)) OR ((vulva cancer) AND Malaysia)) OR ((placental cancer) AND Malaysia)) OR ((fallopian cancer) AND Malaysia)).

Inclusion and exclusion criteria

Studies that reported on the occurrence of female-specific cancers in Malaysia, including cancers of the breast, cervix, uterus, endometrium, vagina, ovary, placenta, vulva, and fallopian tubes, were included in this review. Excluded from the review were studies related to survival rates, cancer patient awareness or anxiety levels, and cancer screening incidences. Only the following study types were considered: reports, prospective, retrospective,

and longitudinal studies, as well as record-based studies. Controlled trials, case studies, opinion pieces, reviews, editorials, and conference presentations were not included.

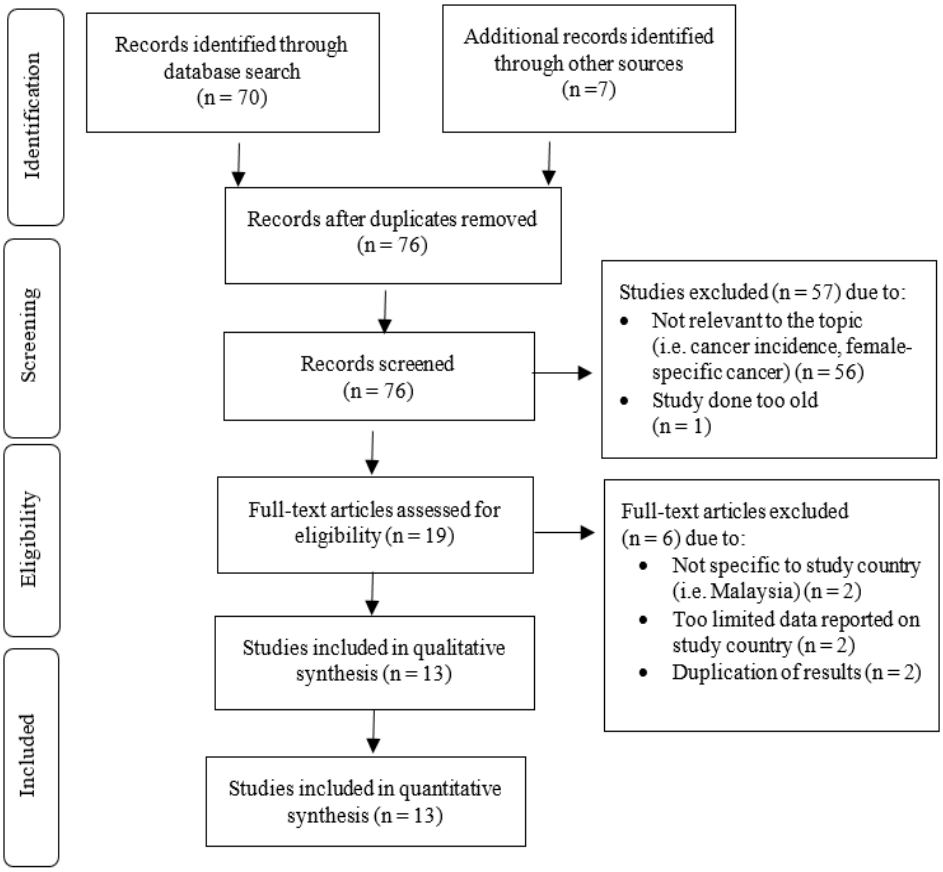

Figure 1. PRISMA 2009 flow diagram

Extraction of data

A custom data extraction template was used to gather key details from the selected articles that satisfied the inclusion criteria. The information collected encompassed: (1) authorship, (2) publication year, (3) research aims, (4) study methodology (e.g., reports, retrospective studies, prospective studies, longitudinal studies, and record reviews), (5) sample size, (6) participant demographics (ethnicity and age), (7) cancer type, and (8) principal results. Furthermore, additional details like age-adjusted incidence rates, cancer presentation, lymph node involvement, and the distribution of tumor subtypes were further categorized by ethnicity.

Analysis of data

The quantitative data obtained from the studies were subsequently analyzed to determine the risk differences for various cancer types across different ethnic groups, as reported in the selected articles.

Results and Discussion

Following the initial search process, 76 publications were retrieved for evaluation. After applying the selection criteria, only 13 studies were deemed suitable for inclusion in this review. The exclusion of the remaining 63 studies was based on several factors: 56 articles did not present data on cancer incidence or were unrelated to female-specific cancers; one study was excluded due to its outdated nature; two studies were not centered specifically on Malaysia; another two lacked sufficient extractable data; and two studies were found to report overlapping results **(Figure 1)**.

Details of the studies selected for review are summarized in **Table 1**. Of these 13 studies, the majority (11 studies) focused solely on the Malaysian population, while 1 study extended its coverage to the ASEAN region [9], and another involved both Singapore and Malaysia [10]. Most of the investigations (10 studies) were conducted within

hospital settings, whereas the remaining three studies sourced their data from cancer registries — specifically, two studies utilized the National Cancer Registry, and one study relied on records from the Penang Cancer Registry.

Table 1. Characteristics of included studies

#	Author	Year	Study design	Study period	Female specific cancers	Ethnic group studied
1	Lim GCC, Yahaya H, Lim TO	2002	Multicentre report	1st Jan 2002 to 31st Dec 2002	Breast-Cervix Uteri-Ovary-Corpus Uteri Vagina-Vulva Placenta-Fallopian Ligament/Adnexa	Malay, Chinese, Indian
2	Lim GCC, Rampal S, Yahaya H	2008	Multicenter report	1st Jan 2003 to 31st Dec 2005	Breast- Cervix Uteri Corpus Uteri-Ovary	Malay, Chinese Indian
3	Azizah Ab M, Devaraj T, Bina Rai S, Norbaiyah Y, Nooraihan M, Noorshila S	2010	Technical report	1st January 2004 to 31st December 2008	Breast-Cervix Uteri Ovary-Corpus Uteri	Malay, Chinese Indian
4	ACTION Study Group, Kimman M, Jan S, Yip CH, Thabrany H, Peters SA, Bhoo-Pathy N, Woodward M.	2015	Prospective longitudinal study	Between March 2012 and September 2013	Breast-Cervix Uterus-Ovary	Not stated
5	Bhoo-Pathy N, Subramaniam S, Taib NA, Hartman M, Alias Z, Tan GH, Ibrahim RI, Yip CH, Verkooijen HM.	2014	Prospective study	Between 1993 and 2011	Breast	Malay, Chinese Indian, Others
6	Bhoo-Pathy N, Hartman M, Yip CH, Saxena N, Taib NA, Lim SE, Iau P, Adami HO, Bulgiba AM, Lee SC, Verkooijen HM	2012	Prospective study	Between 1990 and 2007	Breast	Malay, Chinese Indian
7	Devi C, Tang TS, Corbex M	2012	Prospective study	Between 1998 and 2009	Breast	Not stated
8	Pathy NB, Verkooijen HM, Taib NA, Hartman M, Yip CH.	2011	Prospective study	Between 1993 and 2008	Breast	Malay, Chinese
9	Cheah PL, Looi LM, Sivanesaratnam V.	1999		January 1, 1991 to December 31, 1992, and January 1, 1996, to December 31, 1997	Cervical	Malay, Chinese Indian, Others
10	Hamzi Abdul Raub S, Isa NM, Zailani HA, Omar B, Abdullah MF, Mohd Amin WA, *et al*.	2014	Multicentre retrospective study	Period of 9 years	Cervical	Malay, Chinese Indian, Others
11	Jalil NA, Zin AA, Othman NH.	2015		From 2000 to 2011	Breast-Cervical Ovary-Endometrial	Malay, Chinese Indian
12	Juhan N, Abd Razak N, Zubairi Y Z, Khattak MN, Naing NN	2013	Retrospective record review study	From 1st July 1995 and 30th June 2007	Cervical	Malay, Non-Malay
13	Razak NA, Khattak MN, Zubairi YZ, Naing NN, Zaki NM	2013	Retrospective record review design	Between 1st July 1995 and 30th June 2007	Cervical	Malay Non-Malay

Overall female-specific cancer incidence

Incidence

As reported in GLOBOCAN 2012 by the International Agency for Research on Cancer (IARC) under the World Health Organisation, female-specific cancers represent a significant cancer burden in Malaysia. These cancers contributed to 25.0% of the total cancer cases in the country, translating to 9,363 newly diagnosed cases — a proportion notably higher than the global estimate of 19.7%. Moreover, the 5-year prevalence rate for female-specific cancers in Malaysia stood at 38.4%, exceeding the corresponding global prevalence of 29.5% [11]. Comprehensive data illustrating the incidence rates, 5-year prevalence figures, and mortality statistics for female-specific cancers, as outlined by GLOBOCAN 2012, are presented in **Table 2**.

Table 2. Estimated incidence, 5-year-prevalence, and mortality of female-specific cancers for Malaysia and the World based on GLOBOCAN 2012

Malaysia									
Cancer	**Incidence**			**5-year-prevalence**			**Mortality**		
	Number	(%)	ASR	Number	(%)	Proportions	Number	(%)	ASR
Breast	5,410	14.5	38.7	18,928	23.8	184.4	2,572	11.9	18.9
Cervix uteri	2,145	5.7	15.6	6,130	7.7	59.7	621	2.9	4.7
Corpus uteri	710	1.9	5.3	2,694	3.4	26.3	220	1	1.7
Ovary	1,098	2.9	7.8	2,741	3.5	26.7	645	3	4.9
Total	9,363	25	67.4	30,493	38.4	297.1	4,058	18.8	30.2
Globally									
Breast	1,671,149	11.9	43.1	6,232,108	19.2	239.9	521,907	6.4	12.9
Cervix uteri	527,624	3.8	14	1,547,161	4.8	59.6	265,672	3.2	6.8
Corpus uteri	319,605	2.3	8.2	1,216,504	3.7	46.8	76,160	0.9	1.8
Ovary	238,719	1.7	6.1	586,624	1.8	22.6	151,917	1.9	3.7
Total	2,757,097	19.7	71.4	9,582,397	29.5	368.9	1,015,656	12.4	25.2

In Malaysia, breast cancer accounted for the highest proportion of female-specific cancer cases at 14.5%, with cervical cancer of the uterus following at 5.7%. Ovarian cancer contributed 2.9%, while cancer of the corpus uteri made up 1.9% of cases. On a global scale, breast cancer (11.9%) and cervical cancer (3.8%) similarly ranked as the two most prevalent female-specific cancers, consistent with the pattern observed in Malaysia. However, there was a slight variation in the order of occurrence between cancer of the corpus uteri (2.3%) and ovarian cancer (1.7%) worldwide compared to Malaysia's statistics [11].

Stage at diagnosis and survival

The chances of survival among individuals diagnosed with breast and cervical cancer in Malaysia are largely influenced by three primary prognostic indicators: the stage at which the disease is first identified, the tumor size, and the histopathological characteristics of the cancer [12, 13]. In addition to these, menstrual status serves as a critical prognostic element specific to breast cancer [12]. Moreover, survival outcomes for both breast and cervical cancers are shaped by a range of socio-demographic elements such as age and ethnicity, as well as the accessibility and utilization of cancer prevention and treatment strategies, particularly screening programs [12, 13]. Certain lifestyle choices, including being sexually active, have been associated with a reduced likelihood of developing cervical cancer [13].

In Malaysia, the reported overall 5-year survival rate for breast cancer stands at 49%, while cervical cancer patients exhibit a higher survival rate of 71.1%. Malay women, in particular, are often diagnosed at more advanced stages of cancer, contributing to poorer prognoses and resulting in the lowest survival rate when compared to the other two major ethnic groups. Factors contributing to delays in seeking cancer treatment include being widowed or divorced, absence of breast self-examination practices, and reliance on traditional medicine over conventional healthcare interventions [12, 13].

Mortality

In terms of mortality, female-specific cancers in Malaysia accounted for 18.8% of all cancer-related deaths, totaling 4,058 cases. When compared with the global cancer mortality rate of 12.4%, Malaysia's mortality rate for female-specific cancers is relatively higher. Both in Malaysia and globally, cervical cancer, breast cancer, and ovarian cancer remain the leading causes of cancer-related deaths among women [11].

Four major female-specific cancers in Malaysia

Breast cancer

Since 2002, breast cancer has emerged as the leading cancer among Malaysian women across all ethnic groups, accounting for nearly 31% of all female-specific cancers [7, 8, 14, 15]. The lifetime risk for breast cancer in Malaysian women is approximately 1 in 20, with specific risks of one in sixteen for Chinese women, 1 in 17 for Indian women, and one in thirty-two for Malay women [14, 15]. The average age-standardized rate (ASR) for breast cancer stands at 48.6 per 100,000 women. Incidence rates were observed to be the lowest among Indians, followed by Malays, with Chinese women having the highest incidence, more than double that of Indians [7, 8, 14-17]. Between 2002 and 2008, the ASR was highest among Chinese women, averaging 62 per 100,000, compared to 56 per 100,000 for Indians and 36 per 100,000 for Malays [7, 8, 14-17]. Approximately 80% of women diagnosed with breast cancer had no family history of the disease and had breastfed. Over half of the patients had 3 or more children [16, 17]. The most frequently diagnosed histological type was infiltrating duct carcinoma, NOS, which accounted for 84.5% (4522 cases) of all breast cancer cases [14]. In Malaysia, the incidence of breast cancer rises notably in the 50- to 60-year-old age group, after which it gradually decreases in older groups **(Table 3)**. However, for Malay women and those in Sarawak, the highest incidence is seen in the 40- to 50-year-old age group [7, 8, 16, 18].

Table 3. ASR of female-specific cancers and age sorted according to year of publication

#	Types of cancer	Incidence	Ethnic Groups			Age									
			Malay	Chinese	Indian	< 30	< 40	< 50	30-50	40-60	45-60	50-65	50-70	> 60	> 70
1	Breast	4337	1888	1874	450	92	-	-	2176	-	-	-	1827	-	242
	Cervix uteri	1715	542	887	191	27			763				786		139
	Ovary	707	369	258	55	99			280				276		52
	Corpus uteri	517	204	243	52	10			132				314		61
2	Breast	11952	4969	5051	1265	NR	-	-	NR	-	-	-	NR	-	NR
	Cervix uteri	4057	1205	1968	355										
	Corpus uteri	1253	500	528	161										
	Ovary	1627	745	595	159										
3	Breast	1699	392	1115	182	NR	-	-	NR	-	-	-	NR	-	NR
	Cervix uteri	418	89	284	39										
	Ovary	280	87	153	39										
	Corpus uteri	237	65	124	46										
4	Breast	2445	NR	NR	NR	-	-	2780		2801		2463	-	1467	-
	Cervix	1005													
	Uterus	177													
	Ovary	242													
5	Breast	4930	1054	3179	615	-	-	2177		-	-	1961	-	792	-
6	Breast	5624	968	3767	529	NR		-	NR	-	-		NR	-	NR
7	Breast	1034	NR	NR	NR		141	-		356		314		223	
8	Breast	375	132	202	NR	NR		-	NR	-	-	-	NR	-	NR
9	Cervical	266	39	193	29	NR		-	NR	-	-	-	NR	-	NR
10	Cervical	280	135	112	25	-	21	-	-	81			133	-	45

11	Breast Cervical Ovary Endometrial	437 159 143 121	730	110	4	NR		-	NR	-	-	-	NR	-	NR
12	Cervical	120	99	21	-	-	2	-	-	97	-		-	21	-
13	Cervical	120	99	21	NR	-	15	-	-	46	-	38	-	21	-

- = not available, NR = not reported

The age categories were preserved as stated in the original studies to ensure the clarity of the results and avoid any potential confusion in interpretation.

Through quantitative analysis and comparison of the ethnic groups, the disparities in breast cancer risk between them were further elucidated. A comparison between Malay and Chinese women indicated a 20% lower risk of breast cancer among Malay women (-0.20 [-0.21, -0.19]) **(Table 4)**. However, Malay women exhibited a 22.0% increased risk compared to Indian women (0.22 [0.21, 0.22]) **(Table 5)**. The highest breast cancer risk was observed among Chinese women (0.42 [0.41, 0.43]), followed by Malay and Indian women **(Tables 4-6)**.

Table 4. Risk difference of cancer among Malay and Chinese women

Type of cancer	Malay		Chinese		Risk difference
	Events	Total	Events	Total	CI 95%
Breast cancer					
Lim (2002)	1888	4337	1968	4337	0.00 [-0.02, 0.02]
Lim *et al.* (2008)	4969	11952	5051	11952	-0.01 [-0.02, 0.01]
Pathy *et al.* (2011)	132	375	202	375	-0.19 [-0.26, -0.12]
Azizah *et al.* (2010)	392	1699	1115	1699	-0.43 [-0.46, -0.40]
Bhoo-Pathy *et al.* (2014)	1054	4930	3179	4930	-0.43 [-0.45, -0.41]
Bhoo-Pathy *et al*. (2012)	968	5624	3767	5624	-0.50 [-0.51, -0.48]
Subtotal (95% CI)		**28377**		**28377**	**-0.20 [-0.21, -0.19]**
Total events	**9403**		**15188**		
Cervix uteri					
Lim *et al.* (2008)	1205	4057	1968	4057	-0.19 [-0.21, -0.17]
Lim (2002)	542	1715	887	1715	-0.20 [-0.23, -0.17]
Azizah *et al*. (2010)	89	418	284	418	-0.47 [-0.53, -0.41]
Subtotal (95% CI)		**6190**		**6190**	**-0.21 [-0.23, -0.19]**
Total events	**1836**		**3139**		
Corpus uteri					
Lim *et al.* (2008)	500	1253	528	1253	-0.02 [-0.06, 0.02]
Lim (2002)	204	517	243	517	-0.08 [-0.14, -0.02]
Azizah *et al*. (2010)	65	237	124	237	-0.25 [-0.33, -0.16]
Subtotal (95% CI)		**2007**		**2007**	**-0.06 [-0.09, -0.03]**
Total events	**769**		**895**		
Ovary					
Lim (2002)	369	707	258	707	0.16 [0.11, 0.21]
Lim *et al.* (2008)	745	1627	595	1627	0.09 [0.06, 0.13]
Azizah *et al*. (2010)	87	280	153	280	-0.24 [-0.32, -0.16]
Subtotal (95% CI)		**2614**		**2614**	**0.07 [0.05, 0.10]**
Total events	**1201**		**1006**		
Cervical					
Juhan *et al.* (2013)	99	120	21	120	0.65 [0.55, 0.75]

Hamzi Abdul Raub *et al*. (2014)	135	280	112	280	0.08 [0.00, 0.16]
Cheah *et al.* (1999)	39	266	193	266	-0.58 [-0.65, -0.51]
Subtotal (95% CI)		**666**		**666**	**-0.08 [-0.13, -0.03]**
Total events	**273**		**326**		

Cervical cancer

For the past decade, cervical cancer in Malaysia has consistently ranked as the second most common female cancer after breast cancer [7, 8, 14, 15]. It is widely recognized as the most frequent cancer affecting the female reproductive system [13]. Over 90% of reported cases of invasive cervical cancer are associated with human papillomavirus (HPV), primarily types 16 and 18 [19]. The average age-standardized rate (ASR) of cervical cancer across seven years of cancer registry data stands at 17.3 per 100,000 women [7, 8, 14, 15]. Among ethnic groups, Malay women had the lowest ASR at 9.8 per 100,000, while Chinese women had the highest, at 25 per 100,000. Indian women fell in between, with an ASR of 20 per 100,000 [7, 8, 14, 15]. Data from three national cancer registries (NCR) showed that cervical cancer incidence began to rise after the age of twenty, peaked in the 50- to 59-year-old group, and then decreased with age [7, 8, 14]. Squamous cell carcinoma was identified as the most common type of cervical cancer [14]. Further analysis revealed that Indian women faced a lower risk of cervical cancer compared to Malay (0.22 [0.18, 0.26]) and Chinese women (0.46 [0.41, 0.51]) **(Tables 4-6)**. Chinese women had the highest observed risk for cervical cancer overall.

Ovarian cancer

In 2002, ovarian cancer was ranked as the fourth most common female-specific cancer in Malaysia, dropping to fifth place between 2004 and 2008, representing around 5.0% of all female cancer diagnoses [7, 8, 14, 15]. The average ASR for ovarian cancer during the seven-year cancer registry period was 7.3 per 100,000 women. Chinese and Indian women had higher ASRs (8.0 and 7.8, respectively) compared to Malays, who had an ASR of 6.3 [7, 8, 14, 15]. Ovarian cancer affected women across all age groups, with a sharp increase in incidence after age 40 years, followed by a decline in older age groups [7, 8, 14]. The most common types of ovarian cancer were serous adenocarcinomas, mucinous cyst adenocarcinomas, and adenocarcinomas, making up 22.1%, 18.2%, and 18.0% of cases, respectively [14].

Among the ethnic groups, Indian women had the lowest ovarian cancer risk when compared to Chinese women (0.29 [0.27, 0.31]) and Malay women (0.36 [0.34, 0.38]) **(Tables 4-6)**. The difference in ovarian cancer risk between Chinese and Malay women was 7%, with Malay women having the highest risk, followed by Chinese and Indian women.

Table 5. Risk difference of cancer among Malay and Indian women

Type of cancer	Malay		Indians		Risk difference
	Event	**Total**	**Event**	**Total**	**CI 95%**
Breast cancer					
Lim (2002)	1888	4337	450	4337	0.33 [0.31, 0.35]
Lim *et al*. (2008)	4969	11952	1265	11952	0.31 [0.30, 0.32]
Azizah *et al.* (2010)	392	1699	182	1699	0.12 [0.10, 0.15]
Bhoo-Pathy *et al*. (2014)	1054	4930	615	4930	0.09 [0.07, 0.10]
Bhoo-Pathy *et al.* (2012)	968	5624	529	5624	0.08 [0.07, 0.09]
Pathy *et al.* (2011)	132	375	0	0	Not estimable
Subtotal (95% CI)		**28917**		**28542**	**0.22 [0.21, 0.22]**
Total events	**9403**		**3041**		
Cervix Uteri					
Lim *et al.* (2008)	1205	4057	355	4057	0.21 [0.19, 0.23]
Lim (2002)	542	1715	191	1715	0.20 [0.18, 0.23]
Azizah *et al.* (2010)	89	418	39	418	0.12 [0.07, 0.17]
Subtotal (95% CI)		**6190**		**6190**	**0.20 [0.19, 0.22]**

Total events	**1836**		**585**		
Corpus Uteri					
Lim *et al.* (2008)	500	1253	161	1253	0.27 [0.24, 0.30]
Lim (2002)	204	517	52	517	0.29 [0.24, 0.34]
Azizah *et al.* (2010)	65	237	46	237	0.08 [0.00, 0.16]
Subtotal (95% CI)		**2007**		**2007**	**0.25 [0.23, 0.28]**
Total events	**769**		**259**		
Ovary					
Lim (2002)	369	707	55	707	0.44 [0.40, 0.49]
Lim *et al.* (2008)	745	1627	159	1627	0.36 [0.33, 0.39]
Azizah *et al.* (2010)	87	280	39	280	0.17 [0.10, 0.24]
Subtotal (95% CI)		**2614**		**2614**	**0.36 [0.34, 0.38]**
Total events	**1201**		**253**		
Cervical					
Hamzi Abdul Raub *et al*. (2014)	135	280	25	280	0.39 [0.33, 0.46]
Cheah *et al*. (1999)	39	266	29	266	0.04 [-0.02, 0.09]
Juhan *et al*. (2013)	99	120	0	0	Not estimable
Subtotal (95% CI)		**666**		**546**	**0.22 [0.18, 0.26]**
Total events	**273**		**54**		

Endometrial cancer

Endometrial cancer, the most common form of cancer affecting Malaysian women, was ranked 7th in 2002 and moved up to sixth by 2008 [7, 8, 14, 15]. Between 2002 and 2005, the average age-standardized rate (ASR) for this cancer was 6.5 per 100,000. Indians had the highest average ASR over seven years at 10.0 per 100,000, followed by the Chinese with 7.7, while the Malays had the lowest at 3.7 per 100,000 [7, 8, 14, 15]. The incidence of endometrial cancer was relatively low before the age of thirty, then increased with age, reaching its peak in women aged 60-69 years, after which it declined [7, 8, 14]. The most common histologic type of endometrial cancer was adenocarcinoma, NOS, which represented 55.3% (390) of cases [14].

Further analysis showed a risk difference of (-0.06 [-0.09, -0.03]) for corpus uteri cancer between Malay and Chinese women **(Table 4)**, indicating that Malay women had a 6% lower risk of developing carcinoma of the corpus uteri. In contrast, Malay women exhibited a higher risk when compared to Indian women, with a risk difference of 0.25 [0.23, 0.28] **(Table 5)**. Consistent with other cancer types, Chinese women had the highest risk of developing carcinoma of the corpus uteri. Detailed data can be found in **Tables 4-6**.

Table 6. Risk difference of cancer among Chinese and Indian women

Type of cancer	Chinese		Indians		Risk difference
	Event	Total	Event	Total	CI 95%
Breast cancer					
Bhoo-Pathy *et al.* (2012)	3767	5624	529	5624	0.58 [0.56, 0.59]
Azizah *et al.* (2010)	1115	1699	182	1699	0.55 [0.52, 0.58]
Pathy *et al*. (2011)	202	375	0	0	Not estimable
Bhoo-Pathy *et al.* (2014)	3179	4930	615	4930	0.52 [0.50, 0.54]
Lim (2002)	1874	4337	450	4337	0.33 [0.31, 0.35]
Lim *et al.* (2008)	5051	11952	1265	11952	0.32 [0.31, 0.33]
Subtotal (95% CI)		**28917**		**28542**	**0.42 [0.41, 0.43]**
Total events	**15188**		**3041**		
Cervix Uteri					
Azizah *et al.* (2010)	284	418	39	418	0.59 [0.53, 0.64]
Lim (2002)	887	1715	191	1715	0.41 [0.38, 0.43]

Lim *et al.* (2008)	1968	4057	355	4057	0.40 [0.38, 0.42]
Subtotal (95% CI)		**6190**		**6190**	**0.41 [0.40, 0.43]**
Total events	**3139**		**585**		
Corpus Uteri					
Lim (2002)	243	517	52	517	0.37 [0.32, 0.42]
Lim *et al*. (2008)	528	1253	161	1253	0.29 [0.26, 0.33]
Azizah *et al.* (2010)	153	237	46	237	0.45 [0.37, 0.53]
Subtotal (95% CI)		**2007**		**2007**	**0.33 [0.31, 0.36]**
Total events	**924**		**259**		
Ovary					
Lim (2002)	258	707	55	707	0.29 [0.25, 0.33]
Lim *et al.* (2008)	595	1627	159	1627	0.27 [0.24, 0.30]
Azizah *et al.* (2010)	153	280	39	280	0.41 [0.34, 0.48]
Subtotal (95% CI)		**2614**		**2614**	**0.29 [0.27, 0.31]**
Total events	**1006**		**253**		
Cervical					
Juhan *et al.* (2013)	21	120	0	0	Not estimable
Hamzi Abdul Raub *et al.* (2014)	112	280	25	280	0.31 [0.24, 0.38]
Cheah *et al.* (1999)	193	266	29	266	0.62 [0.55, 0.68]
Subtotal (95% CI)		**666**		**546**	**0.46 [0.41, 0.51]**
Total events	**326**		**54**		

Risk factors for female-specific cancers

Tobacco

Cigarette smoking has long been recognized as a major factor in increasing the risk of various cancers. In particular, smokers face a significantly higher likelihood of developing squamous cell carcinoma of the cervix, with studies showing a 60% increased risk, or up to a two to four times higher risk compared to non-smokers [13]. A meta-analysis has also found that smoking increases the risk of mucinous ovarian cancer by two to three times, and this risk grows in proportion to the amount of smoking. Interestingly, once a person quits smoking, their cancer risk tends to return to baseline levels after twenty to thirty years [20].

The link between smoking and breast cancer has been less conclusive. However, research conducted in the United States suggests that current smokers face a heightened risk of developing breast cancer, with the intensity of smoking influencing the risk in both premenopausal and postmenopausal women [21, 22]. In Malaysia, there has been a rise in female smokers, which correlates with an increase in breast cancer cases. The research points out that young female smokers, as well as long-term exposure to secondhand smoke, elevate the risk of developing premenopausal breast cancer [20, 23].

Diet

Research in Malaysia has identified a connection between the consumption of high-fat foods, including red meat and pork, and an increased risk of breast cancer [20]. High-fat diets are believed to elevate estrogen levels, which can fuel the growth of cancerous cells. Specifically, the intake of such foods during premenopausal years has been linked to a nearly 20% higher likelihood of developing breast cancer [20]. The World Cancer Research Fund has also emphasized that increasing the intake of fruits and vegetables, particularly green vegetables, may help lower the risk of breast cancer. Additionally, the Shanghai Women's Health Study revealed that high soy intake, both during adolescence and adulthood, could offer protection against premenopausal breast cancer [24].

Alcohol

There is a clear connection between alcohol consumption and the development of breast cancer. According to a meta-analysis, even moderate alcohol consumption—ranging from 1 to 3 alcoholic drinks a day—correlates with a modest increase in breast cancer risk [20, 25]. Studies have shown that an additional 10 g of alcohol consumed per day increases the risk by 7.1%. This increase in risk applies equally to both smokers and non-smokers,

although it remains uncertain whether the risk varies between premenopausal and postmenopausal women. For endometrial cancer, no significant risk has been identified with alcohol intake, and some studies have even found that light drinking could be inversely related to endometrial cancer risk [26]. Regarding ovarian cancer, there is some evidence suggesting that alcohol may provide protective effects, though additional research is needed to confirm this [25].

Breastfeeding

Studies in Malaysia suggest that breastfeeding may be associated with a reduced risk of breast cancer, particularly among Malay women [20]. Research has indicated that the duration of breastfeeding plays an important role in lowering this risk. For example, breastfeeding for at least 1 year has been shown to reduce the risk by 32% in women with a BRCA1 mutation, with the risk reduction being even more significant in those who breastfed for 2 or more years [20, 27, 28]. This reduction is likely due to lower cumulative estrogen exposure and the effect of progesterone regulation on breast cancer development. However, no similar relationship was found in women with a BRCA2 mutation, regardless of breastfeeding duration [27, 28].

Moreover, breastfeeding has been associated with a slight decrease in the risk of both ovarian and endometrial cancers, especially when breastfeeding continues for a longer duration [29]. However, a study found that the relationship between breastfeeding and ovarian cancer risk was only significant in premenopausal women [30]. While some studies have shown inconsistent results regarding the risk of endometrial cancer, long-term breastfeeding, particularly in developing countries, may contribute to a lower risk of endometrial cancer compared to women in developed countries [30].

Cancer screening

Cervical cancer screening in Malaysia

The practice of cervical cancer screening, through the conventional Pap smear, was introduced in Malaysia in 1969. By 1995, the screening became part of a wider cancer prevention campaign, offering services every three years to women between the ages of 20 and 65 years [31]. According to the 2003 Clinical Practice Guidelines for cervical cancer management, it is recommended that sexually active women aged 20 to 65 years undergo Pap smear screening for two consecutive years. If both tests are negative, it is advised that the screening be done every three years thereafter [32].

The coverage of Pap smear screening in Malaysia has been gradually increasing, with reports showing 26% coverage in 1996 and reaching 47.3% in 2006. However, this remains relatively low compared to developed nations such as Finland and the United Kingdom, where coverage exceeds 70%. Various barriers contribute to this low rate, such as a low doctor-to-population ratio, a shortage of trained cytoscreeners and smear-readers, and cultural factors. Even among educated women, 36% were unaware of Pap smear screening, 13% expressed fear of the procedure, 10% felt embarrassed, and 3% were unable to find a female physician. Additionally, cervical cancer screening is still viewed as a taboo subject in Malaysia, with many people relying on traditional health care practices instead [33, 34].

Cervical cancer screening has proven to be highly effective in reducing both the incidence and mortality of cervical cancer. Studies have shown that regular screening, whether annually or every two to five years, significantly reduces cervical cancer rates in sexually active women [32]. A European study, for example, found that screening women aged 35 to 64 years every one to three years reduced cervical cancer incidence by over 90%. However, the effectiveness of screening decreases with less frequent testing, with a reduction in efficacy to 83% for screenings every five years, and only 64.1% for screenings every ten years [35].

Despite the high sensitivity and specificity of the conventional cervical cytology test, results can vary due to potential sampling or detection errors. In countries like Malaysia, which face limited healthcare budgets and resources, cervical cancer screening has not been as successful in reducing cancer rates compared to wealthier nations. As a middle-income developing country, Malaysia could benefit from reorganizing its screening program to improve test quality and achieve broader coverage (> 80%) of the target population [32]. In cases where the current Pap smear program fails, low-cost alternatives, such as visual inspection with acetic acid (VIA) and HPV DNA testing, may be considered. However, these alternatives are still under evaluation for their effectiveness and accuracy in developing nations [32].

Breast cancer screening in Malaysia

In Malaysia, the process of breast cancer screening includes approaches such as breast self-awareness (BSA), clinical breast examination (CBE), and mammography. By 2006, the rates of BSA, CBE, and mammography were 57.14%, 51.77%, and 7.57%, respectively. The 30-34-year age group exhibited the highest rates of breast examinations, with 82.04% of women in this bracket engaging in screening. The official guidelines recommend that women aged 20 to 39 years receive a CBE every three years, while women aged 40 years and older, or those considered high-risk, should undergo annual CBE screenings [36]. The limited participation in mammography can be attributed to factors such as the cost, as mammograms are only free at government facilities for women who meet high-risk criteria. Other women must bear the cost of mammography at private clinics.

This review is one of the first to systematically assess the risks associated with female-specific cancers in Malaysia. Chinese women face the highest risks for breast, cervical, and endometrial cancers, while Malay women have the greatest risk for ovarian cancer. The highest occurrence of breast and cervical cancers is found in women aged 50-59 years, while endometrial cancer is most common in those aged 60-69 years. Ovarian cancer, on the other hand, has a noticeable increase in incidence after the age of 40 years.

Breast cancer is the leading cancer affecting Malaysian women, with the highest age-standardized rates (ASR) in comparison to other female-specific cancers, highlighting the need for greater focus. Between 1997 and 2008, the annual mortality rate from breast cancer in Malaysia increased by 6%, a pattern similar to that observed in the Philippines and South Korea. In contrast, countries such as Hong Kong and Singapore have seen stable mortality rates. Thailand's breast cancer mortality rate grew by 7% annually from 2000 to 2006, with an average annual rise of 9% from 1985 onward. Risk factors identified in Malaysia for developing female-specific cancers include obesity, high-fat diets, lack of physical activity, and the use of oral contraceptives.

While cervical cancer is not as prevalent as breast cancer, it has garnered significant attention due to its strong association with HPV and the fact that it is more easily preventable through screening. The National Cancer Society Malaysia has focused on prevention efforts such as HPV vaccination and the promotion of Pap smear tests [37, 38]. In developing countries like Malaysia, HPV-related cervical cancer is more common, and infections contribute to approximately 20% of cancer cases, compared to just 8% in developed countries. Countries with advanced healthcare systems, higher compliance with screenings, and effective public health programs have seen notable reductions in cervical cancer mortality. The WHO has predicted that HPV vaccines will be instrumental in significantly preventing cervical cancer shortly [39].

Limitations

This review has some inherent limitations. Malaysia is home to diverse ethnic populations, each with different genetic predispositions, cultural practices, socioeconomic conditions, and lifestyle habits, all of which influence cancer risks. The Chinese ethnic group, for example, shows distinct cancer rates compared to other groups. Studies that treat all ethnicities as a single category may yield misleading conclusions. Additionally, many studies in Malaysia focus on the primary ethnic groups and fail to include data from minority groups. Furthermore, national studies often concentrate on Peninsular Malaysia or specific regions, which could lead to a bias in reporting due to regional variations in ethnic composition. For instance, Sarawak has a predominance of the Iban ethnic group, while Penang has a higher proportion of Chinese residents. These regional differences may prevent the studies from accurately reflecting the cancer risks of the entire Malaysian population.

Conclusion

Cancer rates are anticipated to increase as the population ages, contributing to a growing cancer burden. The findings of this report indicate that the Chinese population generally faces a higher risk of developing female-specific cancers compared to Indians or Malays, except for ovarian cancer, which is more prevalent among Malays. Given the limitations in the healthcare budget, cancer screening and prevention efforts should prioritize cost-effective strategies, such as focusing on the Chinese population. However, it is crucial to invest in quality training to ensure the development of skilled personnel capable of effectively implementing these programs.

Directions for future research

Research on cancer in Asians, particularly within the Malaysian context, remains limited. The majority of studies conducted in Malaysia have focused on public knowledge through surveys, with a significant emphasis on cervical cancer, while research on other female-specific cancers like breast, ovarian, and endometrial cancer has been

sparse. There is a noticeable gap in data concerning the geographical scope and effectiveness of cancer screening programs. To improve cancer detection and outcomes, more cost-effective screening methods need to be explored, especially since Malaysians tend to prefer traditional and complementary therapies, often leading to later-stage diagnoses. Several challenges need addressing, including the negative perceptions and fear surrounding cancer, as it is often associated with death, along with issues such as limited access to treatment, poverty, and inadequate education. Lastly, comparing the Chinese population in Malaysia with those in other countries, such as China, Singapore, and Indonesia, could help identify potential genetic or lifestyle factors that might explain the higher rates of female-specific cancers in Malaysia.

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