Singapore Cancer Registry

Cancer Survival in Singapore

1968-2007

National Registry of Diseases Office (NRDO)
Health Promotion Board
Level 5
3 Second Hospital Ave
Singapore 168937

Previous Publications

1. K Shanmugaratnam, HP Lee, NE Day: Cancer Incidence in Singapore 1968-1977. IARC Scientific Publications No. 47, 1983.

2. HP Lee, NE Day, K Shanmugaratnam: Trends in Cancer Incidence in Singapore 1968-1982. IARC Scientific Publications No. 91, 1988.

3. HP Lee, KS Chia, K Shanmugaratnam: Cancer Incidence in Singapore 1983-1987. Singapore Cancer Registry, Report No. 3, 1992.

4. KS Chia, HP Lee, A Seow, K Shanmugaratnam: Trends in Cancer Incidence in Singapore 1968-1992. Singapore Cancer Registry, Report No. 4, 1996.

5. KS Chia, A Seow, HP Lee, K Shanmugaratnam: Cancer Incidence in Singapore 1993-1997. Singapore Cancer Registry, Report No. 5, 2000.

6. A Seow, WP Koh, KS Chia, LM Shi, HP Lee, K Shanmugaratnam: Trends in Cancer Incidence in Singapore 1968-2002. Singapore Cancer Registry, Report No. 6, 2004.

7. CS Wong, KY Chow, GH Lim, V Bhalla, HP Lee, KS Chia: Cancer Survival in Singapore 1968-2002. Singapore Cancer Registry, 2008.

8. Trends in Cancer Incidence in Singapore 1968-2007. Singapore Cancer Registry, Report No. 7, 2010.

CONTENTS

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* Observed survival reported only for the last 5-year calendar period of 2003-2007

INTRODUCTION

Survival statistics have long been recognised as important for monitoring and quantifying the effectiveness of cancer control activities at the population level, alongside the information on incidence and mortality. It is important to recognise that cancer survival figures must be interpreted in the presence of incidence and mortality data in order to have a more complete picture of the cancer burden at the population level.[1] For these reasons, the Singapore Cancer Registry (SCR) has compiled this monograph on survival statistics. Incidence statistics can be found in previous monographs of SCR.[2]

Cancer registration in Singapore - The Singapore Cancer Registry

SCR started comprehensive population-based cancer registration in January 1968. The Registry was founded primarily to obtain information on cancer incidence and trends in Singapore. In April 2001, the Registry came under the auspices of the National Disease Registries Office and it resides currently at the Health Promotion Board.

The SCR receives notifications from multiple sources: (a) medical practitioners, (b) pathology records and (c) hospital records. Death certificates are helpful in identifying new cases which are notified in turn. Cancer notification has been made mandatory in 2009 since the sublegislation of cancer as a reportable disease of the National Registry of Diseases Act (Chapter 201B) in 2007. Doctors can notify cancers diagnosed histologically or clinically to SCR through hand delivery (including courier), registered mail or electronic notification. The Registry ensures that notifications are as complete as possible by checking all pathology reports from restructured hospitals and private laboratories, and death certificates issued in Singapore as well as discharge records of all restructured hospitals. Cancer cases identified from these sources are checked against registered cases and reminders are sent to doctors in charge of cases that have not been notified to the Registry. Clinically diagnosed cancer cases are registered by the Registry staff based on information derived from the other sources mentioned above. Cancer registration is generally comprehensive since all cases diagnosed histologically and all cases with mention of cancer in

hospital discharge forms and death certificates are included. There is no personal contact with cases or patient follow-up by the Registry.

The cancer notification forms and a register of cases are maintained on a current chronological basis. All relevant information is coded and the Registry maintains a computerised file of all cases. Duplication of cases is avoided by checking all new cases against the master index using the unique National Registration Identification Number (NRIC). Personal identifiers such as name and NRIC are encrypted.

Certification of death is virtually complete in Singapore. In 2000, 97.6% of all deaths were certified by qualified medical practitioners or the Coroner and 2.4% by Inspecting Officers. The latter would certify a case as cancer only on the basis of a previous hospital diagnosis.

METHODOLOGY

PATIENT SELECTION

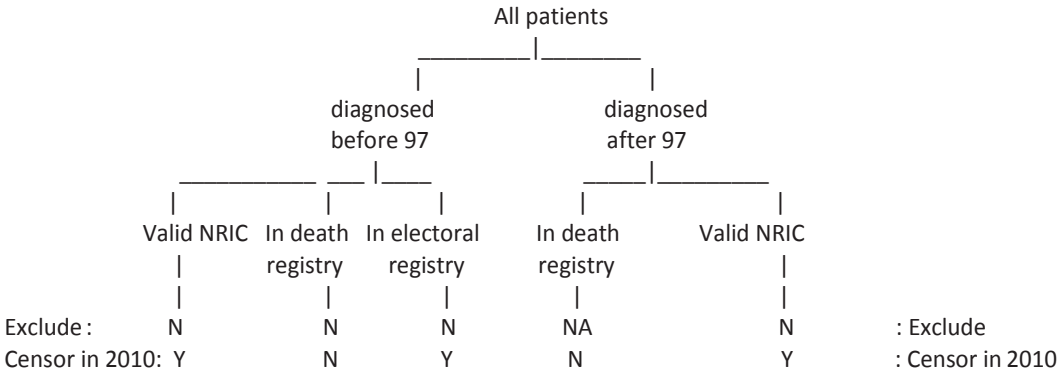
The study population was made up of a total of 193,496 single and multiple primary invasive cancer cases aged 15 and above. Childhood cancer cases are no longer included in the analysis because of their differences in biological characteristics, treatment protocols and survival outcomes.

Of the study population, 6,116 cases that were notified at the time of death (Death Certificates Only, DCO) were excluded. They were diagnosed in Singapore within the period from 1 January 1968 to 31 December 2007. The patients were passively followed up to 31 August 2010. Vital status was matched with the death register. Patients who were not in the death register could either be still alive or lost to follow-up. The 1997 Electoral Register[†] was used to confirm the vital status of the unmatched subjects diagnosed prior to 1997. 6,522 (3.4%) of all invasive cases, who were not in the death register or 1997 Electoral Register, were excluded. Additionally, 127 cases diagnosed on or after 1997 with invalid identification documents, were excluded. This criterion did not have to be applied to the pre-1997 cases as the invalid cases were already filtered out during a one-time match on death status with the Ministry of Home Affairs in 2004. A total of 13,462 (7.0%) of the patients (who were not in the death register but in the 1997 Electoral Register) were censored at 31 August 2010. One can refer to Figure 1 below for a pictorial understanding.

Unlike the previous report, patients diagnosed after 1997 and are not found in the death registry, are no longer ascribed median survival of matched dead patients. This is due to the match on death status as mentioned above. Hence, we can be sure that cases that were diagnosed between 1998 and 1999 and were not found in the death register, were indeed alive. Additionally, the Ministry of Home Affairs started sending cases to NRDO that have passed away since that time, on a regular basis.

[†] Subsequent electoral registers were not available for matching due to changes in the Parliamentary Elections Act

Figure 1. Exclusion and censoring of patients diagnosed before and after 1997



STATISTICAL METHODS

Relative survival is commonly used to describe the survival experience of the patients in a population-based study.[3] When a large number of patients are involved in a population-based study, it becomes very difficult to follow them up over time. The cause of death may also be unreliable. When such a situation occurs, cause-specific survival which relies heavily on an accurate cause of death becomes less useful. In order to circumvent the inaccuracy of death certificates, relative survival is often used and has grown in popularity as a method to estimate net survival (or excess mortality) when registry data is analysed.[4] It has been widely used by many registries, such as EUROCARE,[5] SEER[6] and those in the developing countries[7] to report on cancer survival.

Relative survival is defined as the ratio of observed survival of the patients with the expected survival of a comparable group in the general population, matched with respect to factors believed to be associated with survival at baseline (usually gender, age and calendar year of diagnosis).

The Relative Survival Ratio can be expressed in the following form:

$$RSR_i = \frac{S_i}{S_i^*}$$

where

RSR_i is the relative survival in the i^{th} sub-interval (e.g. i^{th} year)

S_i is the observed survival in the i^{th} sub-interval obtained from the patients

S_i^* is the expected survival in the i^{th} sub-interval obtained from the general population used to compare with the patient population

In this study, the expected survival was estimated from the Singapore general population which included deaths from all causes.[8] The Ederer II method was used to estimate expected survival, which assumes that the matched individuals are at risk until the corresponding patient dies or is censored. Details of the computation are shown in Appendix B. Other methods used to estimate expected survival include Hakulinen and Ederer I.[9] The more popular Hakulinen's method was not used because it required the potential follow-up time of the patients, which remained unascertained in this study. Cumulative survival ratios were computed by taking the product of interval-specific ratios where the follow-up time was set to be one year. Greenwood's formula[3] was used to obtain the standard errors for the corresponding survival ratios.

The Period approach was used to calculate the estimates[10-12] so as to highlight the temporal change in patient survival in a timelier fashion. In contrast to the conventional Cohort method, which describes the survival experience for a certain cohort of patients diagnosed within a time period, the Period method describes the survival experience of the patients during a certain time frame. This is done by restricting the analysis to some recent time period through left truncation of all observations at the beginning of that period in addition to right censoring at its end. Figure 2 illustrates how both Period and Cohort methods capture 5-year survival information.

Figure 2: Differences between Period and Cohort Approaches

Period

Year of Diagnosis	Period of Follow-up									
	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
1993	0-1	1-2	2-3	3-4	4-5	5				
1994		0-1	1-2	2-3	3-4	4-5	5			
1995			0-1	1-2	2-3	3-4	4-5	5		
1996				0-1	1-2	2-3	3-4	4-5	5	
1997					0-1	1-2	2-3	3-4	4-5	5
1998						0-1	1-2	2-3	3-4	4-5
1999							0-1	1-2	2-3	3-4
2000								0-1	1-2	2-3
2001									0-1	1-2
2002										0-1

Cohort

Year of Diagnosis	Period of Follow-up									
	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
1993	0-1	1-2	2-3	3-4	4-5	5				
1994		0-1	1-2	2-3	3-4	4-5	5			
1995			0-1	1-2	2-3	3-4	4-5	5		
1996				0-1	1-2	2-3	3-4	4-5	5	
1997					0-1	1-2	2-3	3-4	4-5	5
1998										
1999										
2000										
2001										
2002										

*Each coloured cell denotes the year of follow-up. For example, 0-1 means the first year of follow-up

STATA Packages (STRS) developed by Paul Dickman were used to obtain the relative survival estimates.[13]

Population Denominators

In the previous report, population denominators that were required for the calculation of expected survival were generated through the intra- and extrapolation of previous population censuses. However, to be aligned with other official publications in Singapore, we now use mid-year resident population estimates for the period 1983-2007, that are released by the Department of Statistics (DOS) on an annual basis since 1980.

Additionally, the software Mortpak was used to unabridge population life tables from 1968-2002 but for the recent period 2003-2007, the Elandt-Johnson (EJ) method was implemented in STATA to obtain complete life tables. This is based on the results of Baili et al., where after comparing the EJ, Kostaki, Brass Logit and Akima Spline methods of unabridging, found that the EJ method gave the best reconstitution at adult ages.[14]

Age-Standardisation

In order to compare patient survival over time and with other countries, we performed direct standardisation on the age-specific survival estimates to adjust for the different age structures (Appendix B). Unlike the previous survival report which used the World Standard Cancer Population as the standard population in age-standardisation, we now use the International Cancer Survival Standards developed by Corazziari et al. in 2004[15]. These standards were constructed with the aim of defining the smallest possible number of standards that are simple to use and provide survival values close to the raw ones by constrained cluster analysis. The standards and age classes applied to the various cancer sites can be found in table A3 of Angelis 2009[16].

Multiple Primaries

Previously, our report excluded all cases with one or more subsequent primary cancers. However for this report, we are including these cases in accordance with the Eurocare-5[17] and Concord-2[18] study protocols. It has been argued that other comorbidities that are even more lethal than subsequent tumours may be present in the cancer patient population. Furthermore, patients that died in the general population, whether from single or multiple primary cancer, are included in the estimation of expected survival. Finally, as newer registries tend to identify less multiple primary cases, purportedly leading to better survival rates, this bias is compounded when rates are compared across registries of different ages.

Cancer Staging

Our National Cancer Registry started to capture cancer staging information in 1968. We adopted principles from the Extent of Disease / End Results Group 1967 Code Manual* for this purpose, although broad rules were constructed to encompass multiple cancer sites, rather than being applied to specific cancer sites. In 2003, the registry adopted stage grouping guidelines from the AJCC Cancer Staging Manual 6th edition.[19] The main advantage is that the new guidelines are more cancer site-specific. As a result, staging is no longer grouped into local, regional or distant

categories but is instead assigned into stages 0-IV. As a result of this switch, trends in survival stratified by stage in the period 2003-2007 can no longer be compared with the past calendar periods.

International Comparisons

Cohort estimates were used for comparison purposes to maintain consistency with the method adopted by other populations such as Eurocare-4, with the exception of the SEER registries where the estimates were calculated using the modified Period approach.[20]

When benchmarking Singapore's survival statistics on an international platform, one should bear in mind the complexity of factors affecting survival, including incidence-related factors such as specific cancer definitions, patient demographics and risk factor distribution, cancer-related factors such as stage and sub-site and health-system factors such as screening, diagnosis, treatment and supportive care.[21]

CANCER SURVIVAL IN SINGAPORE: AN OVERVIEW

The interpretation of cancer survival estimates has to be done within the context of cancer incidence and mortality figures. A total of 163,331 cases of cancer were diagnosed among all Singapore residents during the period 1968-2007. Of these, 110,899 have died. Table 1 shows the trends in incidence and cancer specific mortality rates by gender in 5-year calendar periods.

Table 1: Trends in cancer incidence and mortality by gender, 1968-2007*

		Incidence			Mortality		
Period	Gender	Number	CR	ASR	Number	CR	ASR
1968-1972	Male	6983	135.4	227.3	3675	71.2	122.8
	Female	5086	103.4	154.1	2193	44.6	68.1
1973-1977	Male	8563	158.1	246.3	5337	98.6	155.4
	Female	6187	118.9	161.1	3226	62.0	86.5
1978-1982	Male	10136	175.1	250.3	6545	113.0	164.9
	Female	7997	142.6	175.8	4280	76.3	96.5
1983-1987	Male	11681	185.8	243.3	7433	119.1	157.4
	Female	10051	164.3	183.5	5101	84.1	94.9
1988-1992	Male	13635	197.7	236.2	9036	132.3	159.9
	Female	12739	189.3	191.5	6367	95.5	96.6
1993-1997	Male	16191	213.8	236.7	9601	129.4	142.4
	Female	15704	209.5	195.6	7056	96.1	88.4
1998-2002	Male	18949	231.5	233.3	11540	141.4	143.6
	Female	19727	240.3	203.0	8624	105.5	88.8
2003-2007	Male	21940	254.7	230.0	11694	135.8	123.2
	Female	23200	265.3	203.4	9191	105.1	78.2

CR: Crude rate (per 100,000 per year).
ASR: Age standardised rate (per 100,000 per year).
* Source: Trends in Cancer Incidence in Singapore, 1968-2007

A breakdown of the ten most frequent cancers in males and females for the period 1968-2007 is given in Figures 3 and 4 below.

Figure 3: Ten most frequent cancers in males, 1968-2007

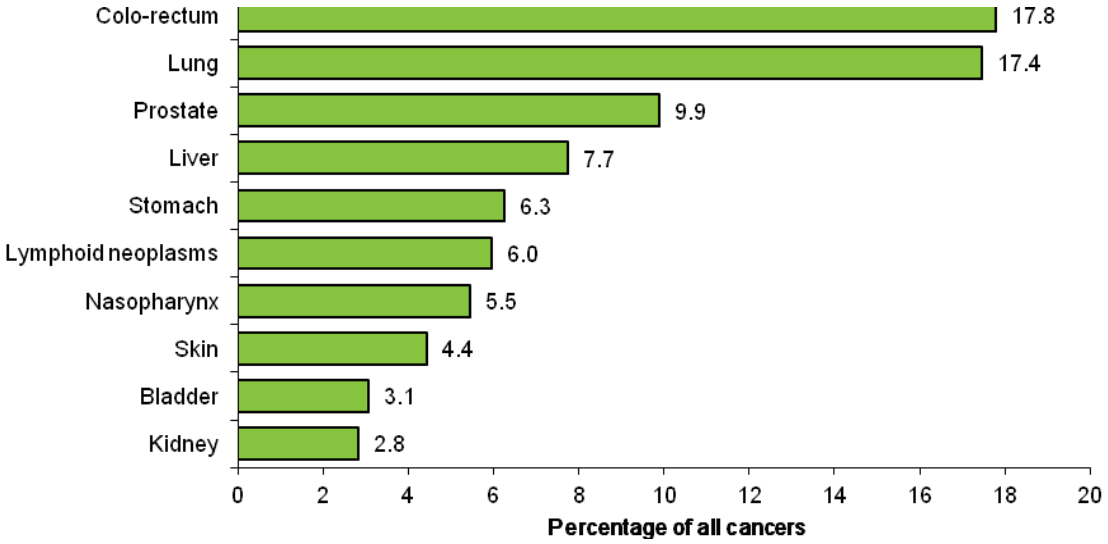
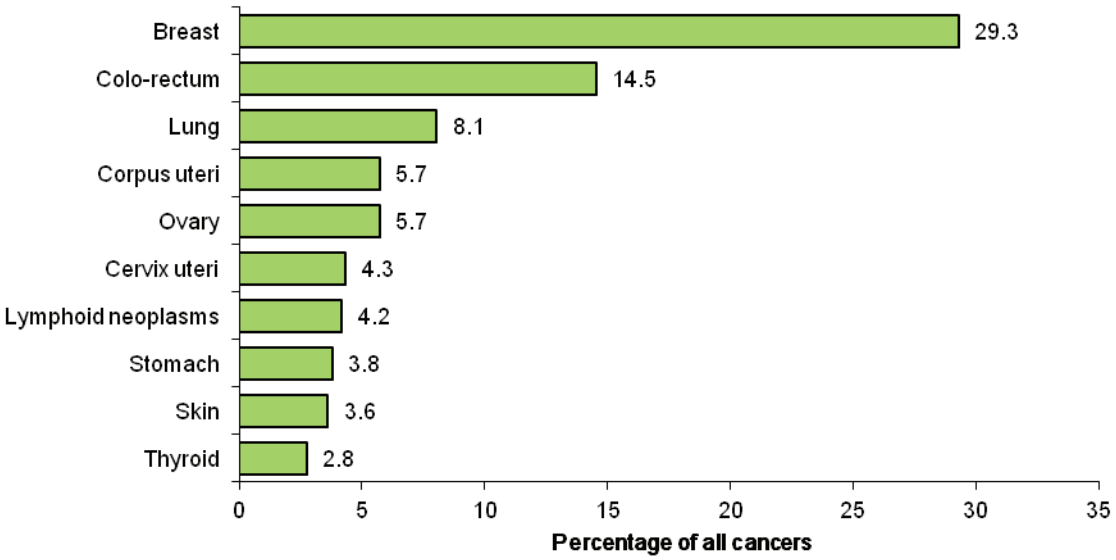


Figure 4: Ten most frequent cancers in females, 1968-2007



Trends in overall cancer survival estimates will be affected by the stage distribution. As can be seen from table 2, there is a larger proportion of females than males with stage I or II cancer. This is mainly attributed to breast, cervical and uterine cancers.

Table 2: Distribution of cancer stage* by gender for cases diagnosed between 2003-2007

	Males		Females	
Stage	No. of cases	Percentage	No. of cases	Percentage
0	41	0.2	13	0.1
1	1992	13.8	4985	29.6
2	3270	22.6	4246	25.2
3	3601	24.9	3922	23.3
4	5566	38.5	3679	21.8
	14,470	100.0	16,845	100.0

*Excludes limited & extended stages of lung cancer as well as unstaged cancer cases

Overall Trends

There was an overall improvement in the relative survival for both the males and females from 1973 to 2007. For the males, the 5-year age standardised relative survival ratio (ASRS) improved from 13.6% in 1973-1977 to 44.6% in 2003-2007. The 10-year ASRS improved from 14.5% in 1978-1982 to 40.7% in 2003-2007. Similarly for the females, the 5-year ASRS increased from 28.3% to 57.5% during the same period of analysis and the 10-year ASRS increased from 26.2% to 52.8% between 1973-1977 to 2003-2007. These trends are represented in Figures 5 and 6 below.

Figure 5: Trends in 5-year ASRS of all cancers by gender

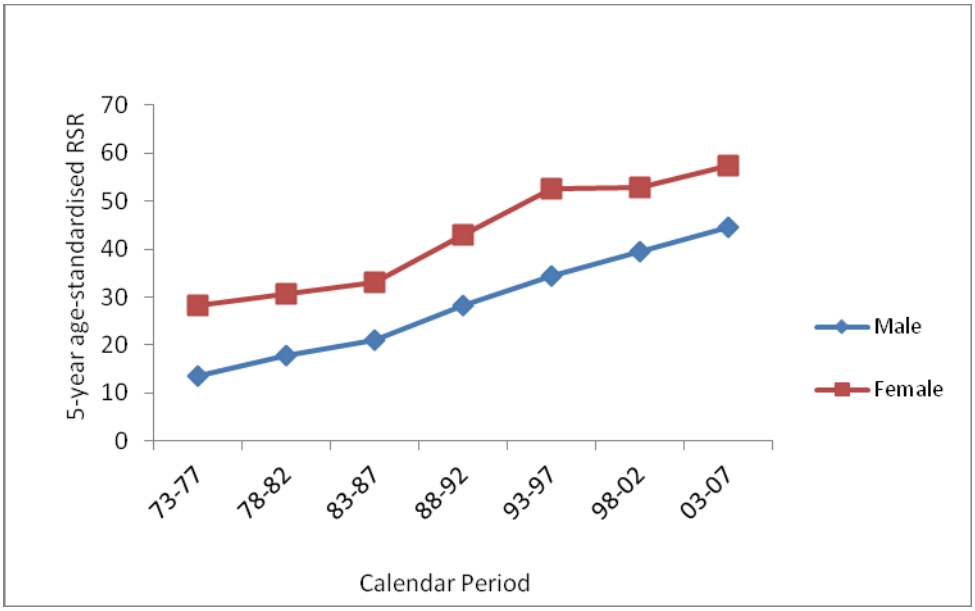
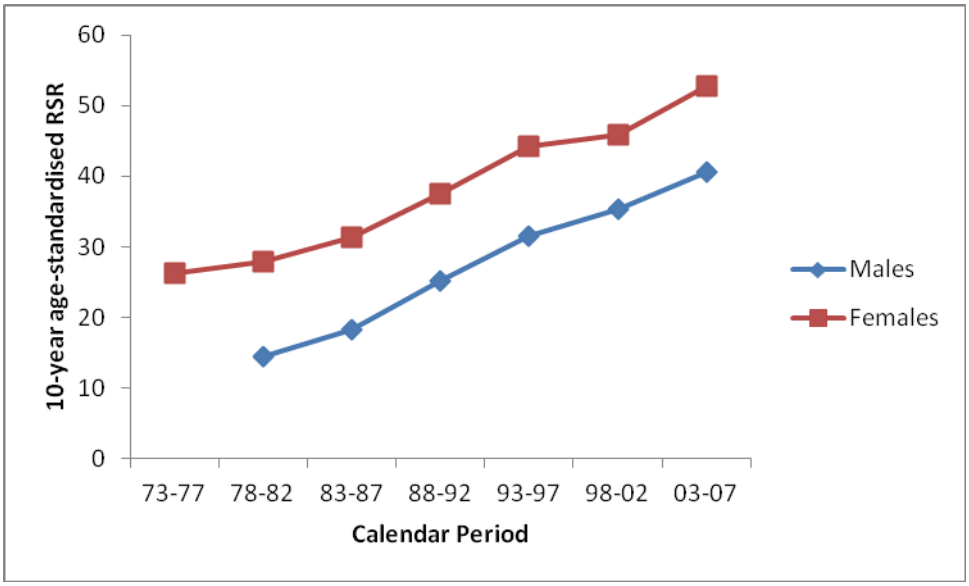


Figure 6: Trends in 10-year ASRS of all cancers by gender*



*Males are missing their ASRS in the 1973-1977 period due to the oldest age group not having any patient survive up to at least 10 years.

Limitations

The calculation of relative survival assumes that the cancer group for whom observed survival is calculated and the general population group for whom expected survival is calculated, is comparable in terms of the distribution of factors that influence mortality from other causes.[22] For instance, patients with smoking-related cancers (eg. Lung cancer) will have a higher exposure to tobacco compared to the general population, thus their risk of death from other tobacco-related conditions will also be considerably greater. This means that the relative survival estimate will be biased downwards.

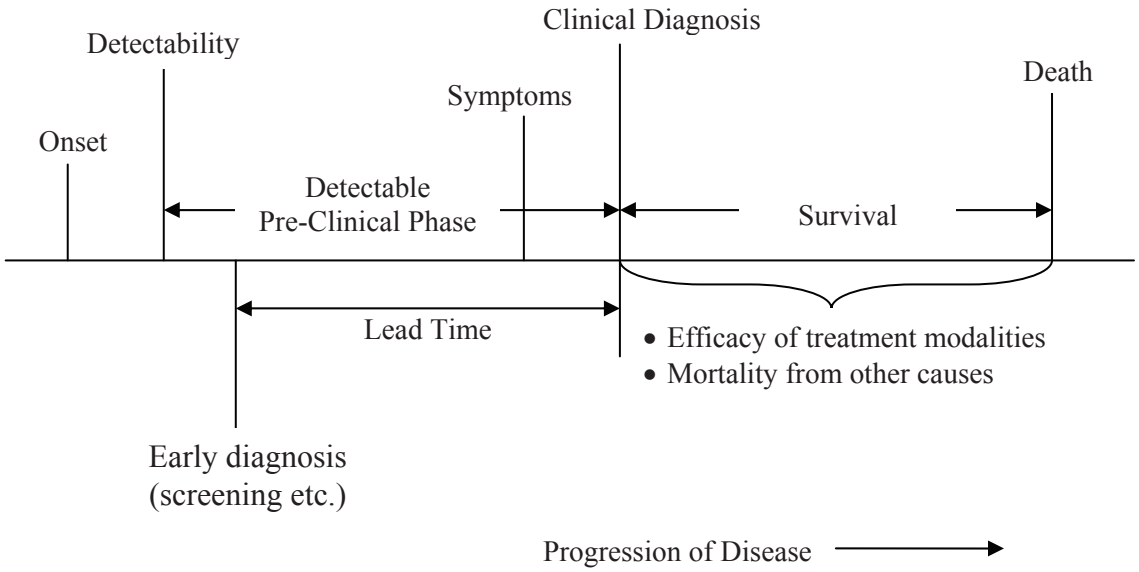
Additionally, it is assumed that the group from the general population used for comparison with the patients is free of the disease of interest. Independent competing risks is assumed.[23]

Apart from that, an increasing survival trend might not necessarily imply advancement in treatment modalities but might instead be due to (i) early detection of the cancer resulting in lead-time bias or (ii) a difference in the tools used to classify cancer stage resulting in a stage migration phenomenon.[3, 24]

Lead-time Bias

Since survival time is the duration between the dates of diagnosis and death, an earlier detection of a cancer will "prolong" a patient's survival time. Therefore, survival time can still increase even if there is no postponement of death. This is known as a lead-time bias when the cancer is detected even before the symptoms of the disease kicks in. This is generally introduced by screening programmes and improved diagnostic tools, and greater general public awareness. A schematic diagram for lead-time bias is shown below in Figure 7.

Figure 7: Schematic representation of lead time bias



Stage Migration

The availability and accessibility of diagnostic instruments may bring about a stage migration phenomenon. This phenomenon occurs when there is a re-classification in cancer staging which is normally a result of advancement in technology. For example, a patient might have been clinically diagnosed with cancer at a regional stage in the 1970s. Over the years with the progress in the development of diagnostic tools, the same patient in the 1970s may have been diagnosed to have metastatic disease today. Thus, this artifact will only make the survival rates appear to be more optimistic at each cancer stage[25] but it will not have an implication on the survival rates obtained from a non-stage-specific analysis.

In view of the above limitations, an analysis looking at relative survival, incidence and mortality trends is encouraged to evaluate therapeutic progress more precisely.[1]

Despite our relative lag in cancer survival compared to international counterparts, one should note that the RSR comparison is for all stages of survival. If stage-specific survival were to be compared, Singapore may be doing just as well as, if not better than other countries, suggesting that our treatment and cancer management is comparable to the international counterparts. Our cases tend to be diagnosed at a later stage compared to other developed countries. Indeed, this was found to be the case when Swedish and Singapore breast cancer cases were compared.[26] Similarly, cancer stage and number of axillary nodes examined were factors significantly affecting 5 year relative survival in multiple regression models using data from 6 European countries (combined into 9 regional groups based on survival similarities).[27]

COMMENTARIES ON SELECTED SITES

This section contains commentaries on common cancer sites for males and females. Time trends of the 5-year age standardised relative survival ratio (ASRS) were plotted together with those of age standardised incidence and cancer-specific mortality rates for these cancers.

Data for international comparisons are taken from:

- Surveillance Epidemiology and End Results (SEER) Cancer Query System, 1996-1998[6]
- EUROCARE-4, 1995-1999[5]
- Osaka Cancer Registry, 1996-1998[28]
- Cancer Survival in Africa, Asia and Central America: a population-based study, International Agency for Research on Cancer (IARC), various years[7]
- Australian Cancer Registries, The International Cancer Benchmarking Partnership, 1995-1999[29]
- Singapore Cancer Registry, 1995-1999

Nasopharynx (ICD-9 147)

The 5-year ASRS of nasopharyngeal cancer (NPC) improved in both males and females over the study period. The 5-year ASRS in males were 30.8% in 1978-1982 and 56.5% in 2003-2007. The corresponding figures in females were 33.8% and 66.1%. The uptrend in females was observed consistently across the entire study period while the increase in survival in males occurred mainly between the third and fifth calendar periods. On an international scale, the 1- and 5-year relative survival ratios for cancer of the nasopharynx in Singapore were higher than that for both genders in UK.

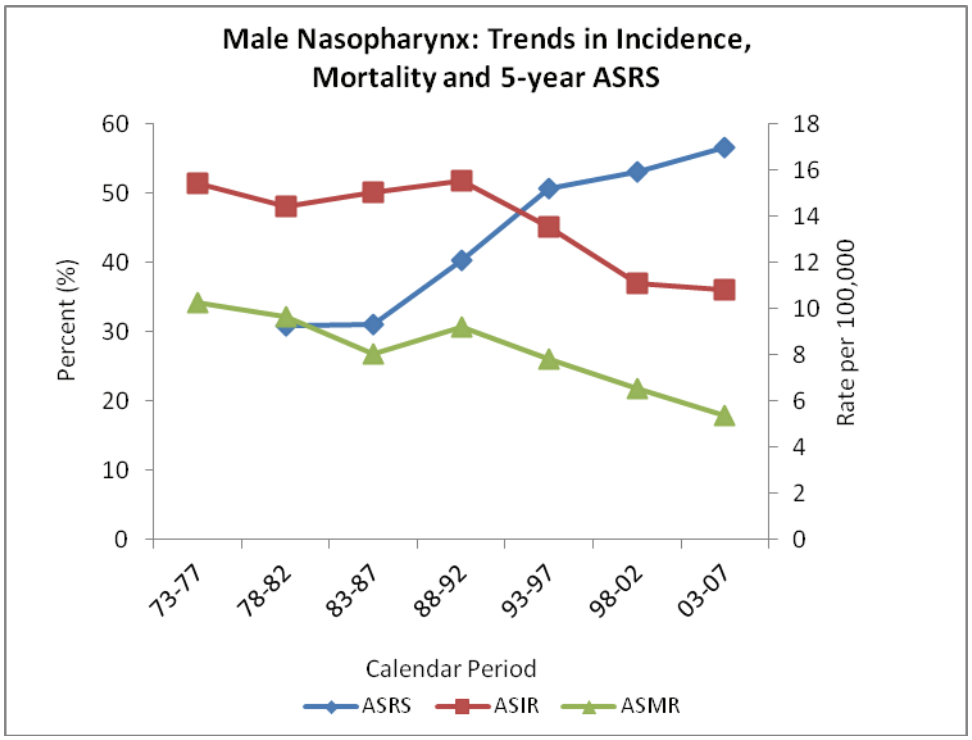
There were steady declines in the incidence and mortality of NPC. The incidence of NPC slid from 15.4 per 100,000 in 1973-77 to 10.8 per 100,000 in 2003-2007 in males. The incidence in females, which was approximately one third of what was observed in males, fell from 6.3 per 100,000 in 1973-77 to 3.4 per 100,000 in 2003-2007. Similarly, the mortality also declined over the study period as the mortality of NPC shrank 50% and 62% in males and females respectively between 1973 and 2007.

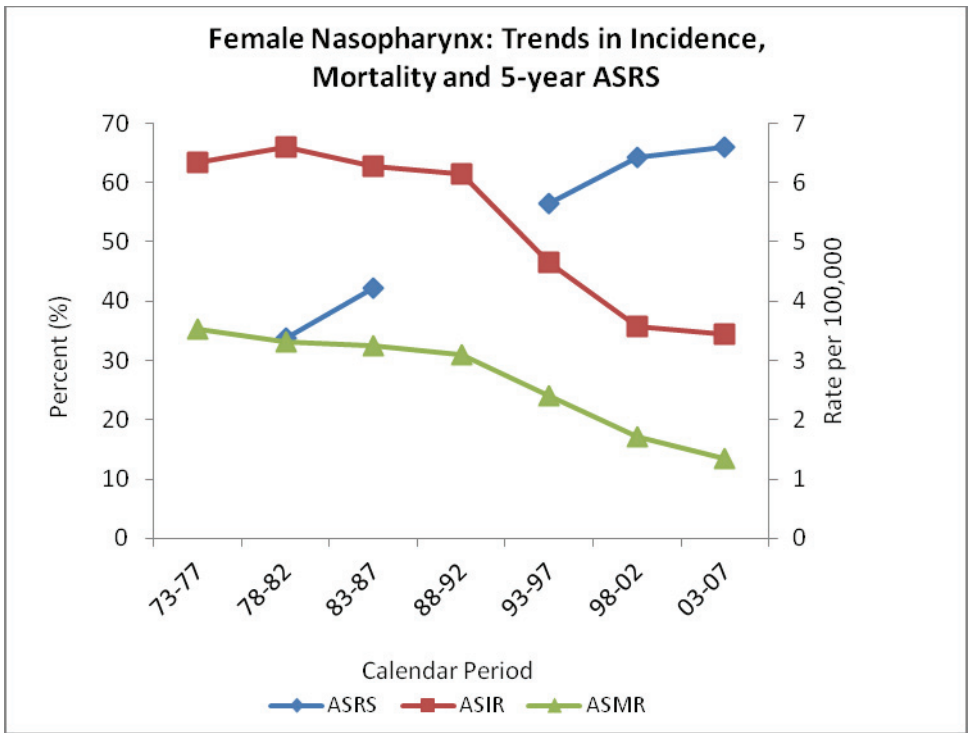
The major risk factors for NPC are the consumption of Cantonese-style salted fish and other preserved foods, Epstein-Barr virus infection and smoking.[30] The drop in incidence could be mostly attributed to changes in dietary habits and lifestyles that accompanied improvements in socio-economic conditions in Singapore over the last few decades.[31] The population had reduced its consumption of preserved foods, possibly due to emergence of alternative foods, improved refrigeration of foods in households and eating places and a gradual Westernisation of overall dietary patterns.

The improvement in overall NPC survival with the corresponding decline in mortality and incidence is likely to be due to improved treatment, in particular, more specific radiotherapy with less long term adverse effects. There is no effective NPC screening procedure and a substantial proportion of NPC cases in Singapore are still diagnosed at an advanced stage.[32]

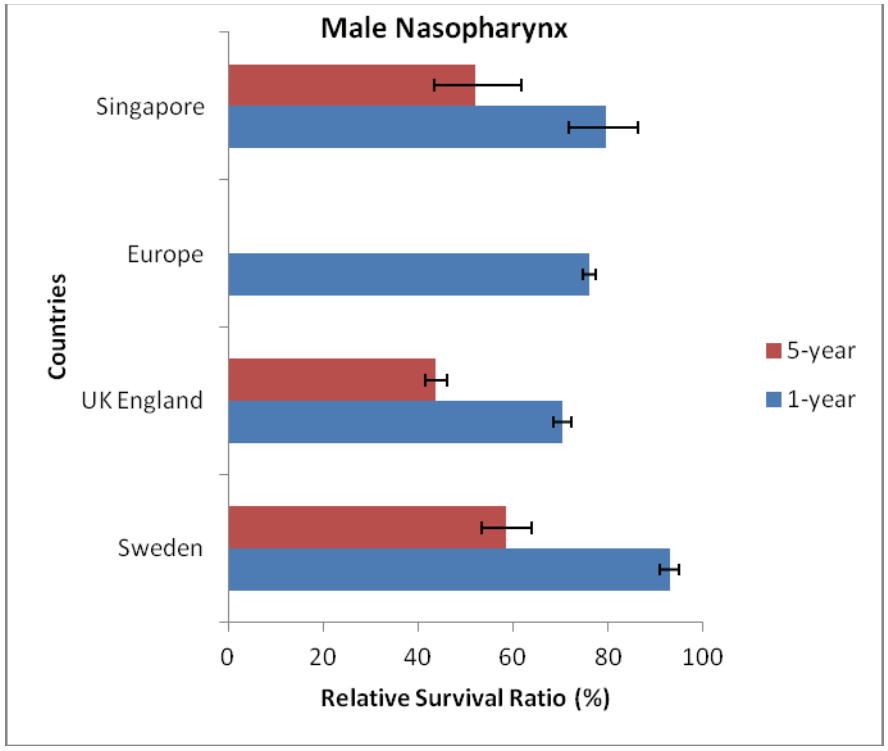
NPC is highly responsive to radiation therapy and treatment using external beam therapy and/or brachytherapy which evolved greatly during the 20th century.[33] Radiotherapy techniques have changed very significantly contributing to loco-regional cure and reduction of toxicities (particularly late) associated with radiotherapy. Radiotherapy is now the initial treatment of choice of stage I/II disease.

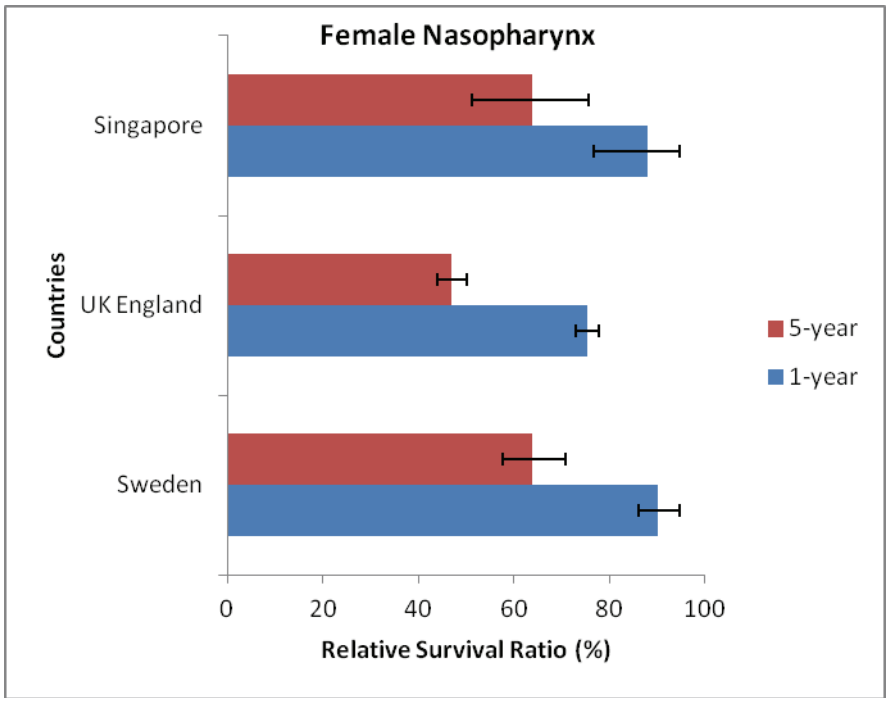
Another key therapeutic development is the addition of chemotherapy to treatment protocols, either as concurrent or neoadjuvant therapy. The use of chemotherapy for stage III/IV is now firmly established.[34] The combination of chemotherapy and radiation therapy protocols has been shown to reduce the risk of distant metastases and increases disease-free survival rates.[35-37] In addition to these medical advances, there were also rapid developments of the healthcare system and infrastructure in Singapore over the study period[38] so that facilities and expertise have become more readily available to provide better medical care for patients with NPC. For example, magnetic resonance imaging (MRI) has replaced computerized tomography scans (CT-scans) as the preferred imaging modality in the assessment and staging of NPC.[39]


Male Nasopharynx: Trends in Incidence, Mortality and 5-year ASRS
Percent (%)
Rate per 100,000
0
10
20
30
40
50
60
0
2
4
6
8
10
12
14
16
18
73-77
78-82
83-87
88-92
93-97
98-02
03-07
Calendar Period
ASRS
ASIR
ASMR


Female Nasopharynx: Trends in Incidence, Mortality and 5-year ASRS
Percent (%)
Rate per 100,000
0
10
20
30
40
50
60
70
0
1
2
3
4
5
6
7
73-77
78-82
83-87
88-92
93-97
98-02
03-07
Calendar Period
ASRS
ASIR
ASMR

1- and 5-year age standardised relative survival in selected countries





Age standardised observed survival and relative survival of nasopharyngeal cancer by calendar period and gender

Calendar Period	Males							
	ASOS (%)				ASRS (%)			
	1yr	3yr	5yr	10yr	1yr	3yr	5yr	10yr
1973-1977	57.1 (46.5-69.8)	30.1 (21.4-42.6)	-	-	58.5 (47.2-72.2)	32.6 (22.1-48.5)	-	-
1978-1982	68.2 (57.2-77.8)	36.4 (27.4-48.2)	27.2 (18.8-39.0)	-	70.0 (58.2-80.2)	38.6 (28.4-52.9)	30.8 (20.1-47.8)	-
1983-1987	69.7 (59.0-78.7)	39.1 (31.2-49.4)	28.0 (20.9-38.1)	-	71.4 (60.1-80.9)	41.4 (32.5-53.5)	31.0 (22.3-44.9)	-
1988-1992	72.6 (64.7-79.5)	47.3 (39.6-55.4)	36.5 (29.3-44.7)	-	74.1 (65.8-81.4)	50.0 (41.3-59.5)	40.3 (31.4-51.0)	-
1993-1997	78.4 (71.1-84.4)	56.3 (49.0-63.6)	45.7 (38.1-53.6)	28.9 (22.3-37.2)	80.2 (72.4-86.5)	59.4 (51.1-68.0)	50.7 (41.2-61.1)	37.3 (25.9-53.9)
1998-2002	81.0 (73.3-86.8)	59.6 (51.6-67.4)	48.7 (41.2-56.7)	31.3 (26.1-38.4)	82.6 (74.6-88.7)	62.9 (53.7-72.0)	53.0 (43.8-63.3)	35.5 (28.4-48.0)
2003-2007	83.2 (76.8-88.1)	66.2 (59.1-72.7)	53.1 (46.2-60.4)	38.3 (31.7-46.0)	84.4 (77.8-89.5)	68.8 (61.1-76.0)	56.5 (48.4-65.2)	45.0 (35.4-57.0)
Calendar Period	Females							
	ASOS (%)				ASRS (%)			
	1yr	3yr	5yr	10yr	1yr	3yr	5yr	10yr
1973-1977	70.8 (50.6-84.5)	42.1 (24.8-58.6)	-	-	72.4 (51.2-86.9)	46.8 (25.9-66.3)	-	-
1978-1982	76.4 (61.2-88.0)	43.5 (32.1-57.2)	32.1 (22.0-44.9)	-	77.8 (61.9-90.0)	44.9 (32.9-60.4)	33.8 (22.9-49.0)	-
1983-1987	80.6 (65.8-90.0)	55.5 (40.1-69.8)	39.0 (26.8-55.0)	-	82.1 (66.6-92.1)	58.7 (41.6-74.9)	42.2 (28.2-63.4)	-
1988-1992	83.5 (70.6-91.4)	60.5 (47.9-72.2)	-	-	84.9 (71.5-93.1)	63.1 (49.3-76.2)	-	-
1993-1997	86.7 (75.1-93.1)	67.2 (54.9-77.1)	53.5 (42.0-64.7)	-	87.9 (75.9-94.7)	69.6 (56.4-80.5)	56.5 (43.8-69.5)	-
1998-2002	88.4 (76.6-94.5)	72.7 (61.1-81.7)	61.7 (50.2-72.1)	-	89.2 (77.2-95.4)	74.4 (62.3-84.0)	64.3 (51.7-75.9)	-
2003-2007	92.2 (82.5-96.5)	74.5 (62.6-83.5)	62.9 (50.8-73.7)	45.9 (35.4-57.5)	93.2 (83.3-97.7)	76.6 (63.9-86.3)	66.1 (52.5-78.2)	50.6 (37.4-66.6)

ASOS: Age standardised observed survival
ASRS: Age standardised relative survival
- : the estimates were not computed due to the absence of cases in one or more age groups.

Stomach (ICD-9 151)

The survival of stomach cancer showed good improvement. The 5-year ASRS more than doubled in both males and females over the study period. The 5-year ASRS in 2003-2007 were 26.5% in males and 28.0% in females. This compared favourably with the 5-year ASRS of less than 10% in both genders in 1973-77. On an international scale, the 5-year relative survival in Singapore was lower than that in Osaka, Japan and SEER, USA but better than that in the European registries.

The incidence of stomach cancer declined steadily in both males and females. In males, the incidence dropped from 36.5 per 100,000 in 1973-77 to 14.5 per 100,000 in 2003-2007. Similarly, in females, the incidence decreased from 16.6 per 100,000 in 1973-77 to 7.4 per 100,000 in 2003-2007. These downward trends are similar to what have been documented in other populations as the incidence of stomach cancer has declined sharply over the latter half of this century in many countries around the world.[40] While the exact causes of the decline are not well understood, possible reasons may include a reduction in risk factors such as improvements in diet and food storage and a decline in the prevalence of Helicobacter pylori infection.[41]

Following the trend seen in the incidence, the mortality of stomach cancer also diminished. Comparing the mortality between the first and most recent calendar periods, the mortality has fallen by half to two-thirds. The trends of stomach cancer incidence and mortality followed each other closely throughout the study period in both genders, a pattern that was seen in other cancers such as liver and lung cancer. These cancers are characterised by poor prognosis of the average patient as most patients are diagnosed only when the tumours have reached advanced stages and treatment options become limited.

In terms of treatment, complete surgical removal of the tumour remains the only effective treatment modality and the most important treatment-related prognostic factor. Gastrectomy with preservation of the spleen and pancreas is the standard procedure in most cases.[42] It is now well-established that extended lymph node

dissection and node sampling (15 nodes or more) greatly improve the accuracy of staging and prediction of prognosis.[43] However, given the lack of significant advances in the treatment of stomach cancer, the declining mortality should be viewed primarily as a consequence of the decline in incidence rather than improvement in treatment effectiveness.

Endoscopic Mucosal Resection (EMR) and Endoscopic Submucosal Dissection (ESD) were techniques alternative to surgery developed in Japan to treat early stomach cancer in patients meeting specific criteria.[44] They have been recently introduced in Singapore. Observational studies have shown that long-term outcomes of patients meeting specific criteria were similar for endoscopic treatment compared to surgery. A multicentre retrospective study conducted in Japan demonstrated that the rate of curative resection and 3-year recurrence-free rate were both significantly higher in the ESD compared to the EMR group. However, the incidence of complications including delayed bleeding and perforation were higher in the ESD group, and the ESD procedure is also lengthier and more technically demanding.

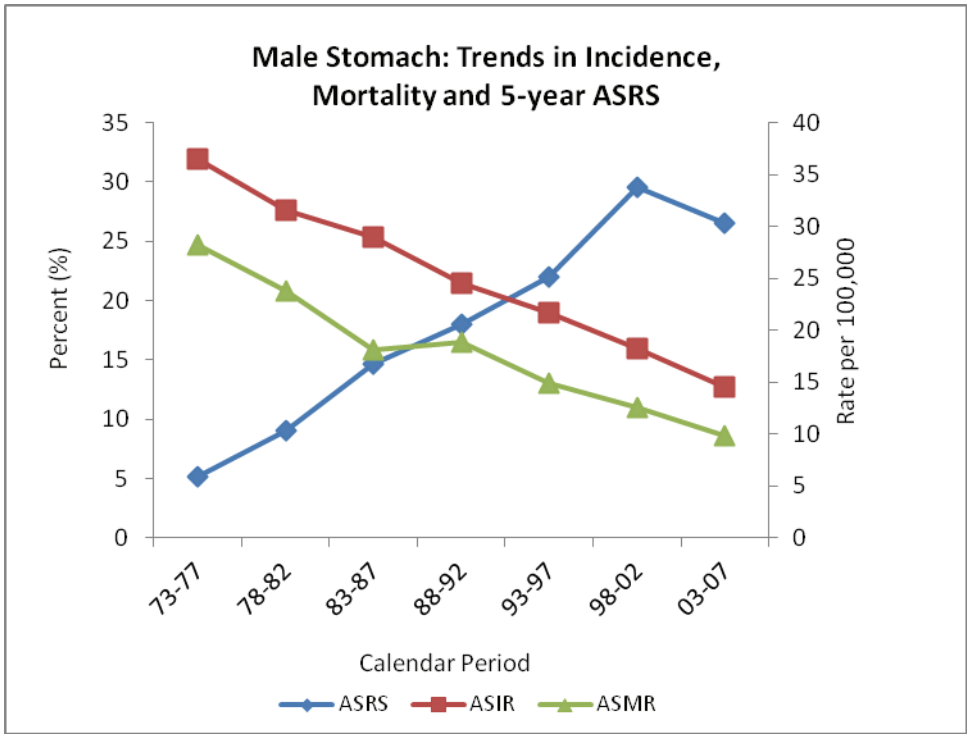
Additionally, a retrospective study conducted in Japan and another in Korea, have shown that there were no significant differences in survival rates among early stomach cancer patients that underwent laparoscopy-assisted distal gastrectomy (LADG) compared to open distal gastrectomy (ODG).[45] Furthermore, LADG patients experienced faster recovery and less pain compared to those who underwent ODG.

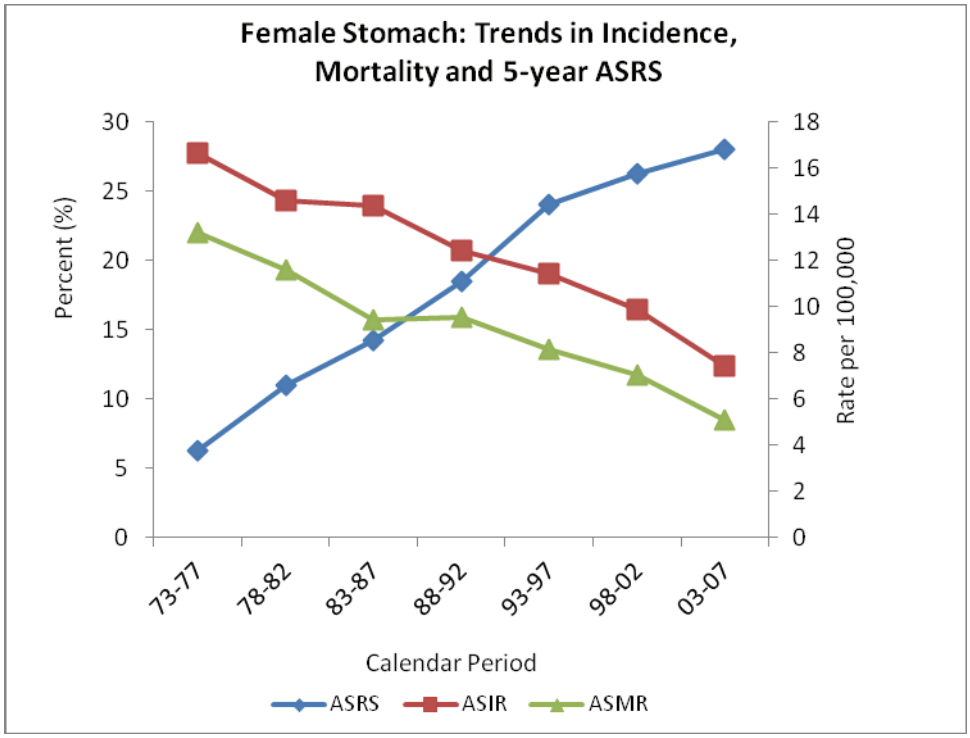
D2 lymphadenectomy is becoming an increasingly common procedure in advanced stomach cancer patients in Singapore, and open surgery rather than laparoscopic surgery is preferred in this case, due to a higher level of technical expertise required in the latter.

One possible explanation for the improvement in survival could be the overall improvement in healthcare infrastructure that affords better care to stomach cancer patients. Patients would have received better peri-operative care and supportive management. However, this alone might not be able to account for evident increase in survival.

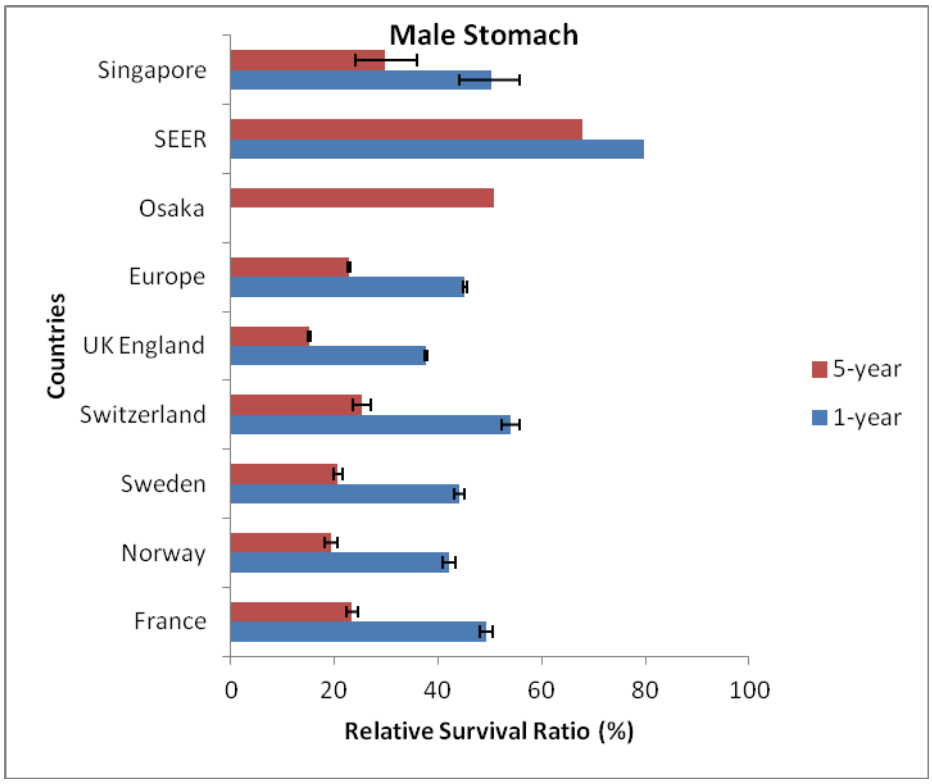
In the absence of significant progress in treatment methods, earlier diagnosis of some of the stomach cancer cases could be another possible reason to explain for the upward trend in survival. Prognosis of stomach cancer patients is clearly related to stage. Japan has one of the best 5-year survival of stomach cancer as indicated by the larger proportion of early stage, curable cancers that are diagnosed through its intensive stomach cancer screening programme.[46] There is basis to believe that there may be factors that contribute to earlier diagnosis in Singapore. While there is no national screening programme for gastric cancer, medical facilities for endoscopic investigations have become more widespread as the overall healthcare infrastructure in Singapore developed rapidly over the past decades. Physicians might have referred patients with early symptoms of stomach cancer for endoscopy at these facilities even for patients with the non-specific early symptoms such as dyspepsia.[47] The increased diagnostic intensity could have led to detection of gastric cancer in earlier stages of the disease and increased the proportion of early gastric cancers over the study period, thereby leading to an increase in the survival.

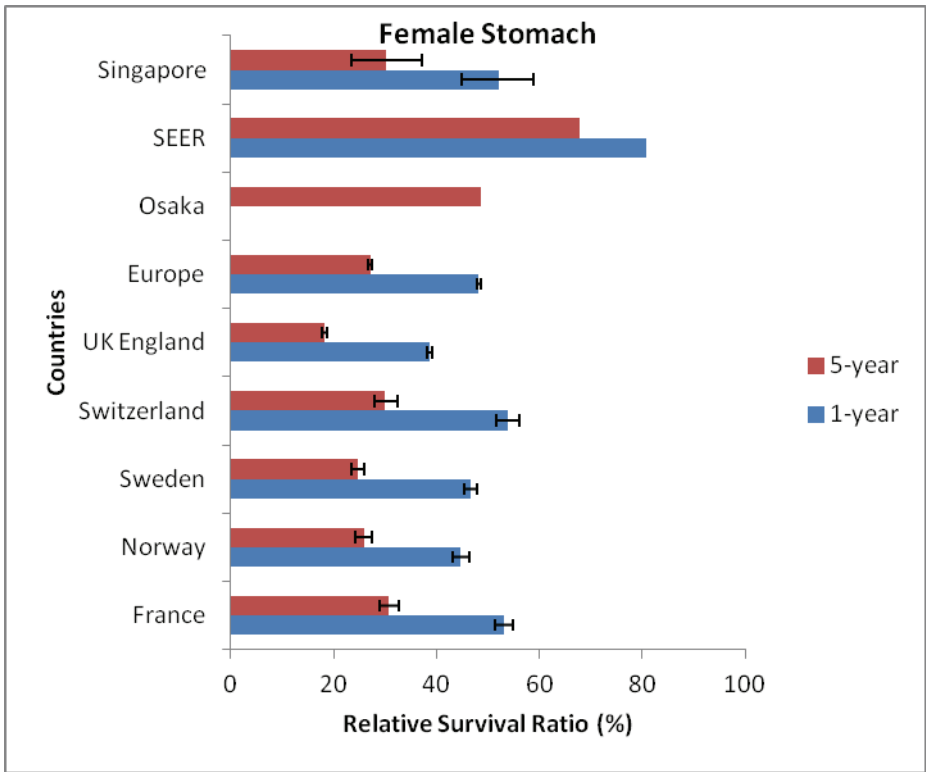
A recent decision analysis using Markov modelling has suggested that it might be cost-effective to screen Chinese men aged 50-70 years.[44] Additionally, high risk groups such as those with a history of gastric adenoma, gastric intestinal metaplasia, pernicious anemia, familial adenomatous polyposis or hereditary non-polyposis colorectal cancer should strongly consider endoscopic screening.


Male Stomach: Trends in Incidence, Mortality and 5-year ASRS
Percent (%)
Rate per 100,000
0
5
10
15
20
25
30
35
40
73-77
78-82
83-87
88-92
93-97
98-02
03-07
Calendar Period
ASRS
ASIR
ASMR


Female Stomach: Trends in Incidence, Mortality and 5-year ASRS
Percent (%)
Rate per 100,000
0
5
10
15
20
25
30
0
2
4
6
8
10
12
14
16
18
73-77
78-82
83-87
88-92
93-97
98-02
03-07
Calendar Period
ASRS
ASIR
ASMR

1- and 5-year age standardised relative survival in selected countries





Age standardised observed survival and relative survival of stomach cancer by calendar period and gender

Calendar Period	Males							
	ASOS (%)				ASRS (%)			
	1yr	3yr	5yr	10yr	1yr	3yr	5yr	10yr
1973-1977	16.5 (12.2-21.6)	5.8 (3.5-9.2)	4.1 (2.3-7.0)	-	17.3 (12.7-22.8)	6.6 (3.9-10.7)	5.2 (2.8-9.7)	-
1978-1982	24.1 (18.9-29.6)	9.8 (6.5-13.9)	7.3 (4.6-11.2)	-	25.2 (19.7-31.0)	11.1 (7.2-16.1)	9.0 (5.4-14.6)	-
1983-1987	32.0 (26.3-37.7)	15.2 (11.2-19.9)	11.8 (8.2-16.1)	-	33.4 (27.5-39.4)	17.2 (12.6-22.7)	14.6 (10.1-20.3)	-
1988-1992	35.0 (29.5-40.5)	19.3 (14.9-24.1)	13.9 (10.1-18.4)	8.8 (5.5-13.2)	36.6 (30.9-42.4)	22.1 (17.0-27.6)	18.0 (13.0-23.9)	16.6 (9.6-26.8)
1993-1997	41.0 (35.3-46.4)	22.8 (18.0-27.9)	18.0 (13.7-22.8)	12.1 (8.6-16.4)	42.7 (36.8-48.4)	25.7 (20.3-31.4)	22.0 (16.6-28.1)	18.5 (12.6-26.3)
1998-2002	47.1 (41.5-52.4)	29.0 (24.1-34.1)	24.7 (20.0-29.5)	17.4 (13.0-22.3)	48.8 (42.9-54.3)	32.2 (26.6-37.8)	29.6 (23.9-35.5)	27.9 (20.1-37.1)
2003-2007	52.7 (46.6-58.2)	29.9 (24.5-35.4)	23.1 (18.2-28.2)	17.5 (13.3-22.2)	54.2 (48.0-60.0)	32.7 (26.8-38.7)	26.5 (20.9-32.6)	25.1 (18.8-32.2)
Calendar Period	Females							
	ASOS (%)				ASRS (%)			
	1yr	3yr	5yr	10yr	1yr	3yr	5yr	10yr
1973-1977	20.7 (14.2-28.1)	8.9 (4.8-14.7)	5.5 (2.6-11.3)	-	21.4 (14.6-29.1)	9.8 (5.2-16.5)	6.3 (2.9-13.9)	-
1978-1982	27.3 (20.0-35.1)	12.9 (8.0-19.1)	9.1 (5.1-14.7)	4.2 (1.7-10.6)	28.4 (20.8-36.6)	14.7 (9.0-22.0)	11.0 (6.0-18.4)	5.8 (2.2-21.0)
1983-1987	31.6 (24.8-38.4)	17.1 (11.8-23.2)	12.7 (8.1-18.5)	8.3 (4.4-13.9)	32.3 (25.4-39.3)	18.2 (12.5-24.9)	14.2 (8.9-21.0)	11.3 (5.8-19.9)
1988-1992	39.0 (31.7-46.0)	20.6 (14.9-27.0)	16.0 (10.8-22.1)	12.6 (7.6-19.3)	40.0 (32.5-47.2)	22.5 (16.2-29.4)	18.5 (12.4-25.7)	18.1 (10.2-29.6)
1993-1997	44.2 (37.1-50.9)	26.5 (20.3-33.1)	20.4 (14.6-26.8)	13.3 (8.4-19.3)	45.4 (38.1-52.3)	28.9 (22.1-36.1)	24.1 (17.3-31.6)	20.7 (13.0-30.3)
1998-2002	46.8 (39.8-53.3)	29.5 (23.4-35.8)	23.7 (18.1-29.7)	16.7 (11.7-22.5)	47.7 (40.6-54.4)	31.4 (24.9-38.0)	26.3 (20.1-32.9)	20.6 (14.2-28.1)
2003-2007	54.5 (46.9-61.3)	30.8 (24.2-37.7)	25.1 (19.0-31.6)	19.0 (13.7-24.9)	55.7 (48.0-62.8)	33.0 (25.9-40.3)	28.0 (21.2-35.2)	25.5 (18.3-33.6)

ASOS: Age standardised observed survival
ASRS: Age standardised relative survival
- : the estimates were not computed due to the absence of cases in one or more age groups.

Colon (ICD-9 153)

The survival of colon cancer patients made good progress. The 5-year ASRS approximately doubled in both genders over the study period. In males, the 5-year ASRS climbed from 25.5% in 1973-77 to 57.5% in 2003-2007. The corresponding 5-year ASRS for females in 1973-77 and 2003-2007 were 30.7% and 57.5% respectively. Internationally, the relative survival for colon cancer in Singapore was comparable to that in Europe but was lower than that in the SEER registries for both genders.

The incidence of colon cancer increased over the study period in both genders. The incidence increased from 12.9 per 100,000 in 1973-77 to 23.0 per 100,000 in 2003-2007 in males. In females, the incidence increased from 11.9 per 100,000 in 1973-77 to 19.1 in 2003-2007. The mortality of colon cancer also increased. The mortality in males increased from 7.1 per 100,000 in 1973-77 to 12.1 per 100,000 in 2003-2007. Similarly, the mortality in females grew from 6.0 per 100,000 in 1973-77 to 9.0 per 100,000 in 2003-2007.

The rise in the incidence of colon cancer was largely due to an increase in its risk factors. Increasing affluence had brought about substantial dietary change in Singapore with the more affluent households purchasing more red meat/offal.[48] Between 1961 and 1983, meat and offal supply to Singapore increased 135%.[49] The National Nutrition Survey conducted in 1998 revealed that consumption of vegetables and wholegrain intakes by Singaporean adults were proportionately lower compared to meat intake[50] and high meat/ vegetable consumption ratio has been shown to predispose towards development of colorectal cancer in Singaporean Chinese.[51] In terms of physical activity, the National Health Survey 2010 showed that only 19.4% of Singaporeans engaged in regular exercise (i.e. at least 20 minutes of exercise for 3 or more times a week) while 54% of Singaporeans are physically inactive.[52]

Strategies for screening of colorectal cancer have been devised and implemented in different populations. The natural history of the development of colorectal neoplasia has been characterised and the majority of colorectal cancers evolve from precursor

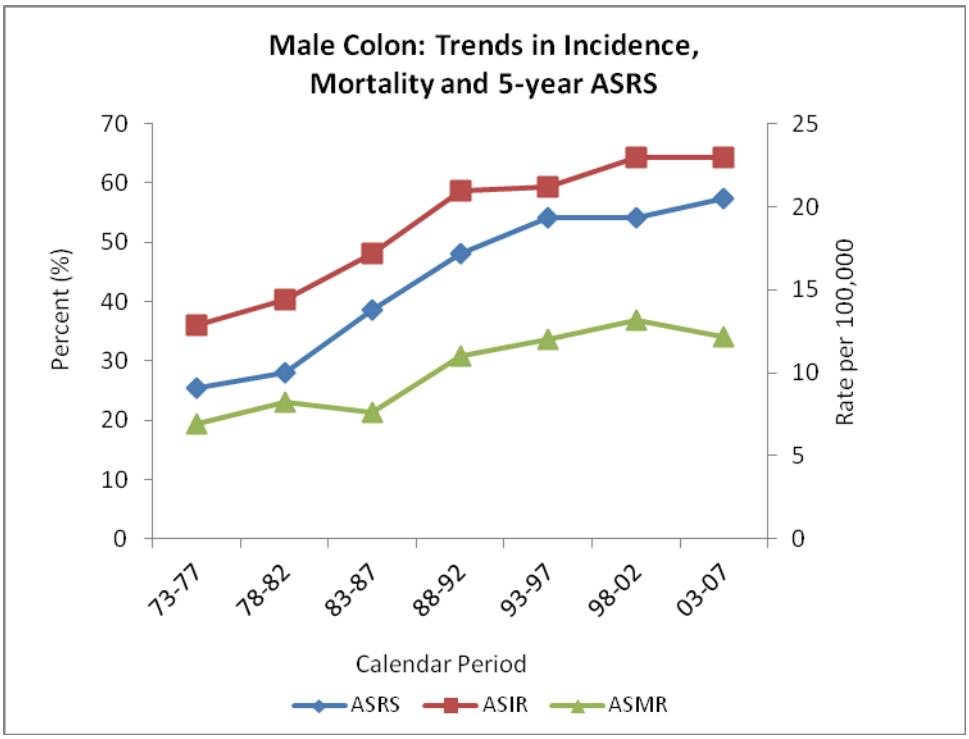
adenomas. Epidemiological evidence estimated that the transformation of adenomatous polyps to cancer takes approximately 10 years[53] and detection and removal of adenomas has been shown to prevent incident cancers.[54] There are several screening tools that can be used for screening of colorectal cancer, including colonoscopy, sigmoidoscopy, barium enema and fecal occult blood testing. While there was no population-based national screening programme for colon cancer in Singapore during the study period, these screening modalities were accessible through opportunistic screening in Singapore.

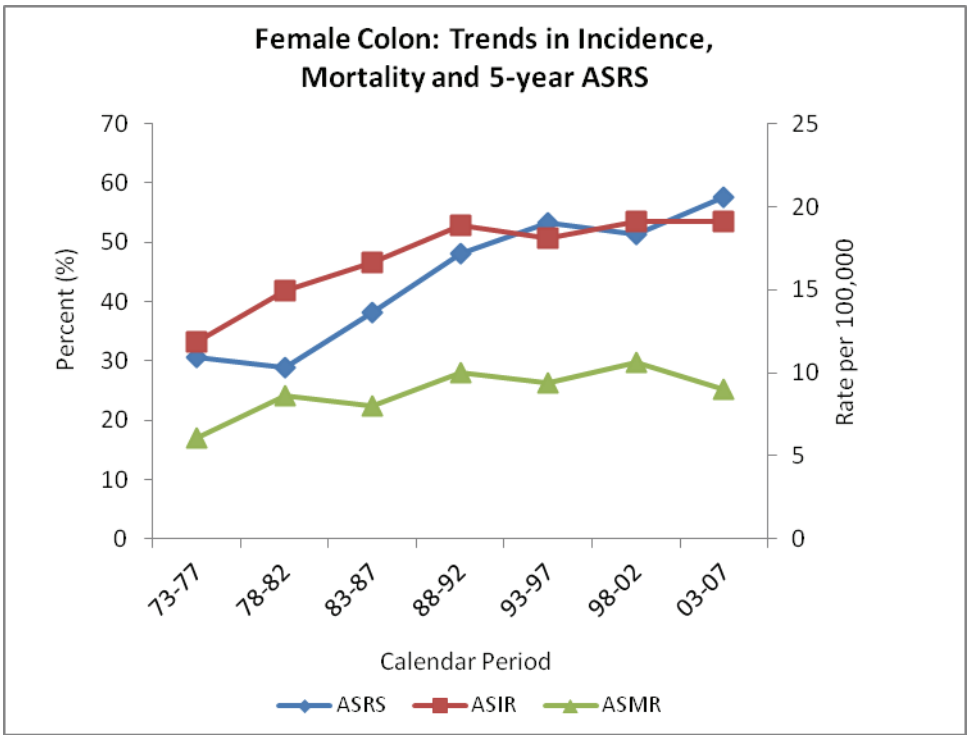
However, we believe that the effect of screening on incidence and survival of colon cancer in this study is likely to be modest. Routine endoscopic polypectomies began in the late 1980s[55] when survival was already on an upward trend. There is no national colorectal carcinoma screening programme in Singapore to detect early lesions. In addition, the level of awareness of colorectal cancer in Singapore had been reported to be poor. In one local study involving two thousand adults living in Singapore, less than 3% named colorectal cancer as a fatal disease. Most were unable to name a single symptom of colorectal cancer and were unaware of screening as an important tool against the development of colorectal cancer.[56] In the 2010 National Health Survey[52], only 27.8% and 14.2% of Singaporeans aged 50 to 69 years reported having had a fecal occult blood test and colonoscopy / sigmoidoscopy at least once respectively.

Improvement in the treatment of colon cancer patients can help to explain the improvement in survival during the study period. A key therapeutic advance is the development of adjuvant chemotherapy. The first definitive data of the effectiveness of adjuvant chemotherapy emerged from trials conducted by the North Central Cancer Treatment Group (NCCTG) in the 1980s which showed improved disease-free status and overall survival for chemotherapy in comparison with observation.[57] Over the past 2 decades, adjuvant chemotherapy has evolved from experimental status to become the standard of care.[58] There were also marked improvements in overall healthcare infrastructure and treatment facilities in Singapore. Surgery remains the definitive treatment for localised colon cancer[59] and it is believed that there has been greater availability to surgical care in Singapore over the past

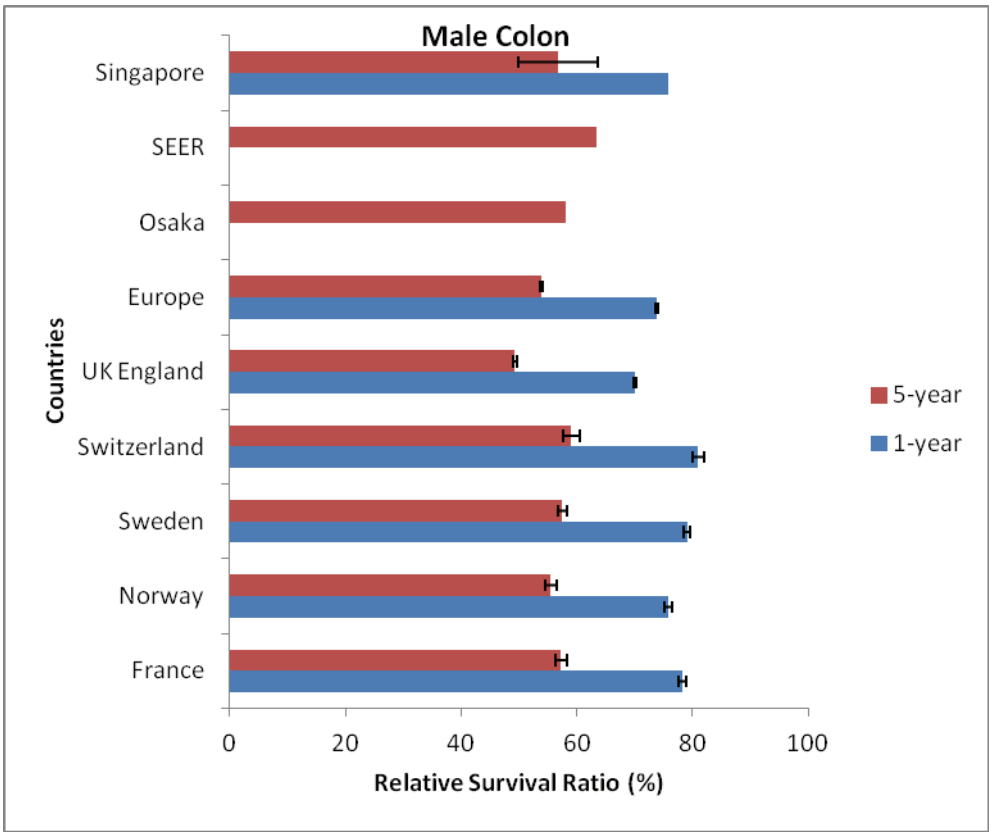
decades and the proportion of colorectal cancer patients receiving surgery may have increased significantly.[60]

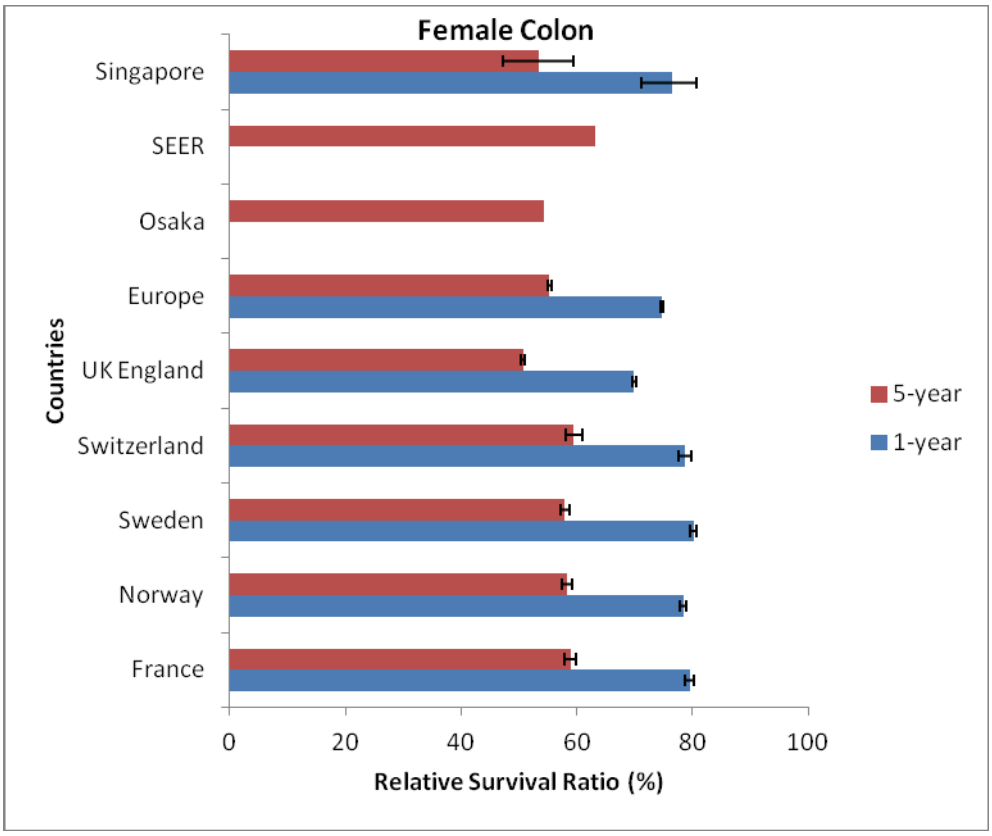
The improvement in survival took place against a backdrop of a rise in mortality that ran in parallel to the rise in incidence. The mortality to incidence ratio fluctuated within a fairly narrow range of 45% to 58% in males and 47% to 58% in females. Due to the insidious nature of the disease in most patients and the lack of widespread screening for colon cancer in the population during the study period, it is possible that a significant proportion of colon cancers were diagnosed only in the advanced stages. There had also been fewer advances made in the treatment of metastatic disease as compared to localised colon cancer. This observation is corroborated by an earlier report that noted that survival for localised and regional colorectal cancers improved between 1968–1992 but not metastatic cancer.[60]


Male Colon: Trends in Incidence, Mortality and 5-year ASRS
Percent (%)
Rate per 100,000
0
10
20
30
40
50
60
70
0
5
10
15
20
25
73-77
78-82
83-87
88-92
93-97
98-02
03-07
Calendar Period
ASRS
ASIR
ASMR


Female Colon: Trends in Incidence, Mortality and 5-year ASRS
Percent (%)
Rate per 100,000
0
10
20
30
40
50
60
70
0
5
10
15
20
25
73-77
78-82
83-87
88-92
93-97
98-02
03-07
Calendar Period
ASRS
ASIR
ASMR

1- and 5-year age standardised relative survival in selected countries





Age standardised observed survival and relative survival of colon cancer by calendar period and gender

Calendar Period	Males							
	ASOS (%)				ASRS (%)			
	1yr	3yr	5yr	10yr	1yr	3yr	5yr	10yr
1973-1977	41.1 (30.2-52.1)	26.1 (16.8-36.9)	20.2 (12.2-31.8)	-	43.3 (31.5-55.2)	30.5 (19.1-44.3)	25.5 (14.5-44.1)	-
1978-1982	47.5 (38.6-56.1)	31.1 (23.3-39.5)	22.6 (15.7-30.7)	15.3 (9.5-24.3)	49.3 (39.9-58.6)	35.0 (25.9-45.3)	28.0 (18.8-39.9)	25.6 (15.4-56.1)
1983-1987	60.7 (52.3-67.9)	39.0 (30.6-47.2)	29.6 (21.5-38.4)	23.6 (15.7-32.4)	63.7 (54.9-71.4)	45.4 (35.4-55.3)	38.5 (27.2-51.3)	71.9 (41.9-108.9)
1988-1992	66.2 (59.7-71.8)	46.6 (39.9-52.9)	36.5 (29.8-43.1)	26.9 (19.7-35.5)	69.6 (62.8-75.5)	54.6 (46.6-62.2)	48.2 (39.0-57.5)	52.5 (33.1-79.9)
1993-1997	70.3 (64.8-75.0)	50.3 (44.5-55.8)	41.1 (35.3-46.8)	29.3 (23.6-35.1)	73.6 (67.8-78.6)	58.3 (51.4-64.9)	54.1 (46.1-61.9)	55.4 (42.4-70.0)
1998-2002	70.4 (65.7-74.4)	54.1 (49.0-58.8)	43.2 (38.0-48.2)	30.5 (25.6-35.5)	73.1 (68.2-77.4)	61.1 (55.2-66.6)	54.2 (47.5-60.7)	51.9 (42.1-62.4)
2003-2007	74.2 (70.0-77.9)	56.5 (51.7-60.9)	47.9 (43.0-52.4)	35.6 (31.0-40.3)	76.7 (72.3-80.5)	62.5 (57.2-67.5)	57.5 (51.6-63.1)	53.7 (45.8-61.8)
Calendar Period	Females							
	ASOS (%)				ASRS (%)			
	1yr	3yr	5yr	10yr	1yr	3yr	5yr	10yr
1973-1977	43.0 (31.8-53.9)	29.9 (19.8-41.0)	25.0 (15.4-36.2)	-	44.6 (32.8-56.0)	33.5 (21.9-46.6)	30.7 (18.2-45.7)	-
1978-1982	49.1 (40.3-57.2)	31.4 (23.6-39.4)	24.3 (17.0-32.3)	18.7 (11.6-27.5)	50.9 (41.7-59.4)	34.9 (26.0-44.3)	29.0 (19.9-39.4)	30.8 (17.3-50.2)
1983-1987	59.2 (51.3-66.2)	38.7 (30.9-46.5)	31.8 (24.2-39.7)	25.0 (17.4-33.6)	61.2 (52.9-68.4)	42.9 (34.1-51.7)	38.1 (28.7-47.9)	39.9 (26.0-56.4)
1988-1992	69.3 (63.1-74.5)	50.8 (44.1-57.0)	40.2 (33.3-47.0)	29.7 (22.6-37.2)	71.5 (65.1-76.9)	56.2 (48.8-63.2)	48.2 (39.8-56.4)	45.2 (33.2-58.5)
1993-1997	71.0 (65.4-75.7)	54.1 (48.2-59.6)	44.8 (38.9-50.4)	34.0 (28.0-39.9)	73.2 (67.5-78.1)	59.8 (53.2-65.9)	53.3 (46.2-60.2)	51.6 (41.8-61.7)
1998-2002	72.5 (67.8-76.4)	54.3 (49.1-59.1)	45.1 (39.8-50.1)	33.5 (28.5-38.5)	74.1 (69.3-78.2)	58.2 (52.6-63.4)	51.3 (45.3-57.0)	43.8 (36.7-51.0)
2003-2007	78.1 (74.1-81.4)	60.1 (55.4-64.4)	50.6 (45.7-55.3)	40.5 (35.6-45.3)	80.0 (75.9-83.4)	64.7 (59.6-69.3)	57.5 (52.0-62.8)	55.2 (48.2-62.2)

ASOS: Age standardised observed survival
ASRS: Age standardised relative survival
-: the estimates were not computed due to the absence of cases in one or more age groups.

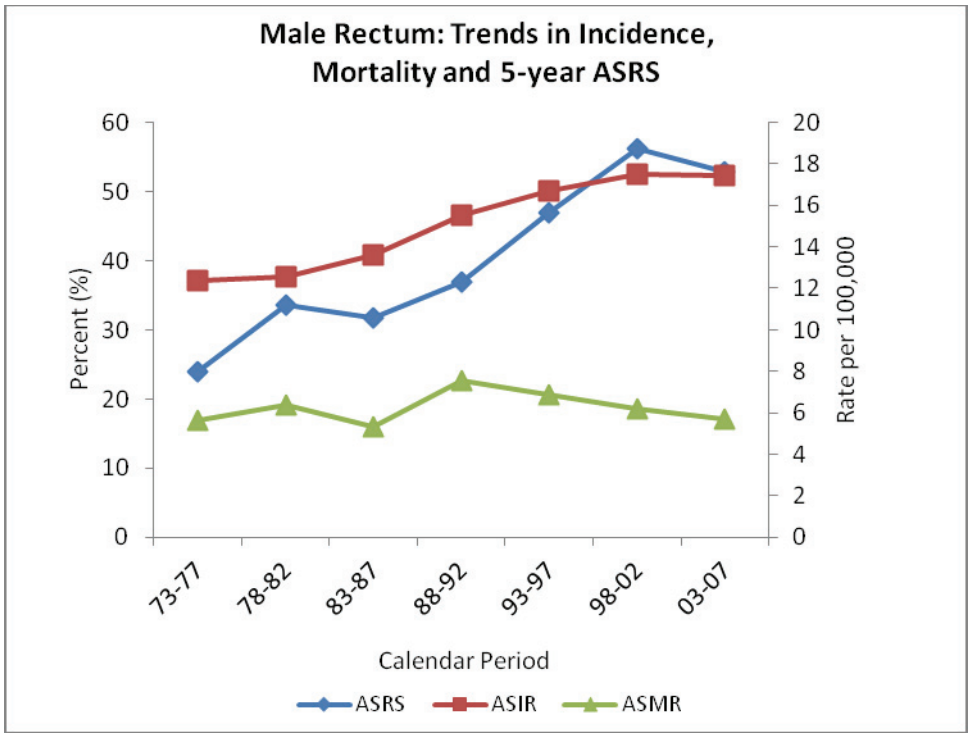
Rectum (ICD-9 154)

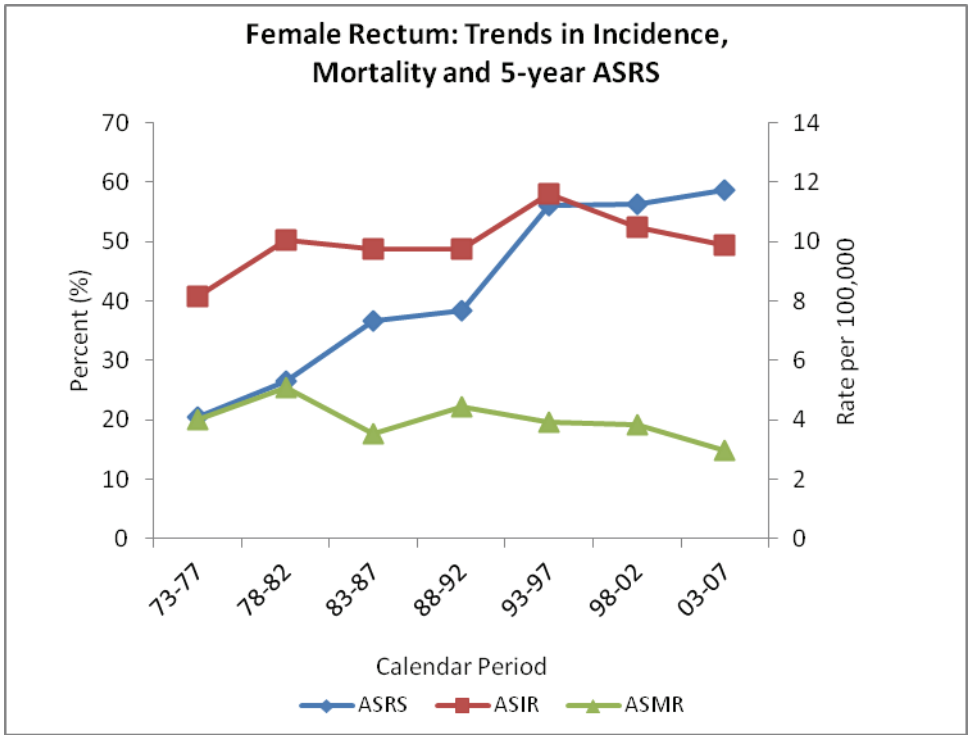
Similar to colon cancer, the survival of rectal cancer showed clear improvement over the study period. Females demonstrated a greater degree of improvement of survival than males. In males, the 5-year ASRS increased from 23.9% in 1973-77 to 52.8% in 2003-2007 and in females, the 5-year ASRS climbed from 20.4% in 1973-77 to 58.7% in 2003-2007. Internationally, the 5-year relative survival of rectal cancer was worse than that in the SEER registries but similar to that in Osaka and Europe.

There were gender differences in the change of incidence of rectal cancer. The incidence in males increased steadily over the study period, from 12.4 per 100,000 in 1973-77 to 17.5 per 100,000 in 2003-2007 while the incidence in females, notwithstanding minor fluctuations, maintained at a level of 10 per 100,000 throughout the study period. The mortality of rectal cancer for both genders remained fairly stable throughout the period of interest.

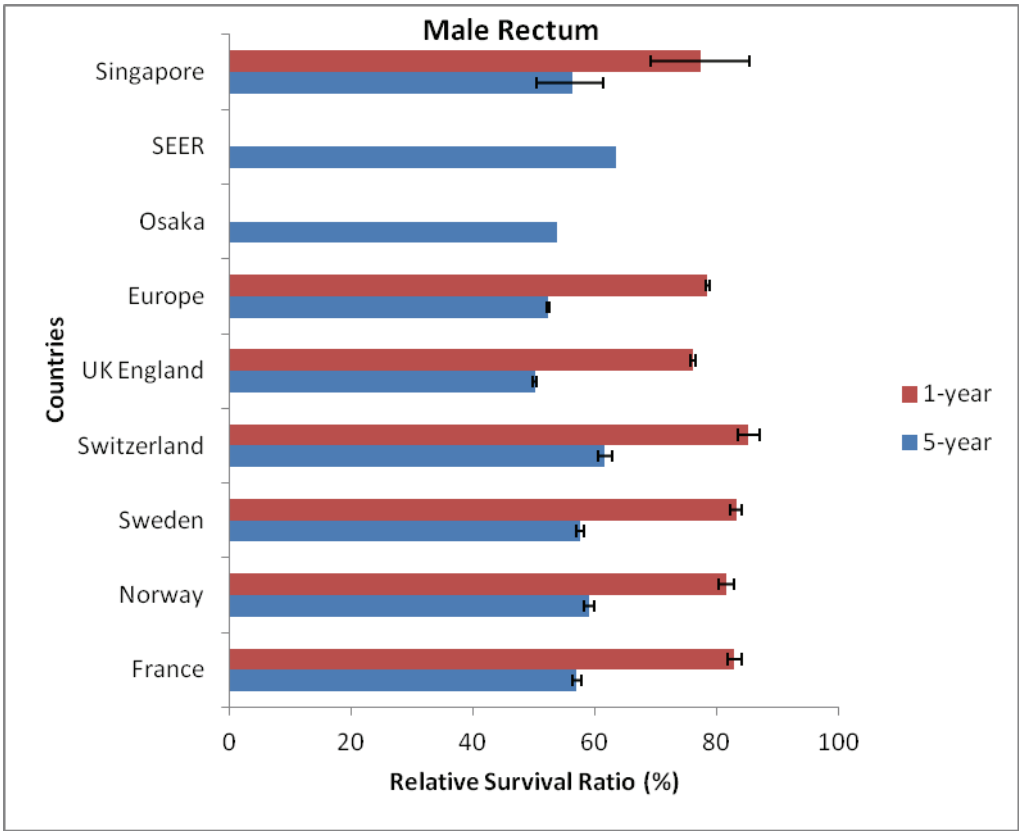
Even though colorectal cancer screening modalities were present in Singapore during the study period, we do not think that screening had a significant impact on the incidence, mortality and survival trends of rectal cancer. The reasons for this were discussed in the earlier section on colon cancer.

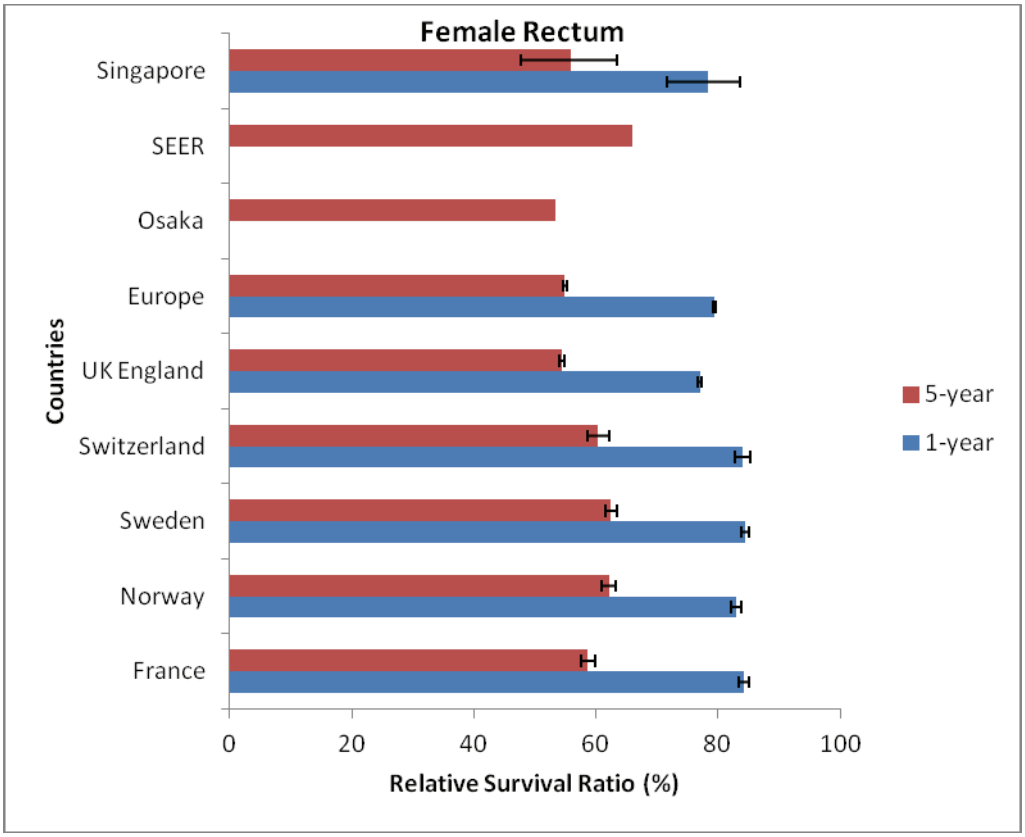
There have been improvements in the treatment of rectal cancer over the past decades, in particular, in local control of the tumour. Preoperative radiotherapy is effective in improving local control of rectal cancer. In 1990, citing evidence from randomised clinical trials, a panel of experts at the National Institutes of Health Consensus Development Conference concluded that adjuvant therapy combining chemotherapy and radiation therapy improves local control and survival for Stage II and III rectal cancer patients.[61] Another therapeutic advance during the study period was the emergence of total mesorectal excision in local control of rectal cancer. This surgical technique was shown to reduce local recurrence following surgery to less than 10%.[62] In addition, the improvement of survival of colorectal patients in Singapore was attributed to the improvement in medical infrastructure to support the treatment needs of cancer patients.[60]


Male Rectum: Trends in Incidence, Mortality and 5-year ASRS
Percent (%)
Rate per 100,000
0
10
20
30
40
50
60
0
2
4
6
8
10
12
14
16
18
20
73-77
78-82
83-87
88-92
93-97
98-02
03-07
Calendar Period
ASRS
ASIR
ASMR


Female Rectum: Trends in Incidence, Mortality and 5-year ASRS
Percent (%)
Rate per 100,000
0
10
20
30
40
50
60
70
0
2
4
6
8
10
12
14
73-77
78-82
83-87
88-92
93-97
98-02
03-07
Calendar Period
ASRS
ASIR
ASMR

1- and 5-year age standardised relative survival in selected countries





Age standardised observed survival and relative survival of rectal cancer by calendar period and gender

Calendar Period	Males							
	ASOS (%)				ASRS (%)			
	1yr	3yr	5yr	10yr	1yr	3yr	5yr	10yr
1973-1977	43.7 (31.4-55.5)	21.9 (12.1-33.7)	15.1 (6.9-26.9)	-	46.6 (33.2-59.6)	27.8 (14.7-43.8)	23.9 (9.6-47.0)	-
1978-1982	59.7 (48.6-69.1)	31.4 (21.7-41.6)	22.6 (13.9-32.7)	13.7 (6.5-23.9)	63.4 (51.5-73.5)	38.5 (26.3-51.5)	33.6 (19.8-49.8)	57.4 (24.2-104.8)
1983-1987	62.0 (52.7-70.0)	36.2 (27.5-45.0)	23.6 (16.0-32.2)	12.8 (6.8-21.5)	65.2 (55.4-73.7)	42.3 (31.9-53.0)	31.8 (21.2-44.2)	27.5 (12.8-50.5)
1988-1992	68.0 (60.3-74.5)	39.6 (32.0-47.2)	29.0 (22.0-36.4)	19.6 (13.0-27.3)	71.5 (63.4-78.4)	46.0 (36.9-55.0)	36.9 (27.5-47.1)	43.0 (25.9-64.7)
1993-1997	68.8 (62.5-74.1)	46.7 (40.1-53.0)	35.1 (28.7-41.6)	22.9 (16.8-29.7)	72.3 (65.6-78.0)	54.5 (46.6-62.2)	46.9 (37.9-56.1)	45.2 (30.9-62.3)
1998-2002	76.5 (71.3-80.7)	55.0 (49.0-60.4)	44.3 (38.3-50.2)	29.8 (23.9-36.0)	79.5 (74.1-83.9)	62.1 (55.2-68.6)	56.1 (48.0-64.0)	52.0 (39.6-65.9)
2003-2007	76.6 (71.9-80.5)	55.1 (49.8-60.1)	44.3 (39.0-49.4)	32.9 (27.9-38.1)	79.2 (74.4-83.2)	61.0 (55.1-66.6)	52.8 (46.3-59.2)	49.5 (40.7-58.9)
Calendar Period	Females							
	ASOS (%)				ASRS (%)			
	1yr	3yr	5yr	10yr	1yr	3yr	5yr	10yr
1973-1977	45.4 (31.5-58.2)	20.9 (11.0-33.3)	16.5 (7.9-28.9)	-	47.5 (32.8-61.0)	24.0 (12.4-38.6)	20.4 (9.3-37.3)	-
1978-1982	58.2 (47.0-67.8)	32.0 (21.9-42.6)	21.3 (12.5-32.0)	12.9 (5.4-24.2)	60.8 (48.9-70.9)	36.5 (24.8-49.0)	26.6 (15.1-41.1)	26.1 (9.5-53.7)
1983-1987	66.5 (56.8-74.4)	39.8 (30.3-49.2)	30.0 (21.2-39.4)	17.4 (9.9-27.8)	69.1 (58.9-77.3)	44.6 (33.8-55.4)	36.7 (25.6-48.5)	24.3 (13.1-43.3)
1988-1992	71.2 (62.7-77.9)	44.9 (36.0-53.2)	32.2 (23.8-40.7)	22.3 (14.7-30.8)	73.4 (64.6-80.3)	49.4 (39.6-58.6)	38.3 (28.2-48.8)	33.9 (21.4-48.7)
1993-1997	74.8 (68.0-80.3)	56.8 (49.0-63.7)	47.1 (39.0-54.7)	32.8 (24.6-41.3)	77.1 (70.0-82.7)	62.7 (54.1-70.4)	56.0 (46.2-65.3)	48.7 (34.8-64.1)
1998-2002	77.2 (71.0-82.1)	58.9 (51.9-65.1)	49.4 (42.4-56.0)	35.1 (28.0-42.2)	79.1 (72.7-84.1)	63.4 (55.8-70.1)	56.3 (48.2-63.8)	47.0 (36.9-57.4)
2003-2007	79.7 (74.0-84.1)	60.5 (54.0-66.3)	51.9 (45.4-58.0)	41.8 (35.3-48.0)	81.6 (75.7-86.1)	64.9 (57.9-71.2)	58.7 (51.1-65.7)	56.7 (47.5-65.9)

ASOS: Age standardised observed survival
ASRS: Age standardised relative survival
-: the estimates were not computed due to the absence of cases in one or more age groups.

Liver (ICD-9 155)

There is marked international variation in the incidence of primary liver cancers with the majority of cases arising in developing countries in Sub-Saharan Africa and Southeast Asia.[63] The incidence of hepatocellular carcinoma in Singapore is higher than that in most Western countries but it is lower than the levels seen in other Asian regions such as Hong Kong and Osaka.[63] Hepatocellular carcinoma is the most common histologic subtype of liver cancer.[64] In the period 2003-2007, it accounted for 79.4% of all primary liver cancers diagnosed. Thus changes in the trends of the incidence, mortality and survival of primary liver cancer reflect mainly those of hepatocellular carcinoma.

Between 1973 and 2007, the incidence of liver cancer in Singapore declined steadily. The incidence in males dropped from 27.4 per 100,000 in 1973-77 to 17.8 per 100,000 in 2003-2007 while the incidence in females decreased from 6.9 per 100,000 in 1973-77 to 4.7 per 100,000 in 2003-2007. The time trends of mortality followed that of incidence very closely in both genders and this reflects the poor prognosis of liver cancer where patients typically succumb to the disease in months after diagnosis.

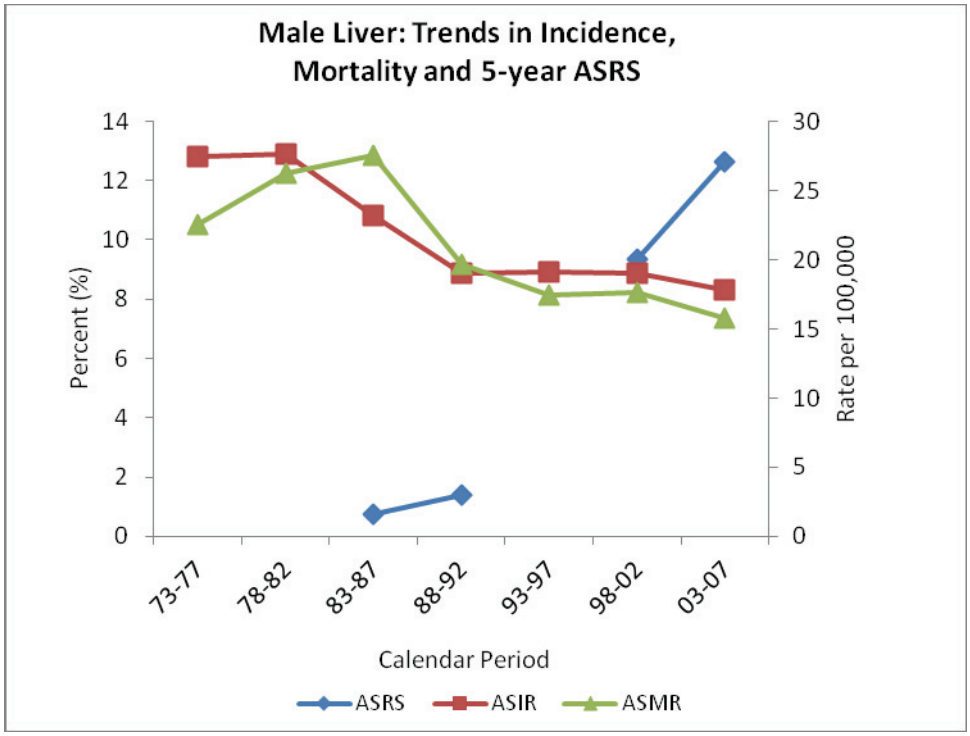
The reasons for the decline in incidence of hepatocellular carcinoma are not clear. It was suggested that the falling incidence of hepatocellular carcinoma seen in developing countries could have been a result of a reduction in the prevalence in risk factors (e.g. cofactors of HBV) of hepatocellular carcinoma.[63] Chronic hepatitis B infection is an important risk factor for hepatocellular carcinoma in Singapore.[65-66] In order to prevent and control hepatitis B in Singapore, hepatitis B vaccination was introduced as integral part of National Childhood Immunisation Programme in 1987.[67] While we expect the incidence of hepatocellular carcinoma to fall with increasing immunity against hepatitis B infection within the population, the benefits of the immunisation programme towards reduction of the incidence of hepatocellular carcinoma would not be felt during the study period. This is because the development of hepatocellular carcinoma usually occurs several decades after the initial virus infection.

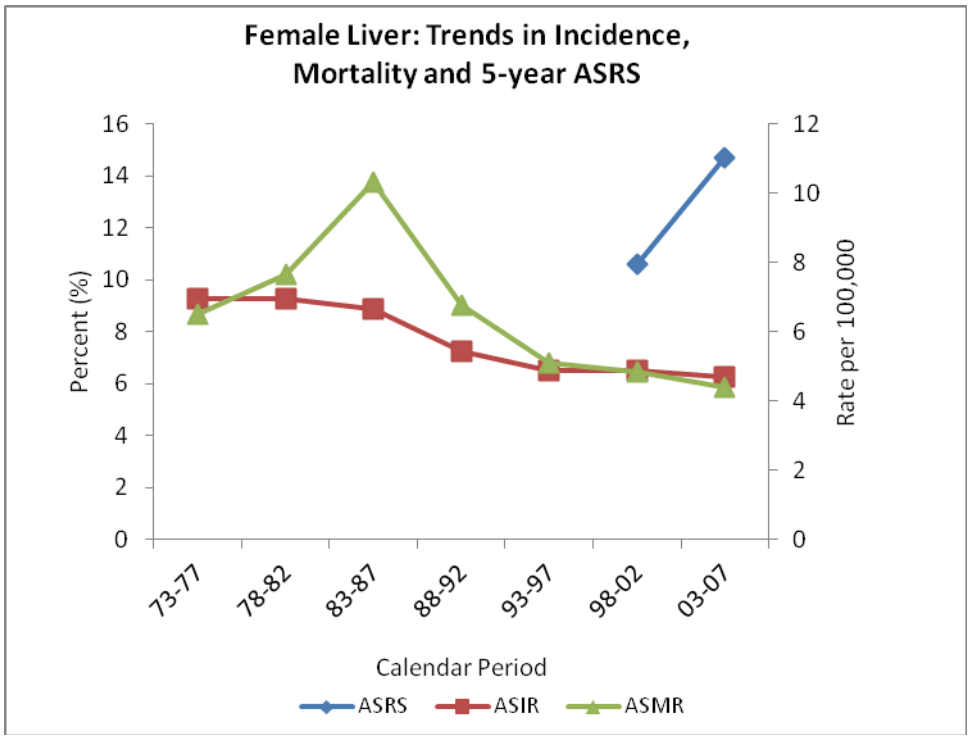
At the same time, the proportion of cancer cases with foreign countries of birth, where there are no established hepatitis B vaccination programmes, has decreased dramatically over time. For instance, the percentage of liver cancer cases with birth origin China has declined from 61.2% in 1968-1972 to 13.6% in 2003-2007. In comparison, the percentage of liver cancer cases with birth origin Singapore has increased from 26.2% in 1968-1972 to 68.9% 2003-2007.

It was also proposed that the initial high incidence seen in Singapore was a result of misclassification of metastatic cancers in the liver in the early days of cancer registration.[68] However, we think that this will not create significant bias in the interpretation of the survival of liver cancer as the prognoses of patients with primary liver cancer and patients with metastatic cancers are uniformly poor.

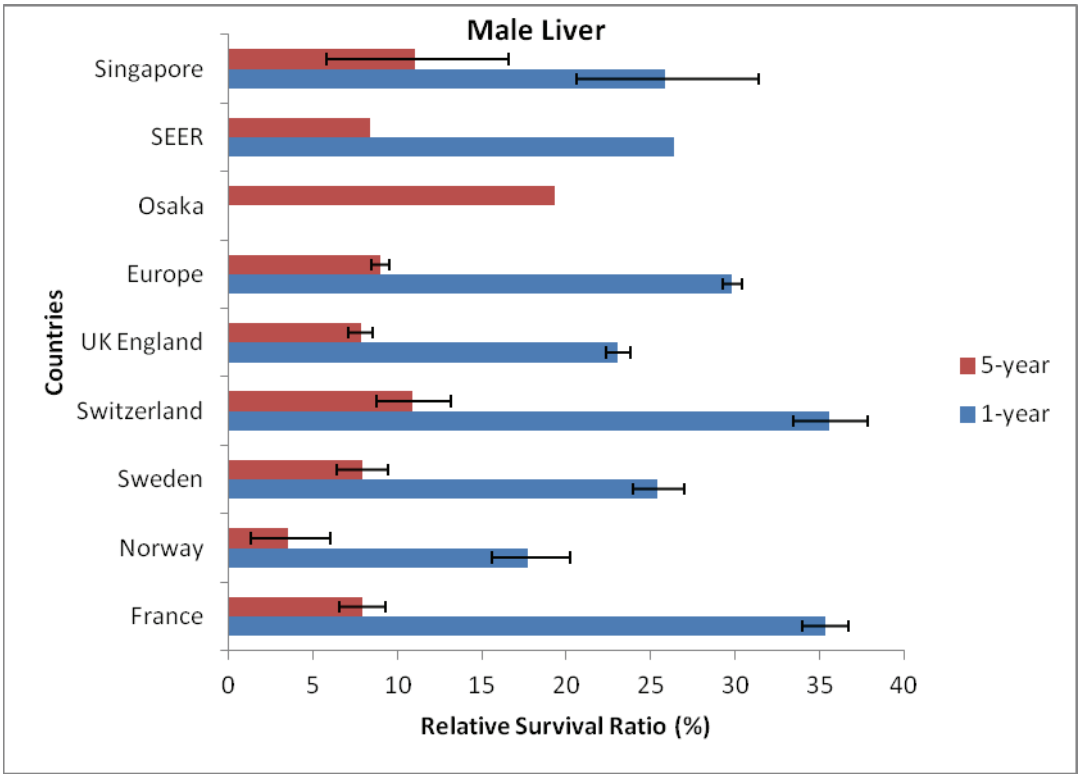
Despite a rise in survival in the most recent calendar period in both genders, the 5-year ASRS of liver cancer remained less than 15%. The 5-year relative survival for liver cancers among males in Singapore was better than that in the European countries analysed and the SEER registries but worse than that in Osaka whereas that among females in Singapore was worse than the countries of comparison except for Sweden and UK.

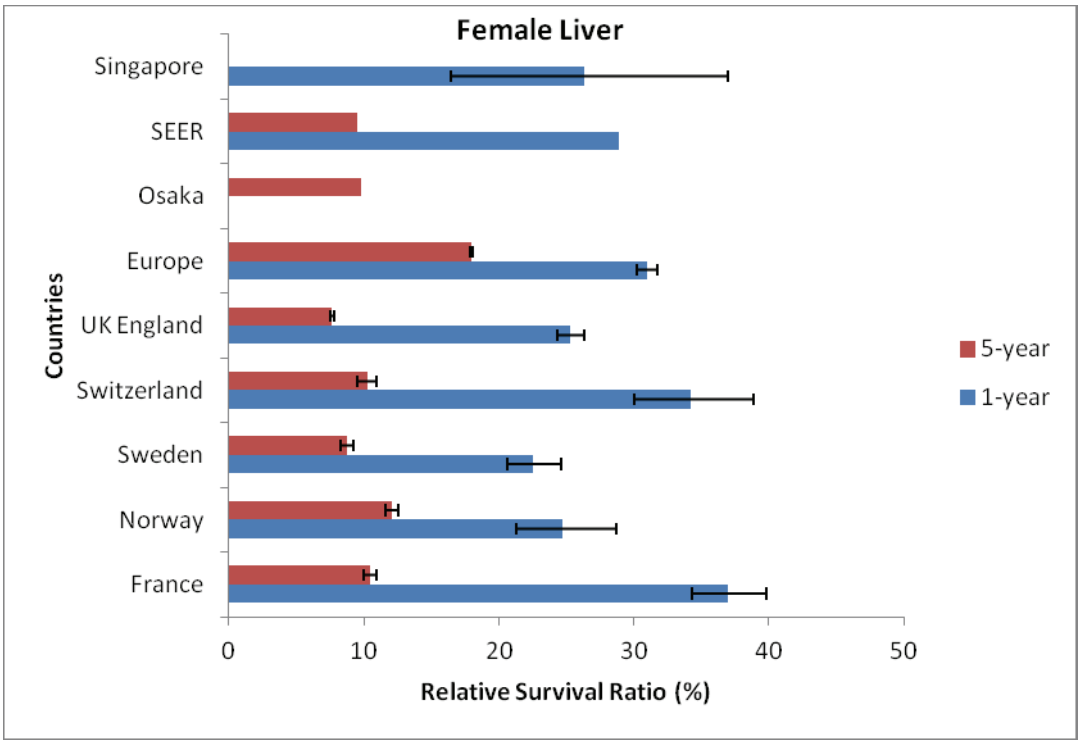
The poor survival of liver cancer might be largely attributed to the fact that most liver cancers were diagnosed only when the disease had become advanced and the lack of effective treatment for late disease. There was little progress in the treatment of liver cancer during the study period that would significantly improve survival. Liver resection and liver transplantation, which are now viewed the definitive treatment for hepatocellular carcinoma[69], are the only two curative treatments available.[70] However, the majority of liver cancers are already unresectable at presentation and do not qualify for liver transplantation.


Male Liver: Trends in Incidence, Mortality and 5-year ASRS
Percent (%)
Rate per 100,000
0
2
4
6
8
10
12
14
0
5
10
15
20
25
30
73-77
78-82
83-87
88-92
93-97
98-02
03-07
Calendar Period
ASRS
ASIR
ASMR


Female Liver: Trends in Incidence, Mortality and 5-year ASRS
Percent (%)
Rate per 100,000
0
2
4
6
8
10
12
14
16
0
2
4
6
8
10
12
73-77
78-82
83-87
88-92
93-97
98-02
03-07
Calendar Period
ASRS
ASIR
ASMR

1- and 5-year age standardised relative survival in selected countries





Age standardised observed survival and relative survival of liver cancer by calendar period and gender

Calendar Period	Males							
	ASOS (%)				ASRS (%)			
	1yr	3yr	5yr	10yr	1yr	3yr	5yr	10yr
1973-1977	0.7 (0.3-1.5)	-	0.2 (0.1-0.7)	-	0.7 (0.3-1.5)	-	0.3 (0.1-1.0)	-
1978-1982	1.8 (0.9-3.3)	0.6 (0.2-1.6)	-	-	1.8 (0.9-3.5)	0.7 (0.2-1.9)	-	-
1983-1987	3.2 (1.8-5.5)	1.1 (0.4-2.6)	0.6 (0.1-1.8)	-	3.4 (1.8-5.7)	1.2 (0.4-3.1)	0.7 (0.2-2.4)	-
1988-1992	8.4 (5.1-12.8)	2.0 (0.7-4.6)	1.2 (0.4-3.5)	-	8.7 (5.3-13.3)	2.3 (0.8-5.3)	1.4 (0.4-4.4)	-
1993-1997	11.9 (8.5-15.8)	4.3 (2.3-7.3)	-	-	12.3 (8.9-16.4)	4.8 (2.5-8.3)	-	-
1998-2002	22.3 (18.0-26.9)	11.5 (8.3-15.2)	7.8 (5.1-11.2)	-	23.0 (18.5-27.8)	12.6 (9.1-16.8)	9.4 (6.1-13.6)	-
2003-2007	31.2 (26.4-36.2)	16.7 (12.9-20.9)	11.1 (7.9-14.9)	7.8 (5.1-11.3)	32.1 (27.1-37.2)	18.1 (14.0-22.7)	12.6 (8.9-17.1)	10.8 (6.7-16.3)
Calendar Period	Females							
	ASOS (%)				ASRS (%)			
	1yr	3yr	5yr	10yr	1yr	3yr	5yr	10yr
1973-1977	3.0 (0.9-7.1)	-	-	-	3.1 (0.9-7.2)	-	-	-
1978-1982	6.4 (2.2-12.9)	-	-	-	6.5 (2.2-13.1)	-	-	-
1983-1987	3.1 (0.8-7.6)	-	-	-	3.1 (0.9-7.7)	-	-	-
1988-1992	8.0 (2.9-16.0)	1.9 (0.3-9.2)	-	-	8.2 (3.0-16.5)	2.1 (0.3-10.2)	-	-
1993-1997	10.3 (5.0-17.7)	4.4 (1.3-10.6)	-	-	10.6 (5.1-18.1)	4.7 (1.4-11.4)	-	-
1998-2002	25.3 (16.5-34.2)	12.7 (6.3-20.8)	10.0 (4.3-18.1)	-	25.6 (16.7-34.7)	13.2 (6.6-21.5)	10.6 (4.5-19.2)	-
2003-2007	35.1 (25.6-44.1)	19.5 (12.1-27.9)	13.7 (7.1-22.0)	10.3 (4.5-18.8)	35.7 (26.1-44.9)	20.4 (12.7-29.2)	14.7 (7.7-23.7)	12.3 (5.3-23.0)

ASOS: Age standardised observed survival
ASRS: Age standardised relative survival
-: the estimates were not computed due to the absence of cases in one or more age groups.

Lung (ICD-9 162)

Lung cancer is an important public health issue. It is one of the most frequent cancers in our population. The incidence of lung cancer is ranked highest among all cancers in males and third highest in females in 2003-2007.[64] Thus, it is worthy to note that during the study period, the incidence of lung cancer declined from 58.0 per 100,000 in 1973-77 to 40.8 per 100,000 in 2003-2007 among males, and from 18.5 per 100,000 in 1973-77 to 16.0 per 100,000 in 2003-2007 among females.

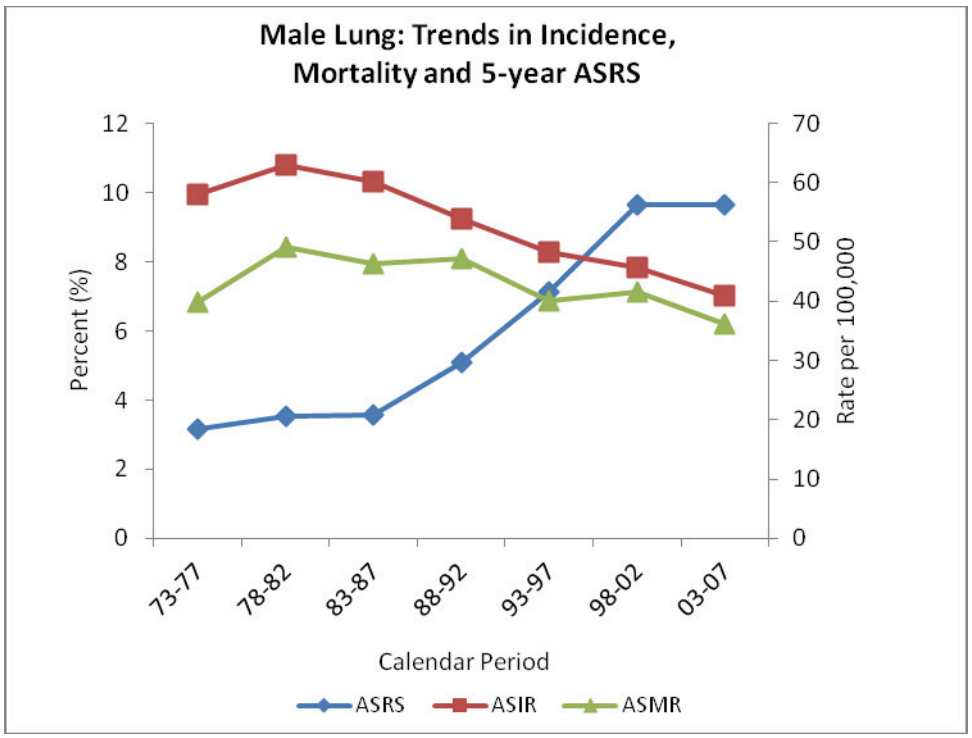
The mortality of lung cancer in each period was very close to that of the incidence across the entire period, suggesting that case fatality was very high for this condition. While there had been some upward trend seen in the survival, this modest improvement in survival of lung cancer patients over the last three decade should not distract us from the overall poor survival of this condition. The 5-year ASRS stood at less than 10% for males in the most recent period in this study, i.e. 2003-2007, making this disease to be the one with the poorest survival in our analysis. Internationally, the relative survival for lung cancers in Singapore was comparable to that in most of Europe but lower than that in the SEER registries, France and Osaka, Japan.

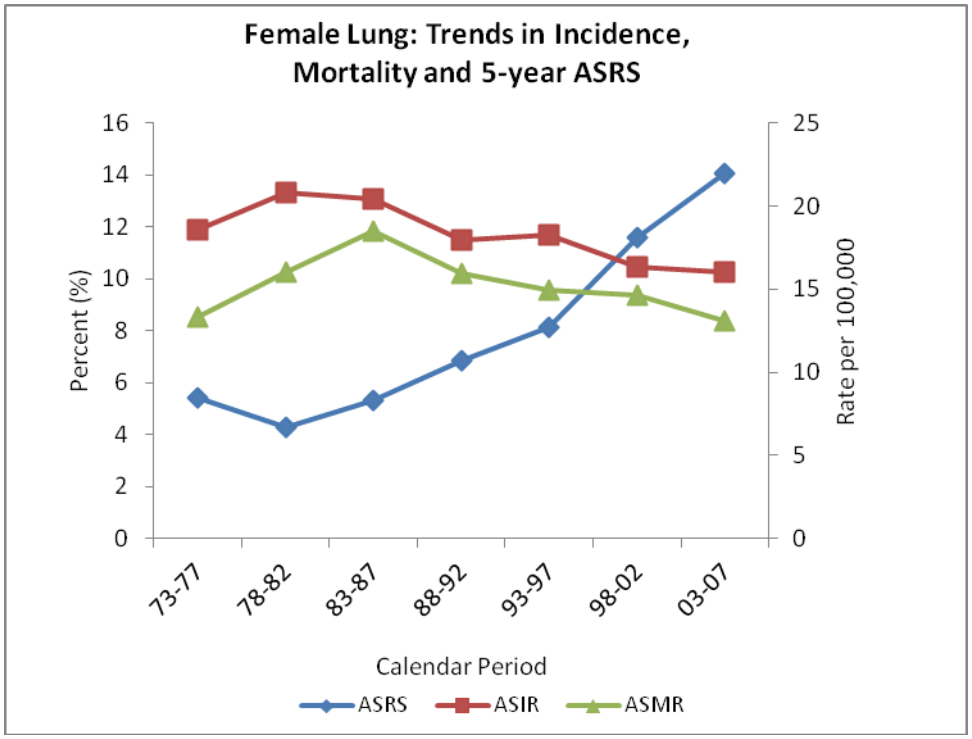
The interpretation of lung cancer incidence, mortality and survival is made more straightforward by the absence of an accepted proven screening modality. Screening may lead to lead time bias and overdiagnosis that can affect interpretation of incidence, mortality and survival trends. As there is no method devised to screen for lung cancer with the aim of picking up lung cancer at an earlier stage, lung cancer is usually diagnosed at an advanced stage when a patient presents to the physician with respiratory or systemic symptoms. Recently, endobronchial ultrasound transbronchial lung biopsy (EBUS-TBLB) for diagnosis and endobronchial ultrasound transbronchial needle aspiration (EBUS-TBNA) for staging, have been introduced on a trial basis at the Singapore General Hospital.[71] These techniques have been found to be accurate alternatives for TBLB with fluoroscopy and transthoracic needle aspiration (TTNA), respectively. Although TTNA was found to be more cost-effective than TBLB, it is suitable only for peripheral lung lesions and has a high complication rate.

While there could have been some increase in intensity of diagnosis through improved access to medical care, there is no proven screening tool in asymptomatic persons. Hence, the change in incidence pattern could not be related to a change in diagnostic intensity.

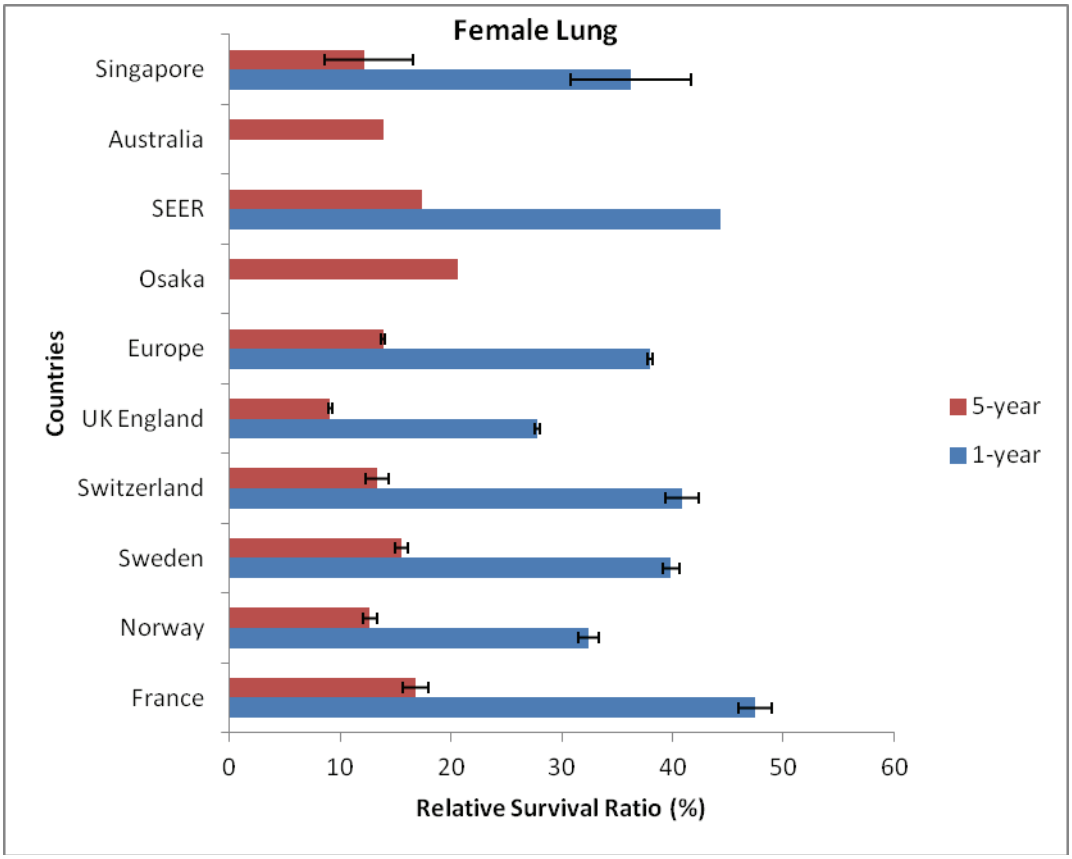
The downward trend of incidence is likely to reflect a reduction in overall population risk for lung cancer. Smoking is the single most important risk factor for the development of lung cancer, and the lag between smoking and lung cancer has been estimated to be about 20 years.[72] Between 1984 and 1998, the prevalence of smoking in males fell by 27%.[73] However, unlike males, cigarette smoking is not responsible for the majority of lung cancer in Chinese women[74] who make up most of the female lung cancer cases locally.

There was no significant breakthrough in lung cancer treatment to improve survival considerably during the study period even though recent advances in molecular targeted therapy have been shown to improve survival of non-small cell lung cancer in Asians.[75-76] Only surgically resectable lung cancers are considered to be curable and all other modes of treatment should be considered to be palliative in intent. Disease control measures should focus on primary prevention of this disease.


Male Lung: Trends in Incidence, Mortality and 5-year ASRS
Percent (%)
Rate per 100,000
0
2
4
6
8
10
12
0
10
20
30
40
50
60
70
73-77
78-82
83-87
88-92
93-97
98-02
03-07
Calendar Period
ASRS
ASIR
ASMR


Female Lung: Trends in Incidence, Mortality and 5-year ASRS
Percent (%)
Rate per 100,000
0
2
4
6
8
10
12
14
16
0
5
10
15
20
25
73-77
78-82
83-87
88-92
93-97
98-02
03-07
Calendar Period
ASRS
ASIR
ASMR

1- and 5-year age standardised relative survival in selected countries



Age standardised observed survival and relative survival of lung cancer by calendar period and gender

Calendar Period	Males							
	ASOS (%)				ASRS (%)			
	1yr	3yr	5yr	10yr	1yr	3yr	5yr	10yr
1973-1977	12.0 (8.9-15.6)	3.6 (2.0-5.9)	2.3 (1.0-4.6)	-	12.6 (9.3-16.5)	4.1 (2.2-7.0)	3.2 (1.3-6.7)	-
1978-1982	13.8 (10.9-17.1)	4.5 (2.9-6.8)	2.9 (1.6-5.0)	1.8 (0.8-3.6)	14.4 (11.3-17.9)	5.1 (3.2-7.8)	3.5 (1.9-6.5)	2.7 (1.1-7.8)
1983-1987	16.5 (13.6-19.6)	4.3 (2.8-6.3)	3.1 (1.9-4.7)	-	17.2 (14.2-20.4)	4.8 (3.1-7.0)	3.6 (2.2-5.6)	-
1988-1992	18.3 (15.3-21.5)	6.2 (4.4-8.4)	4.2 (2.8-6.2)	2.6 (1.4-4.4)	19.0 (15.9-22.3)	6.8 (4.8-9.3)	5.1 (3.3-7.6)	4.9 (2.4-9.3)
1993-1997	26.7 (23.3-30.1)	9.0 (6.8-11.5)	5.8 (4.0-8.1)	3.4 (2.0-5.6)	27.7 (24.2-31.3)	10.1 (7.6-13.0)	7.1 (4.9-10.0)	6.1 (3.2-11.1)
1998-2002	28.6 (25.4-31.8)	11.0 (8.9-13.4)	8.2 (6.3-10.4)	5.1 (3.4-7.3)	29.5 (26.1-32.8)	12.1 (9.7-14.8)	9.7 (7.4-12.3)	8.2 (5.2-12.2)
2003-2007	32.5 (29.2-35.7)	12.5 (10.1-15.1)	8.5 (6.5-10.8)	5.8 (4.1-7.7)	33.3 (29.9-36.6)	13.4 (10.9-16.1)	9.6 (7.4-12.2)	8.0 (5.7-10.8)
Calendar Period	Females							
	ASOS (%)				ASRS (%)			
	1yr	3yr	5yr	10yr	1yr	3yr	5yr	10yr
1973-1977	14.2 (8.9-20.6)	5.6 (2.4-10.7)	4.7 (1.9-9.9)	-	14.7 (9.2-21.4)	6.3 (2.7-12.1)	5.4 (2.1-12.2)	-
1978-1982	15.4 (10.7-20.9)	5.4 (2.8-9.4)	3.6 (1.5-7.2)	-	15.9 (11.0-21.7)	6.0 (3.1-10.5)	4.3 (1.8-8.8)	-
1983-1987	17.6 (12.9-22.8)	6.6 (3.6-10.7)	4.7 (2.2-8.5)	3.1 (1.3-6.5)	18.1 (13.3-23.4)	7.0 (3.8-11.6)	5.3 (2.5-10.0)	3.7 (1.5-9.8)
1988-1992	22.0 (17.1-27.3)	7.8 (4.8-11.7)	6.3 (3.6-10.0)	-	22.5 (17.4-27.8)	8.2 (5.0-12.4)	6.9 (3.9-11.0)	-
1993-1997	30.6 (25.5-35.8)	10.7 (7.2-14.8)	7.3 (4.4-11.3)	3.9 (1.8-7.4)	31.3 (26.1-36.6)	11.4 (7.7-15.8)	8.1 (4.8-12.7)	4.7 (2.2-9.5)
1998-2002	33.6 (28.7-38.4)	14.4 (10.8-18.5)	10.6 (7.4-14.3)	6.7 (3.7-10.7)	34.2 (29.2-39.0)	15.2 (11.4-19.4)	11.6 (8.2-15.7)	8.4 (4.6-13.8)
2003-2007	43.7 (38.8-48.4)	19.4 (15.4-23.6)	13.0 (9.5-16.9)	8.7 (5.8-12.4)	44.5 (39.4-49.2)	20.3 (16.1-24.8)	14.1 (10.4-18.4)	11.4 (7.5-16.3)

ASOS: Age standardised observed survival
ASRS: Age standardised relative survival
-: the estimates were not computed due to the absence of cases in one or more age groups.

Female Breast (ICD-9 174)

The survival of female breast cancer increased steadily over the study period. The 5-year ASRS were 49.0% and 76.4% in 1973-77 and 2003-2007 respectively. Relative survival for breast cancer in Singapore was lower than that in Europe, the SEER registries and Osaka, Japan but higher than that in certain parts of Asia.

Despite this, one should note that the RSR comparison across countries is for all stages of survival. If stage-specific survival is compared, Singapore may be doing just as well as, if not better than other countries, signifying that our treatment and cancer management is probably comparable. Instead, our cases tend to be diagnosed at a later stage compared to other developed countries. Indeed, this was found to be the case when Swedish and Singapore breast cancer cases were compared.[26] Similarly, cancer stage and number of axillary nodes examined were factors significantly affecting 5 year relative survival in multiple regression models using data from 6 European countries (combined into 9 regional groups based on survival similarities).[27]

Breast cancer is the most frequent cancer among females in Singapore. The incidence of breast cancer increased steadily over the study period. The incidence of breast cancer jumped from 22.0 per 100,000 in 1973-77 to 58.5 per 100,000 in 2003-2007. The increase in incidence was likely due to a genuine increase in breast cancer risk in the population as Singapore experienced changes in risk factors of breast cancer that accompanied improvement in socioeconomic conditions through its progression from a developing country to an industrialised country.[77-79] Breast cancer risk is dependent on reproductive factors such as age at first birth, parity and age at menarche. The total fertility rate declined over the study period and more Singaporean women delayed childbirth until a later age. These trends could have translated into higher risk of breast cancer in Singaporean females over time. In addition, the increase in breast cancer risk might also be partly attributed to increasing obesity within the population[80-81], possibly a result of a more Westernised lifestyle and changing dietary patterns among Singaporean females.

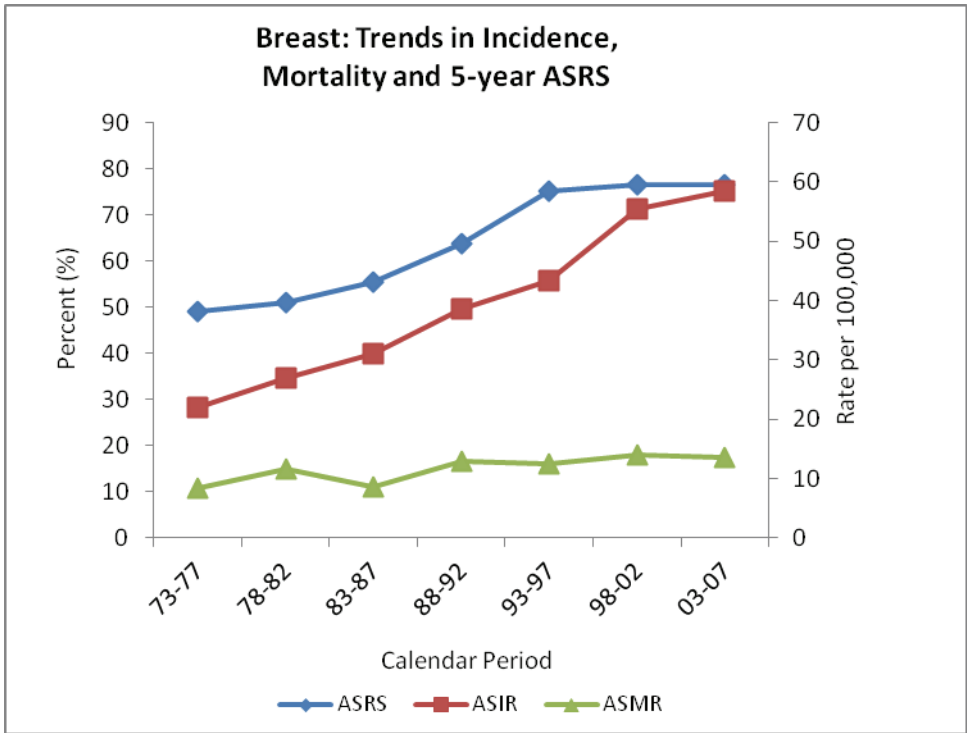
While randomised trials of breast self-examination have failed to show benefit[82], mammographic screening has been shown to decrease breast cancer mortality in Western populations[83-84] and national breast cancer screening programmes have been launched in several countries. In Singapore, over the study period, breast cancer screening was carried out mainly on an opportunistic basis when women attending antenatal and postnatal examinations were taught how to examine their breasts for lumps. The Well Woman Clinics which began in 1987 offered a more structured approach, with a package that included a clinical breast examination, instruction in breast self-examination and cervical cytology. It was not until 1989 when women above the age of 40 attending these clinics were encouraged to go for a mammogram.[85] It is important to note that the uptrend in incidence and survival of breast cancer preceded these developments in the late 1980s. More recently, Singapore also started the first population-based mammographic breast screening programme in Asia (BreastScreen Singapore) in 2002.[86]

While the study of breast cancer trends might be influenced by the local screening practices, the overall impact of breast cancer screening on the trends of breast cancer in Singapore was likely to be small because the utilisation of breast cancer screening during the study period was limited. The National Health Survey 1998 reported that only 46.7% of Singaporean women aged 50 to 69 years were aware of mammography and 34.2% had ever attended screening.[81] This percentage increased to 90.9% and 66.3% respectively in 2010.[52]

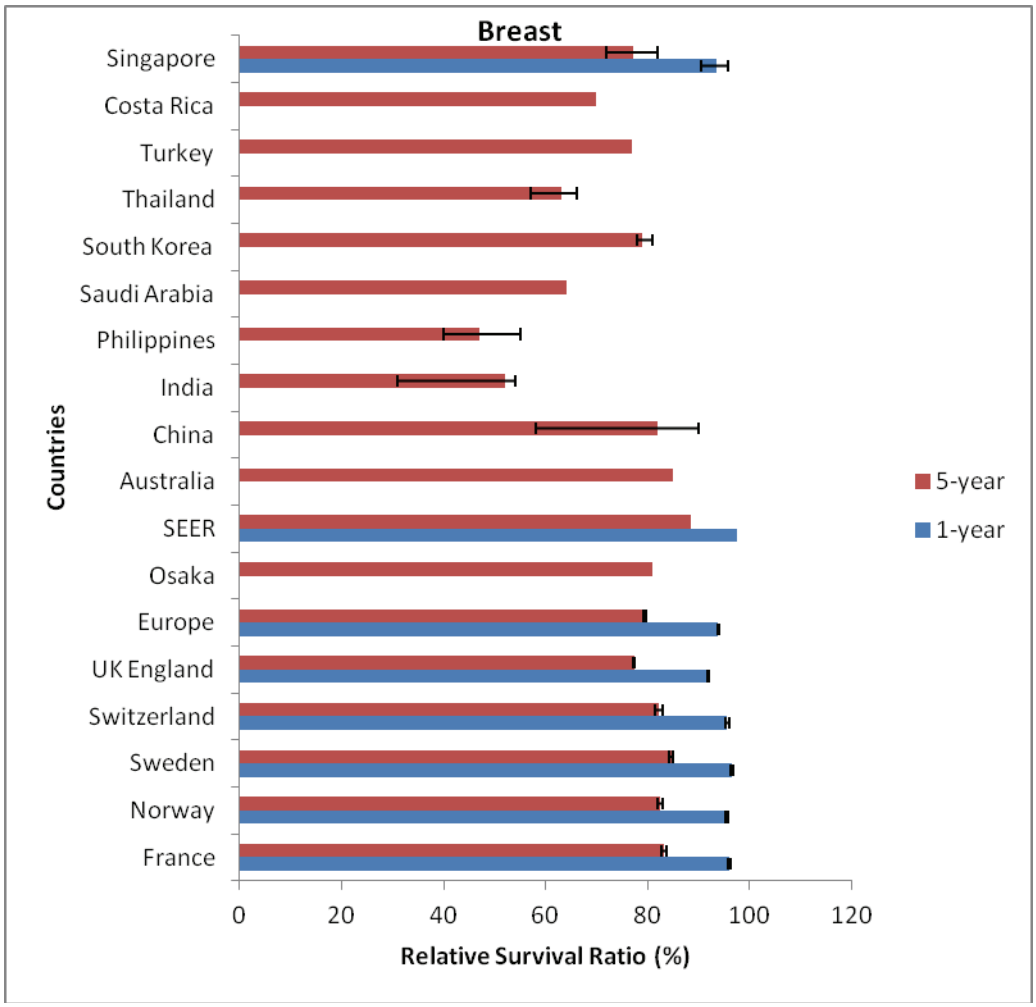
Besides screening, another way which intensified detection of early stage cancer was through increased awareness. As Singapore progressed economically over the past few decades, the overall education level of the population increased. It is possible that the more recent generations of Singaporean women have greater awareness of breast cancer and the symptoms associated with the condition. Hence they would have presented to their physicians earlier and be diagnosed at an earlier stage of disease which inherently carried a better prognosis and survival. However, we do not have local data to draw strong conclusions on this point.

The difference between the incidence and mortality patterns was striking as the incidence more than doubled over the study period while mortality remained fairly

stable since the 1980s. The divergence of incidence and mortality, together with a rise in survival, suggests that there was progress in the effectiveness in the treatment of breast cancer. The treatment modalities for breast cancer expanded over the last few decades to include adjuvant systemic therapy in the form of chemotherapy and endocrine manipulation. As adjuvant chemotherapy has been shown to improve survival, it is being recommended to the majority of women with localised breast cancer regardless of nodal, menopausal, or hormone receptor status.[87] Tamoxifen treatment has been shown to substantially improve the 10-year survival of women with ER-positive tumours.[88] In addition, aromatase inhibitors (AIs) have become available for local use in postmenopausal women in recent years. AIs have shown significant survival benefit over endocrine therapies in randomized controlled trials although one should also take into consideration their cost and side effects.[89]



1- and 5-year age standardised relative survival in selected countries



Age standardised observed survival and relative survival of female breast cancer by calendar period

Calendar Period	Females							
	ASOS (%)				ASRS (%)			
	1yr	3yr	5yr	10yr	1yr	3yr	5yr	10yr
1973-1977	77.5 (67.1-84.9)	50.7 (40.2-60.8)	39.4 (29.2-50.5)	26.3 (16.9-38.6)	81.2 (70.0-89.1)	57.6 (44.8-70.1)	49.0 (34.6-65.3)	42.4 (24.8-70.9)
1978-1982	78.9 (71.2-84.7)	51.6 (42.8-59.8)	38.5 (30.2-47.0)	25.1 (17.9-33.7)	83.1 (74.8-89.4)	60.7 (49.7-71.0)	50.9 (38.6-63.6)	52.0 (31.3-78.9)
1983-1987	80.6 (74.1-85.6)	60.3 (52.8-67.1)	45.2 (37.8-52.5)	29.3 (22.5-36.8)	83.7 (76.9-89.1)	68.3 (59.3-76.4)	55.3 (45.2-65.6)	47.0 (33.2-63.7)
1988-1992	85.4 (81.0-88.9)	66.8 (61.0-71.9)	53.9 (47.8-59.8)	35.5 (28.8-42.7)	88.2 (83.6-91.8)	73.6 (67.0-79.5)	63.8 (56.0-71.4)	54.4 (41.2-69.7)
1993-1997	87.1 (83.5-89.9)	72.1 (67.5-76.2)	62.6 (57.6-67.3)	42.9 (37.3-48.5)	89.9 (86.1-92.8)	79.5 (74.1-84.3)	75.1 (68.5-81.3)	64.4 (53.6-75.7)
1998-2002	91.8 (89.4-93.8)	77.4 (73.9-80.6)	67.5 (63.4-71.3)	48.3 (43.7-52.8)	94.1 (91.5-96.0)	83.2 (79.2-86.8)	76.6 (71.6-81.3)	64.1 (56.7-71.6)
2003-2007	91.7 (89.7-93.3)	78.6 (75.7-81.2)	67.9 (64.7-71.0)	52.5 (48.9-56.1)	93.8 (91.7-95.5)	84.3 (81.0-87.2)	76.4 (72.5-80.2)	68.5 (62.6-74.5)

ASOS: Age standardised observed survival
ASRS: Age standardised relative survival
-: the estimates were not computed due to the absence of cases in one or more age groups.

Cervix (ICD-9 180)

Survival of cervical cancer patients has markedly improved with the 5-year ASRS having increased over the study period, from 47.8% in 1973-77 to 66.6% in 2003-2007. This rate, though lower than that in the SEER registries, was comparable to that in Europe.

The better survival rate is accompanied by progressive declines in both the incidence and mortality rates of cervical cancer over the same study period. The incidence of cervical cancer dropped from 17.5 per 100,000 in 1973-77 to 8.8 per 100,000 in 2003-2007. The mortality of cervical cancer decreased from 7.0 per 100,000 in 1973-77 to 3.4 per 100,000 in 2003-2007. Several reasons could explain these observations.

The impact of cervical cytology screening on reducing the incidence and mortality of cervical cancer is well documented in observational studies, in particular, in countries with organised screening programmes.[90-92] The Papanicolaou smear ("Pap smear") has been widely available since its first introduction into Singapore in 1964. [93]. In spite of its opportunistic approach in the early period, studies conducted in the early 1990s showed that most women in the 21-65 age group were aware of the Pap smear and 54.4% of the married women ever had a Pap smear.[93,94] In the 1998 National Health Survey[81], 81.9% of women aged 25 to 69 years in Singapore felt that it was important to have Pap smears. The survey also revealed that 64.2% of women had undergone Pap smear. The positive attitude of Singapore women towards screening and the relatively high participation rate were the most important factors for the improvement in cervical cancer control in Singapore. Data from the United Kingdom clearly demonstrated that the annual percentage change in the age-standardised mortality rate of cervical cancer among women in England and Wales incidence of cervical cancer in England and Wales declined by 50% when 80% of the eligible women were screened during the 10 years of introducing an organized national cervical cancer programme.[95] For this reason, the national cervical cancer screening programme "CervicalScreen Singapore" was launched in Singapore in 2004. It aims to encourage women aged 25 - 69 who ever had sex to go for Pap

smears once every 3 years. In 2010, it was found that 71.3% of women had ever had Pap smear.[52]

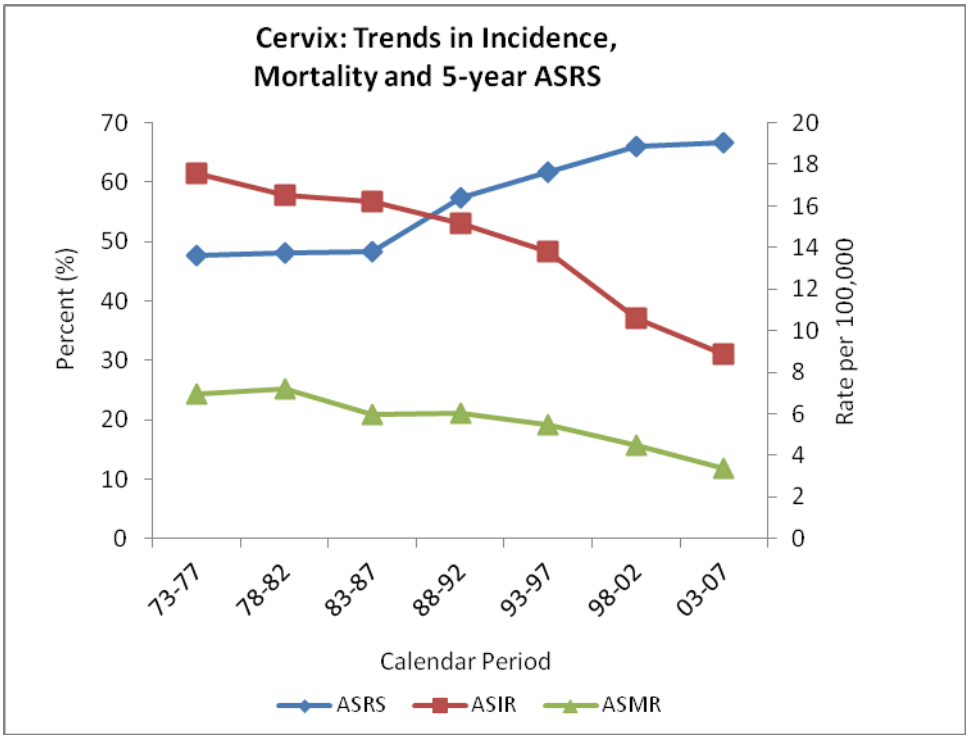
In Singapore, the healthcare infrastructure for primary care services includes a widely distributed network of private outpatient clinics and more than a dozen subsidised public polyclinics which were able to provide services at an affordable cost. The development of these facilities would have acted as the enablers to increase the accessibility of Pap smear to women in the general population who are at risk. Indeed, the "CervicalScreen Singapore" is rolled out through the public polyclinics.

Cytology screening, by detecting pre-invasive disease of cervical cancer (cervical intraepithelial neoplasia, or CIN) and allowing their effective treatment, reduces the incidence of cervical cancer. [96-97] It also aids the detection of cervical cancers at an earlier stage, even when the patient is still asymptomatic. This will improve survival of cervical cancer as the stage of disease is an important prognostic indicator of cervical cancer. Cervical cancer is known to be caused by oncogenic subtypes of human papillomavirus (HPV). Epidemiological study has shown that the prevalence rate of oncogenic HPV DNA detection in Singapore is similar to other parts of the world.[98] Without any intervention, the incidence rate of cervical cancer would have been as high as those seen in some poor resource countries without screening.

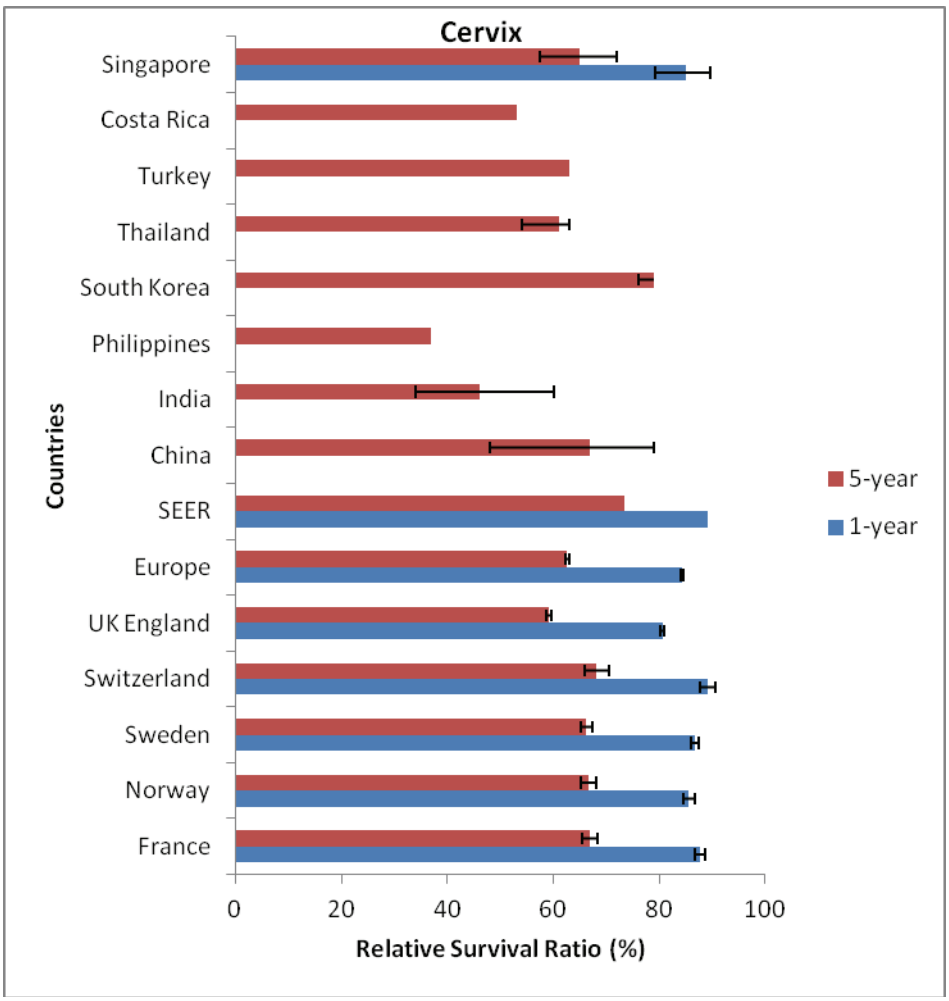
A case-control study in 1986 clearly showed that parity was one of the most important risk factors for cervical cancer in Singapore.[99] The association of high parity with an increased risk of cervical cancer has been shown to be independent from HPV infection in many studies in other countries. The exact mechanism linking repeated childbirths with cervical cancer is unknown. In Singapore, a rapid decline in parity occurred from the 1970s. The low parity of Singaporean women could have been an important additional reason to reduce the incidence of cervical cancer in Singapore.

The improvement in survival from cervical cancer is related to the detection of cancer at earlier stages through screening and to the more efficacious modality of cancer treatment in recent years. Concurrent chemoradiation therapy was shown to be a more effective way for locoregional control in locally advanced cancer as pelvic

irradiation alone was unable to control locally advanced cervical cancer in 35–90% of the cases.[100] Clinical trials demonstrated superiority of combined platinum-based chemoradiation compared with radiation alone for locally advanced and high-risk early-stage cervical cancers.[100-102] The role of improved socio-economic status in Singapore is likely to have contributed significantly to better survival of cervical cancer patients. With the availability of highly skillful medical expertise, more patients will survive for longer if more modalities of treatment can be administered. Better general health status of women with improved socio-economic condition results in more women who could tolerate more lines of therapy.



1- and 5-year age standardised relative survival in selected countries



Age standardised observed survival and relative survival of cervical cancer by calendar period

Calendar Period	Females							
	ASOS (%)				ASRS (%)			
	1yr	3yr	5yr	10yr	1yr	3yr	5yr	10yr
1973-1977	73.3 (63.2-81.3)	50.3 (40.7-59.8)	42.7 (33.6-52.3)	35.5 (26.8-46.0)	75.0 (64.3-83.3)	53.5 (42.6-64.5)	47.8 (36.3-60.4)	45.5 (31.4-67.5)
1978-1982	75.8 (66.8-82.8)	51.8 (42.8-60.5)	43.6 (35.4-52.4)	33.7 (26.7-41.9)	77.6 (68.2-84.9)	55.1 (45.0-65.1)	48.2 (38.2-59.4)	41.6 (31.0-59.1)
1983-1987	80.7 (73.2-86.4)	54.4 (46.0-62.4)	44.3 (36.2-52.4)	37.6 (29.9-45.9)	82.2 (74.4-88.1)	57.2 (47.9-66.0)	48.2 (38.8-58.0)	47.1 (35.0-61.4)
1988-1992	83.0 (76.5-87.9)	60.6 (53.3-67.3)	53.3 (45.9-60.3)	40.8 (33.7-48.5)	84.2 (77.5-89.3)	63.1 (55.3-70.4)	57.5 (49.0-65.6)	47.5 (37.7-59.0)
1993-1997	82.9 (77.0-87.5)	64.8 (57.8-71.0)	56.9 (49.9-63.5)	45.7 (39.1-52.4)	84.3 (78.2-89.0)	67.9 (60.3-74.7)	61.6 (53.4-69.4)	53.4 (44.2-63.6)
1998-2002	84.1 (78.3-88.4)	68.5 (61.7-74.3)	62.1 (55.2-68.3)	52.9 (46.0-59.6)	85.0 (79.1-89.5)	70.9 (63.7-77.1)	66.1 (58.5-73.1)	61.3 (51.8-70.8)
2003-2007	84.2 (78.5-88.4)	67.9 (61.4-73.5)	63.6 (57.1-69.3)	54.2 (48.0-60.1)	85.1 (79.3-89.4)	69.9 (63.0-75.9)	66.6 (59.5-73.1)	60.5 (52.6-68.2)

ASOS: Age standardised observed survival
ASRS: Age standardised relative survival
-: the estimates were not computed due to the absence of cases in one or more age groups.

Corpus Uteri (ICD-9 182)

Uterine cancer is the sixth most common cancer in Singaporean women in 2003-2009.[64] The highest age specific incidence is observed in postmenopausal women. The overwhelming majority of uterine cancers originate from the endometrium and among the histologic subtypes, endometrioid carcinoma dominates.

Uterine cancer had one of the highest 5-year ASRS among the various cancers at the start of the study period and it had shown good improvement in survival over the past two decades. Between 1973 and 2007, the 5-year ASRS increased by 19.7%, from 50.7% in 1973-77 to 70.4% in 2003-2007. The relative survival for cancer of the uterus in Singapore was lower than that in the SEER and European registries but higher than that in Osaka, Japan.

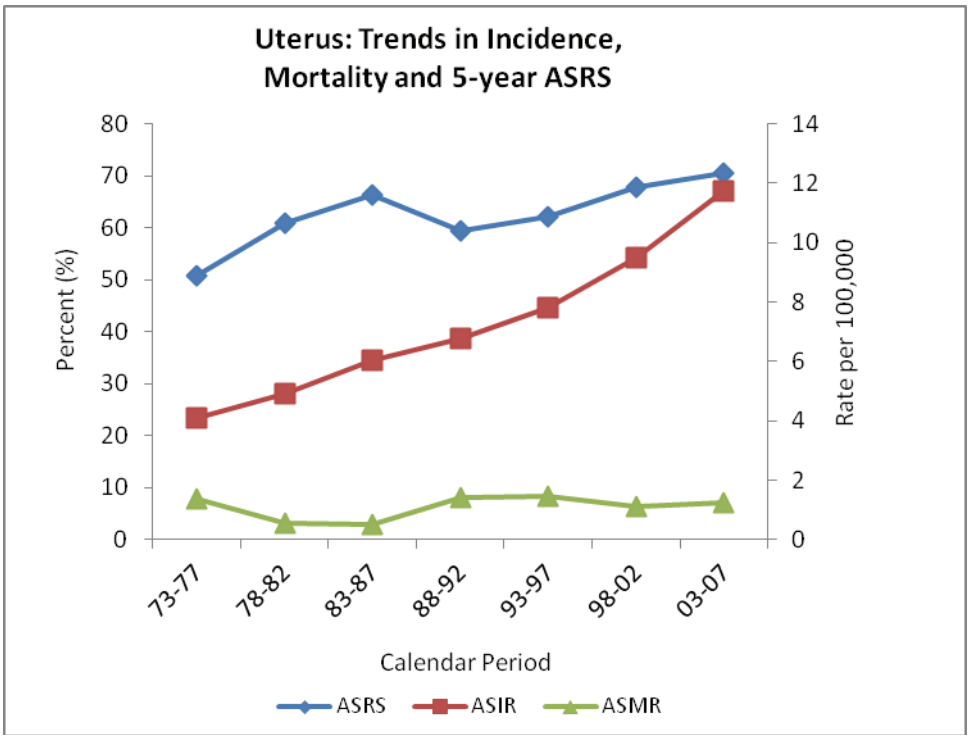
The improvement in survival took place against a background of an increasing incidence and a stable and low mortality rate of this cancer during the study period. The incidence of uterine cancer increased steadily over the last three decades, from 4.1 per 100,000 in 1973-77 to 11.7 per 100,000 in 2003-2007. The mortality of this disease remained at around 1.0 per 100,000 throughout the study period.

Most patients with uterine cancer are diagnosed with the condition after they present with symptoms of the disease e.g. postmenopausal per vaginal bleeding or spotting.[103] There is no test that has been developed for the screening for uterine cancer in asymptomatic persons. There is also no precursor of the disease that can be identified in the general population for intervention from a preventive perspective. Therefore, screening cannot explain the increasing trend seen in the incidence of uterine cancer. Other forms of bias are probably not sufficient to explain the steady rise and doubling of the incidence of uterine cancer. The rising incidence of uterine cancer likely reflects a true increase in the risk for the disease within the population over the study period.

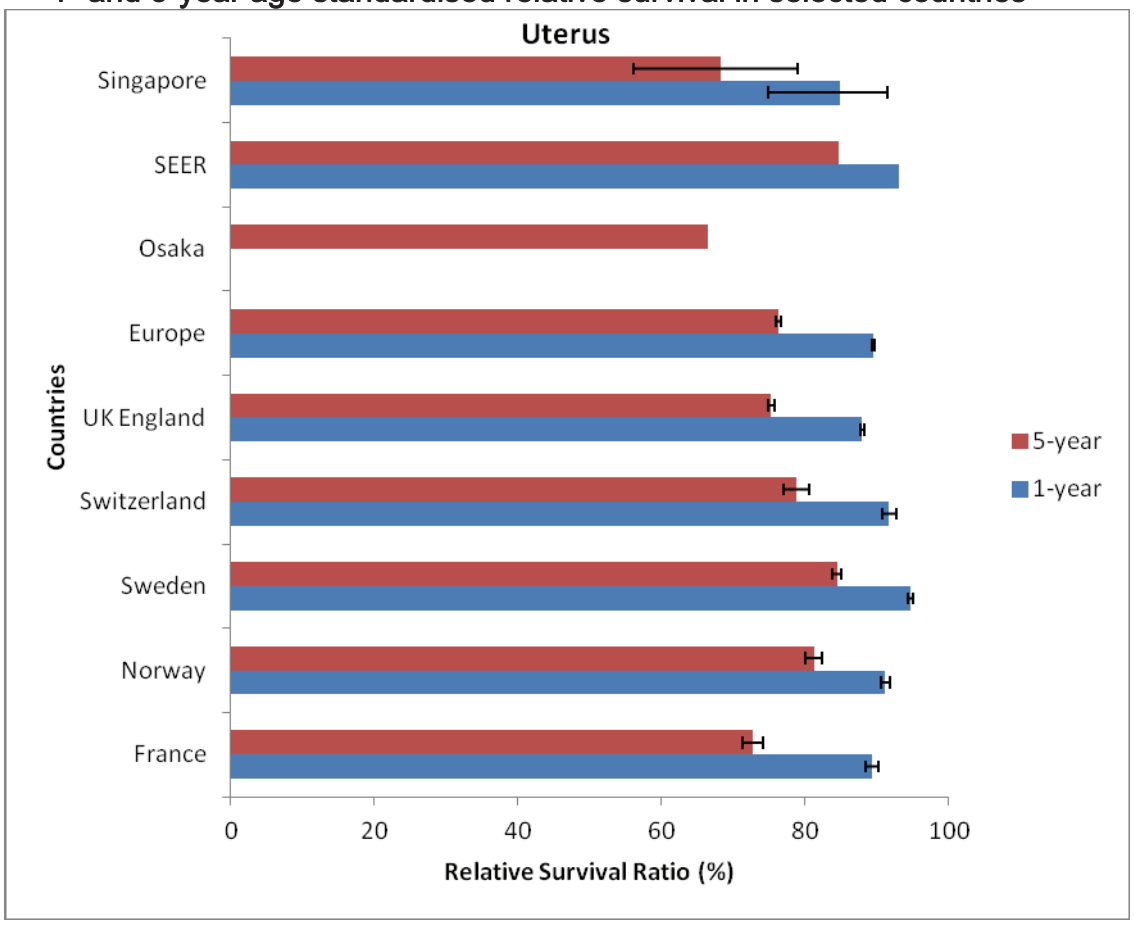
Endometrial cancer is the most common form of uterine cancer. The high survival seen in uterine cancer is related to the fact that most of endometrial cancers are

localised within the uterus at the time of diagnosis. For these localised tumours, the chances of survival are excellent for the patient. In addition, there has been progress in the treatment of uterine cancer that may explain the increasing survival. For many years, the standard treatment was simple total hysterectomy and bilateral salpingo-oopherectomy. Surgical staging was introduced in 1980s in recognition of the need to identify node involvement. In the last 15 years, there has been an increased interest in the use of chemotherapy, particularly when there is gross residual or distal disease.[104] There has also been a more judicious and better use of radiotherapeutic modalities for this cancer resulting in lower morbidity. The overall effect of these advances is to reduce mortality of patients with uterine cancer and improve survival of this disease.

Both complete pelvic lymph-node (PLN) and para-aortic lymph-node (PALN) adenectomy are the most accurate methods for assessing lymph-node metastases. Several observational studies have shown improved survival in i) all patients ii) patients that had at least a stage I grade 3 endometrial cancer iii) patients with a certain number of lymph nodes removed, who had undergone a PLN adenectomy.[105] However, a large randomized control trial reported no survival benefit for stage I or stage IIA patients who had undergone systematic lymphadenectomy, although the authors conceded that the lymphadenectomy protocol was not comprehensive and did not include all pelvic and para-aortic nodes. Observational studies of PALN adenectomy have also not been favorable, except for a small study that showed increased disease-free survival in patients with >=2 positive PLN sites.[106] Thus far, randomized studies on PALN have not been conducted. Regardless, PLN and PALN adenectomy have been performed selectively on endometrial cancer patients in Singapore.



1- and 5-year age standardised relative survival in selected countries



Calendar Period	Females							
	ASOS (%)				ASRS (%)			
	1yr	3yr	5yr	10yr	1yr	3yr	5yr	10yr
1973-1977	68.0 (37.5-82.7)	41.2 (19.7-63.2)	38.5 (17.3-60.7)	-	71.3 (38.8-86.7)	48.3 (21.4-76.0)	50.7 (20.1-82.9)	-
1978-1982	74.2 (53.2-87.0)	53.5 (36.8-70.3)	50.6 (33.8-67.8)	31.0 (15.9-52.9)	77.1 (54.9-90.7)	58.6 (39.5-78.7)	60.8 (38.9-85.5)	51.4 (19.8-103.9)
1983-1987	78.3 (61.2-88.7)	63.3 (44.8-77.5)	55.5 (37.5-72.1)	43.2 (25.6-62.5)	81.0 (63.0-92.0)	70.0 (48.5-86.4)	66.3 (42.2-89.1)	68.5 (33.5-112.2)
1988-1992	72.7 (60.4-82.0)	58.6 (46.8-69.2)	53.0 (41.1-64.3)	44.0 (32.1-56.2)	74.6 (61.6-84.4)	62.5 (49.3-74.7)	59.4 (45.0-73.5)	60.9 (41.0-82.6)
1993-1997	83.4 (72.9, 90.1)	67.4 (55.1, 77.1)	55.7 (42.5-70.8)	45.5 (36.3-57.0)	85.5 (74.6-92.5)	72.7 (58.9-83.7)	62.0 (45.7-81.6)	57.3 (43.3-78.3)
1998-2002	81.7 (73.2-87.8)	69.3 (59.8-77.2)	61.8 (52.1-70.4)	49.1 (38.8-62.6)	83.2 (74.4-89.5)	73.2 (62.8-81.8)	67.7 (56.4-77.8)	59.0 (43.9-80.9)
2003-2007	85.5 (79.4-89.9)	69.1 (62.1-75.2)	64.1 (56.7-70.8)	55.9 (47.9-63.4)	87.3 (81.1-91.9)	73.1 (65.2-80.0)	70.4 (61.6-78.5)	70.0 (58.1-81.8)

Age standardised observed survival and relative survival of uterine cancer by calendar period

ASOS: Age standardised observed survival
ASRS: Age standardised relative survival
*: the estimates were not computed due to the absence of cases in one or more age groups

Ovary (ICD-9 183)

Ovarian cancer has been dubbed “the silent killer” in women.[107] This disease has minimal or no symptom until it reaches an advanced stage and by then, the treatment options become limited and are less efficacious. Unfortunately, the majority of patients present at a late stage when disease is already locally advanced or metastatic. The stage of disease is highly prognostic in ovarian cancer. When ovarian cancer is diagnosed at the localised stage, the 5-year relative survival is 95%. However, this figure drops to less than 30% when the disease is diagnosed at an advanced stage. [108]

Ovarian cancer is the fifth most frequent cancer among females in Singapore. It accounted for 5.7% of all female cancers diagnosed in 2003-2007.[64] The incidence of ovarian cancer had increased steadily from 6.2 per 100,000 in 1973-77 to 12.0 per 100,000 in 2003-2007. The mortality of this disease remained at around 4.0 per 100,000 throughout the study period. In terms of survival, the 5-year ASRS increased from 35.3% in 1983-87 to 51.2% in 1988-92 and stabilised at that level until the present calendar period. Internationally, the relative survival for ovarian cancer in Singapore was higher than that in SEER, Europe, India and Thailand.

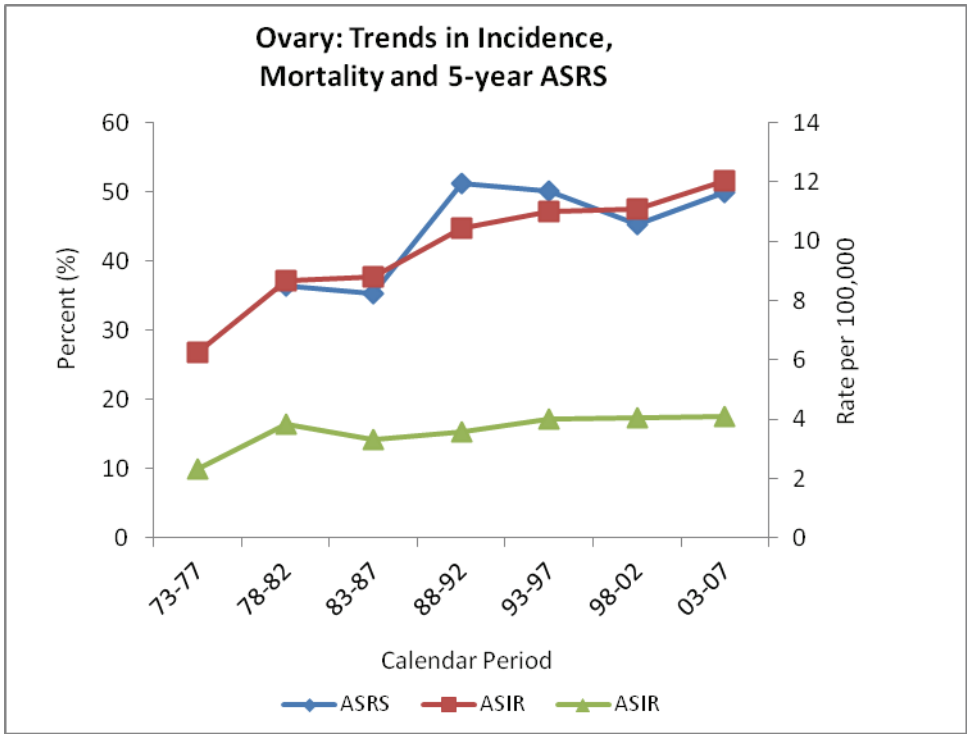
During the past few decades, several advances in the management of ovarian cancer have emerged and these have contributed to the improvement in survival. The practices of abdominal radiotherapy or single agent chemotherapy are now replaced by procedures such as cytoreductive surgery and multiagent chemotherapy. Cytoreductive surgery is important as survival of patients with advanced ovarian cancer progressively increased when the maximum residual disease decreased.[109] Accurate surgical staging and optimal tumour cytoreduction followed by platinum-based chemotherapy is the standard of care in the management of ovarian cancer and results in improved patient survival.[107]

More specifically, carboplatin has been found to be better tolerated than cisplatin and is now commonly combined with paclitaxel as first-line treatment.[110] Additionally, the dose density and frequency of chemotherapy has been investigated and no evidence has been found to support an increase in platinum dose. On the other hand, the

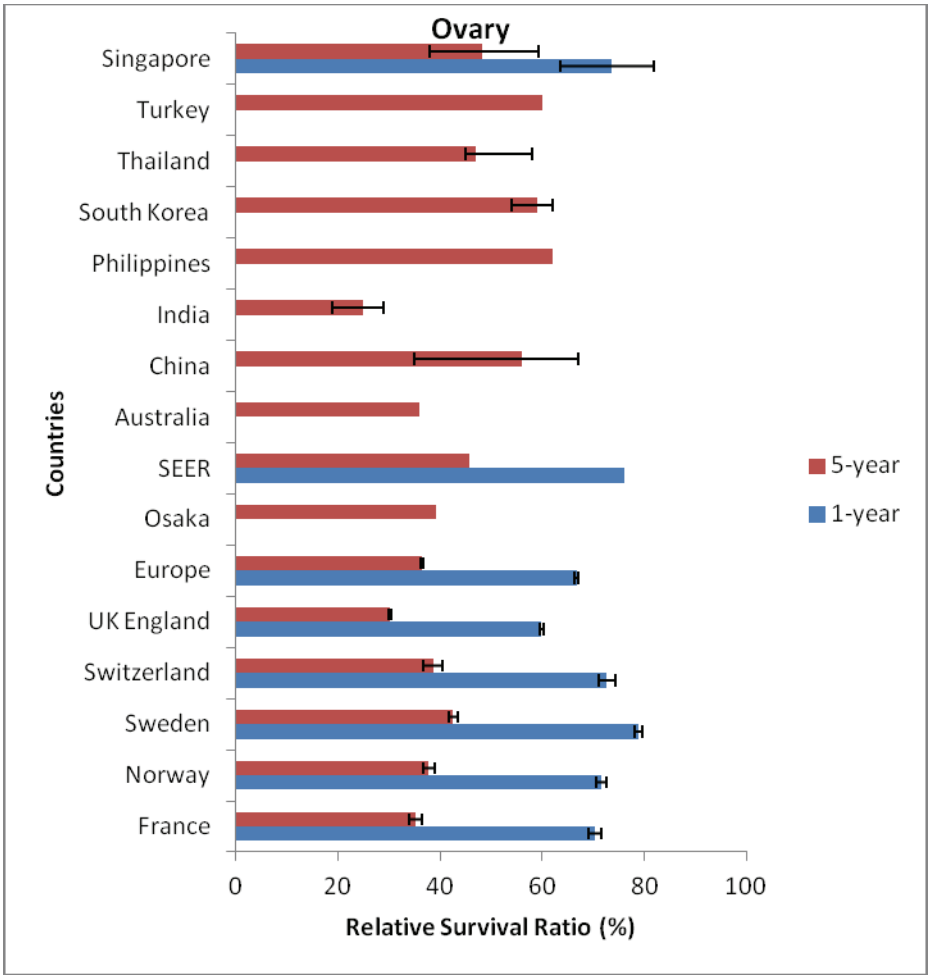
Japanese Gynecologic Oncology Group had demonstrated a significant progression-free survival improvement of greater than 10 months for 3 weekly carboplatin used with weekly paclitaxel compared to 3 weekly combination therapy.

Furthermore, the mode of treatment delivery has also been studied as it was theoretically found that higher concentrations of chemotherapeutic drugs can be achieved when administered intraperitoneally instead of intravenously.[111] Indeed, survival gains were significant in randomized trials although the studies were small in scale and had suboptimal control arms. Moreover, drug toxicities were higher.

There is no proven screening tool of ovarian cancer to detect ovarian cancer in asymptomatic individuals. CA-125 is a tumour marker that is used to detect recurrence of ovarian cancer after treatment and it has been offered as part of a panel of tumour markers in health screening packages locally. We do not have data on the number of ovarian cancers that have been diagnosed through elevated CA-125 tumour marker levels in health screening but elevated levels of CA-125 tend to be associated with advanced ovarian cancer rather than early ovarian cancer. Over 90% of advanced ovarian cancers will have an elevated CA-125 and 50% of stage 1 ovarian cancers will have a normal CA-125.[112] Thus, earlier diagnosis of ovarian cancer from CA-125 screening is likely to be slight and will not have caused significant impact on the survival estimates in our study.



1- and 5-year age standardised relative survival in selected countries



Age standardised observed survival and relative survival of ovarian cancer by calendar period

Calendar Period	Females							
	ASOS (%)				ASRS (%)			
	1yr	3yr	5yr	10yr	1yr	3yr	5yr	10yr
1973-1977	48.3 (30.6-67.1)	-	-	-	49.6 (31.1-69.3)	-	-	-
1978-1982	53.6 (37.8-67.6)	33.3 (20.7-47.6)	28.9 (17.2-43.2)	-	56.2 (39.3-71.2)	37.8 (22.6-55.3)	36.3 (19.9-57.6)	-
1983-1987	54.4 (40.4-68.0)	35.0 (24.0-48.9)	30.2 (19.7-44.2)	-	56.0 (41.2-70.4)	38.0 (25.2-54.8)	35.3 (21.6-55.3)	-
1988-1992	65.4 (54.4-74.8)	50.6 (39.6-61.1)	44.2 (33.0-55.3)	32.9 (21.6-48.8)	67.0 (55.5-76.7)	54.3 (42.0-66.2)	51.2 (37.3-65.2)	46.0 (26.3-79.1)
1993-1997	65.8 (57.1-73.4)	51.0 (41.7-59.8)	43.7 (34.6-52.9)	31.8 (23.9-40.8)	67.3 (58.2-75.3)	54.9 (44.4-65.0)	50.1 (38.8-61.8)	43.2 (30.0-59.6)
1998-2002	73.6 (65.1-80.5)	50.9 (42.4-59.3)	41.7 (33.8-49.9)	33.9 (26.5-42.2)	74.9 (66.1-82.0)	53.4 (44.1-62.7)	45.3 (36.2-55.1)	41.4 (30.9-53.9)
2003-2007	73.7 (66.7-79.5)	54.7 (47.3-61.6)	45.8 (38.4-53.1)	36.1 (28.9-43.7)	75.1 (67.9-81.1)	57.6 (49.6-65.2)	50.0 (41.5-58.6)	45.8 (35.1-57.9)

ASOS: Age standardised observed survival
ASRS: Age standardised relative survival
-: the estimates were not computed due to the absence of cases in one or more age groups.

Prostate (ICD-9 185)

Undoubtedly, prostate specific antigen (PSA) screening has greatly influenced the trends of prostate cancer. The U.S. Food and Drug administration approved the PSA test for the purpose of monitoring disease status in prostate cancer in 1986 and the use of PSA test for screening increased thereafter. This happened despite the concerns about the PSA tests increasing the number of prostate cancer diagnoses and potentially harmful treatments without clear evidence of improved outcomes.

Prostate cancer is now the third most frequent cancer among Singapore males[64] and the incidence had more than quadrupled during the study period. The incidence increased from 5.2 per 100,000 in 1973-77 to 9.6 per 100,000 in 1988-92 before accelerating to reach 23.9 per 100,000 in 2003-2007. The mortality of prostate cancer increased from 1.4 per 100,000 in 1973-77 to 4.7 per 100,000 in 2003-2007. There appears to be improvement in survival of prostate cancer across the period of interest. The 5-year ASRS rose from 40.0% in 1973-77 to 84.7% in 2003-2007. Internationally, the relative survival for prostate cancer in Singapore was lower than that in the SEER registries but higher than that in England and Osaka.

It has been suggested that the increase in incidence may reflect a true increase in the prevalence in risk factors. Many Asian countries, with globalisation and gradual Westernisation, may be losing their protective cultural factors and acquiring high-risk ones.[113] However, the increased diagnostic intensity through screening should have contributed considerably to this uptrend. We observed that PSA test was often bundled together with other investigations in health screening packages in asymptomatic individuals. While we do not have data on the utilisation rates of PSA tests in Singapore, the accelerated increase in incidence in the last two calendar periods in the study could have represented more widespread use of PSA tests in screening.

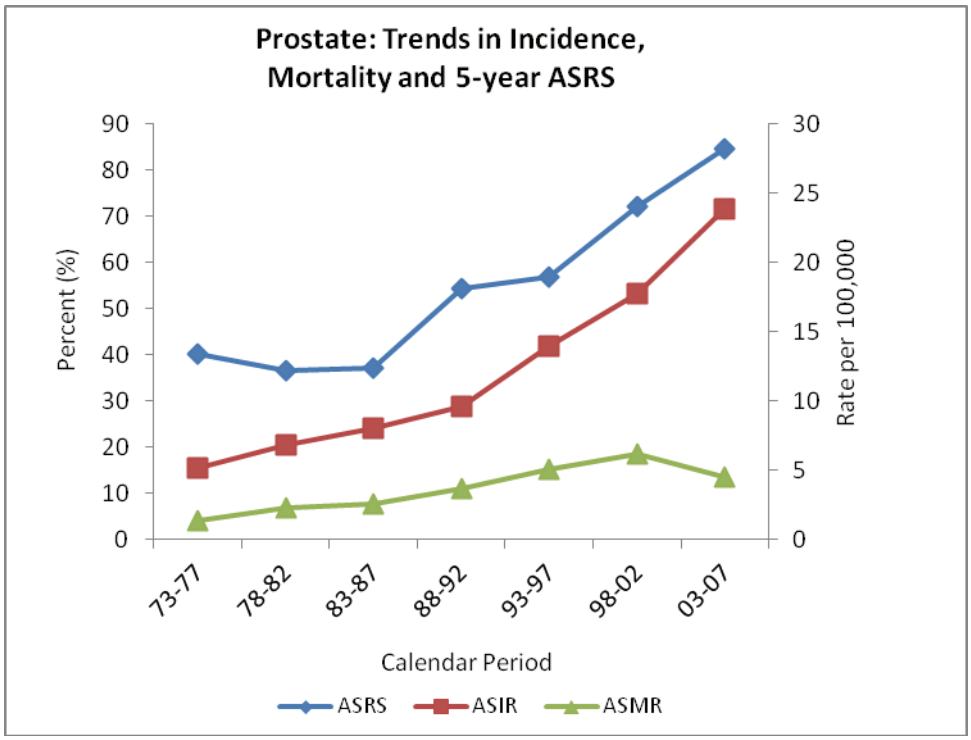
The interpretation of survival trends of prostate cancer is complicated by bias created by the screening of prostate cancer. Screening is able to detect cancer at an earlier stage in the natural history of the cancer among asymptomatic persons. As these early stage cancers takes a longer time to progress and cause death than the more

advanced tumours, there will appear to be an improvement in survival by the sheer dilution of the more advanced cancers in the pool of prostate cancer cases. This will take place even if effective therapy that is able to prolong survival for the early stage cancers do not exist.

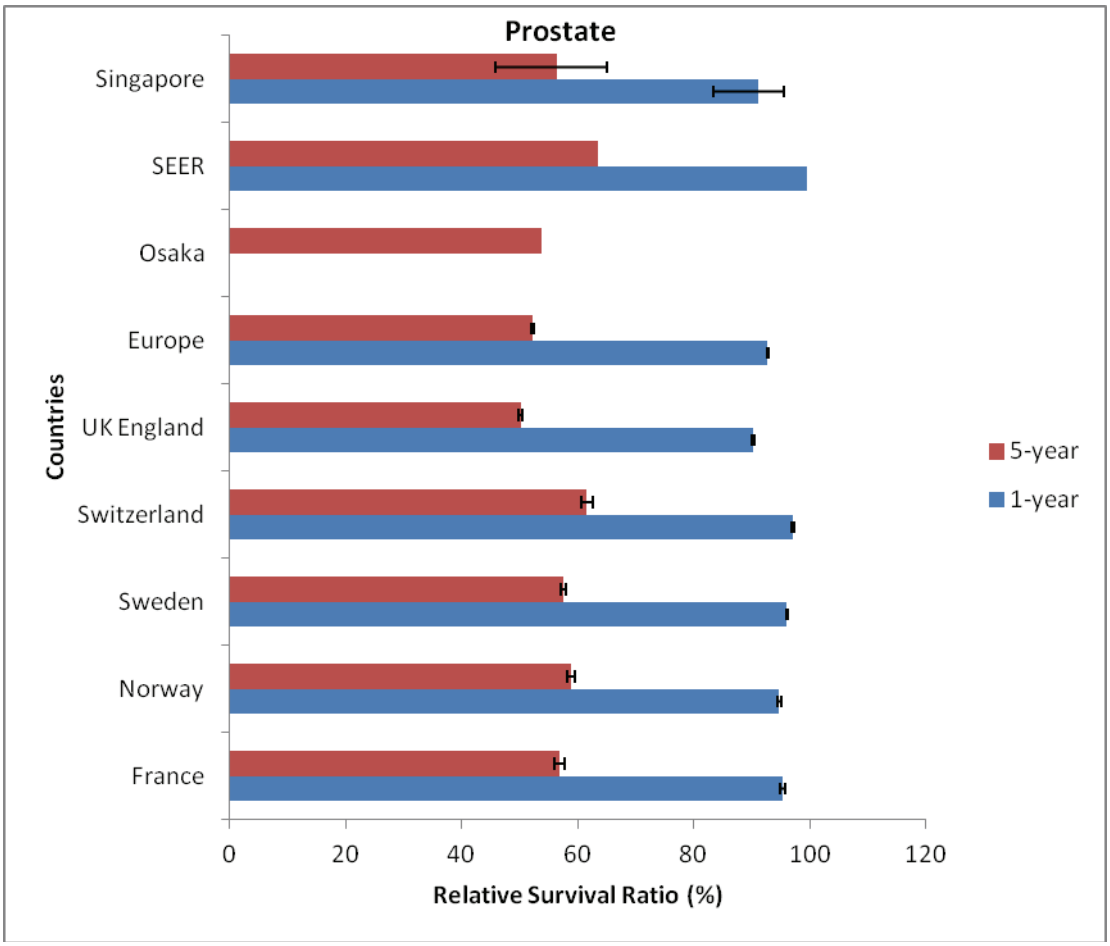
Most countries currently still do not advocate screening. The European Randomized Study of Screening for Prostate Cancer followed 162, 243 men between the age of 55 and 69, who were either randomized to a group that was offered PSA screening at an average of once every 4 years or to a control group with no screening, over a duration of between 3 to 11.5 years.[114] The primary outcome was the rate of death from prostate cancer. It was found that 1410 men would need to be screened and 48 additional cases of prostate cancer would need to be treated to prevent one death from prostate cancer. The authors concluded that PSA-based screening reduced the rate of death from prostate cancer by 20% but was associated with a high risk of overdiagnosis. On the other hand, a systematic review and meta-analysis of six RCTs on prostate cancer screening found no significant effect of screening on death from either prostate cancer or any cause, although the authors admitted that all the trials included in the review had one or more substantial methodological limitations.[115]

To the extent that survival rates help to assess therapeutic progress in prostate cancer, we must be mindful that no treatment with a curative intent existed for prostate cancer until the late 1980s when radical prostatectomy started.[1] Prior to that, the key treatment option was that of hormonal manipulation which offered palliation with no cure. Therefore, no survival trend could be attributed to improved cure before 1990 because no such treatment was in use.[1]

Prostate cancer is a slow progressive disease and "latent" (microscopic) prostate cancer is more common than overt clinical prostate cancer.[116] Latent cancer had been detected in 12% of men who died of other causes.[116] PSA screening and detection of these non-fatal cancers, which otherwise will remain clinically silent throughout the lifetimes of the patients, will raise the survival of prostate cancer.



1- and 5-year age standardised relative survival in selected countries



Age standardised observed survival and relative survival of prostate cancer by calendar period

Calendar Period	Males							
	ASOS (%)				ASRS (%)			
	1yr	3yr	5yr	10yr	1yr	3yr	5yr	10yr
1973-1977	65.0 (41.6-81.0)	40.4 (23.3-60.1)	26.4 (11.2-47.7)	-	70.6 (45.6-87.6)	53.4 (31.0-78.4)	40.0 (16.0-74.5)	-
1978-1982	68.4 (50.7-81.0)	38.4 (23.2-56.2)	-	6.0 (2.3-18.7)	73.5 (54.8-86.7)	48.8 (30.2-69.9)	-	13.5 (5.0-82.8)
1983-1987	66.9 (51.8-78.2)	39.2 (27.4-52.2)	23.7 (15.1-35.1)	-	71.3 (55.5-83.2)	49.2 (34.9-64.5)	37.0 (24.0-53.6)	-
1988-1992	80.0 (63.7-87.0)	53.7 (37.3-66.8)	38.8 (22.6-52.6)	-	84.9 (68.1-92.3)	65.1 (46.7-80.0)	54.4 (34.1-72.1)	-
1993-1997	83.9 (73.7-89.0)	55.7 (45.4-65.2)	39.8 (30.8-50.6)	18.3 (12.4-28.3)	88.5 (78.0-93.8)	67.4 (55.7-78.1)	56.8 (45.0-70.4)	45.8 (30.4-67.5)
1998-2002	89.7 (84.4-92.7)	70.5 (63.2-75.8)	57.3 (48.5-64.2)	-	93.7 (88.3-96.8)	80.5 (72.4-86.6)	72.2 (61.7-80.8)	-
2003-2007	93.3 (90.2-94.8)	80.0 (75.5-83.3)	70.4 (64.8-74.6)	48.0 (39.2-55.2)	96.6 (93.4-98.2)	89.0 (83.9-92.7)	84.7 (78.0-90.0)	75.2 (62.2-86.7)

ASOS: Age standardised observed survival
ASRS: Age standardised relative survival
-: the estimates were not computed due to the absence of cases in one or more age groups.

Bladder (ICD-9 188)

Bladder cancer is the ninth most frequent cancer among males in Singapore in 2003-2007. It is less frequent among females. The male-to-female ratio was 3:1 during 2003-2007.[64] Among the various histological subtypes, transitional cell carcinoma accounted for more than 90% of the bladder cancers diagnosed between 2003 and 2007. The differentiation between invasive and in-situ bladders cancers is not always straightforward nor standardised[117-118], and this may have led to difficulties in interpretation and comparison of bladder cancer trends. Some cancer registries e.g. the SEER program in USA has combined in-situ and invasive cancers for the reporting of incidence and survival of bladder cancer.[117] On the other hand, the Singapore Cancer Registry has continued to include only Ta to T4 tumours.

The incidence and mortality of bladder cancer remained fairly stable over the study period. Among females, the mortality of bladder cancer dipped slightly from 1.0 per 100,000 in 1973-77 to 0.6 per 100,000 in 2003-2007 while its incidence fluctuated between 1.7 and 2.3 per 100,000. On the other hand, the incidence and mortality of bladder cancer in males ranged from 6.3 to 7.7 per 100,000 and 1.7 to 3.1 per 100,000 respectively during the study period. In terms of survival, both genders showed improvement. The 5-year ASRS had increased by 45.5% and 17.2% in males and females respectively over the study period. The relative survival for bladder cancer in Singapore was lower than that in Europe and SEER for both genders.

Therapeutic advances such as the use of intravesical Bacillus Calmette-Guerin (BCG) could help to explain the improvement in the survival in bladder cancer. This treatment modality evolved out of the need to prevent tumour recurrence after successful local surgical resection. Morales *et al* demonstrated that intravesical instillation of BCG reduced the number of recurrence in superficial bladder cancer[119] and this treatment became more widely accepted after clear benefit was demonstrated in terms of decreased recurrence rate and increased median time to recurrence in patients given BCG immunoprophylaxis after local surgery in a randomised trial.[120] Besides its role as an immunoprophylactic agent, BCG also has

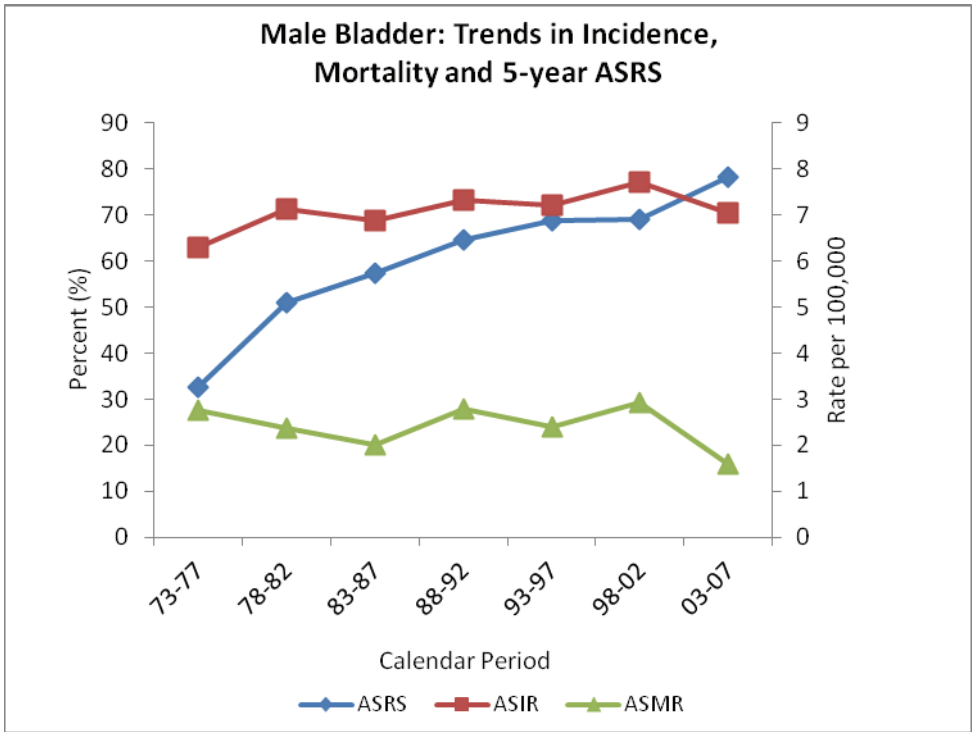
50–60% effectiveness against small residual bladder tumours and a 70–75% complete response rate for carcinoma-in-situ of the bladder.[121]

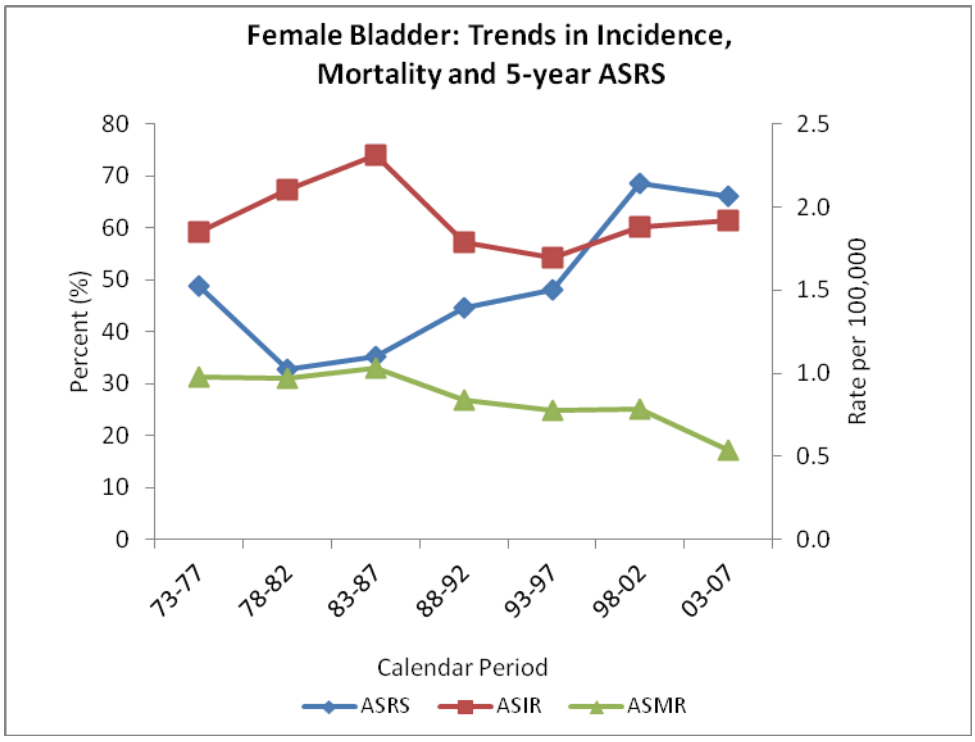
The level of care of bladder cancer patients was likely to have improved alongside the overall progress of healthcare infrastructure in Singapore over the past decades. Additionally, there was greater specialisation in the discipline of urology over the study period. The first urology division was established in Singapore General Hospital in 1987 and this was followed by other specialised units in other public hospitals.[122] These units provided the infrastructure for service and training of urology expertise. Such developments would have directly contributed to better care for bladder cancer patients.

There were other factors during the study period that could have predisposed towards earlier diagnosis of bladder cancer and hence elevated the survival estimates as a result of lead time bias. We did not have adequate local data to quantify the extent of such bias. These factors included advances in the diagnosis of bladder cancer such as the use of flow cytometry and fluorescence cystoscopy. Flow cytometry is considered to be more sensitive than and as specific as the more traditional voided urinary cytology.[123] Fluorescence cystoscopy allowed for guided biopsies that are more sensitive in detecting dysplasia or bladder cancer.[124] Furthermore, there were marked improvements in overall socioeconomic status and educational status of the population during the study period, it would be conceivable that in general, Singaporeans would be more aware of new urinary symptoms e.g. haematuria and would present earlier to their physicians with these symptoms. The earlier diagnoses would lead to an apparent improvement in survival simply because the patients would be diagnosed at an earlier time point along the natural history of the disease.

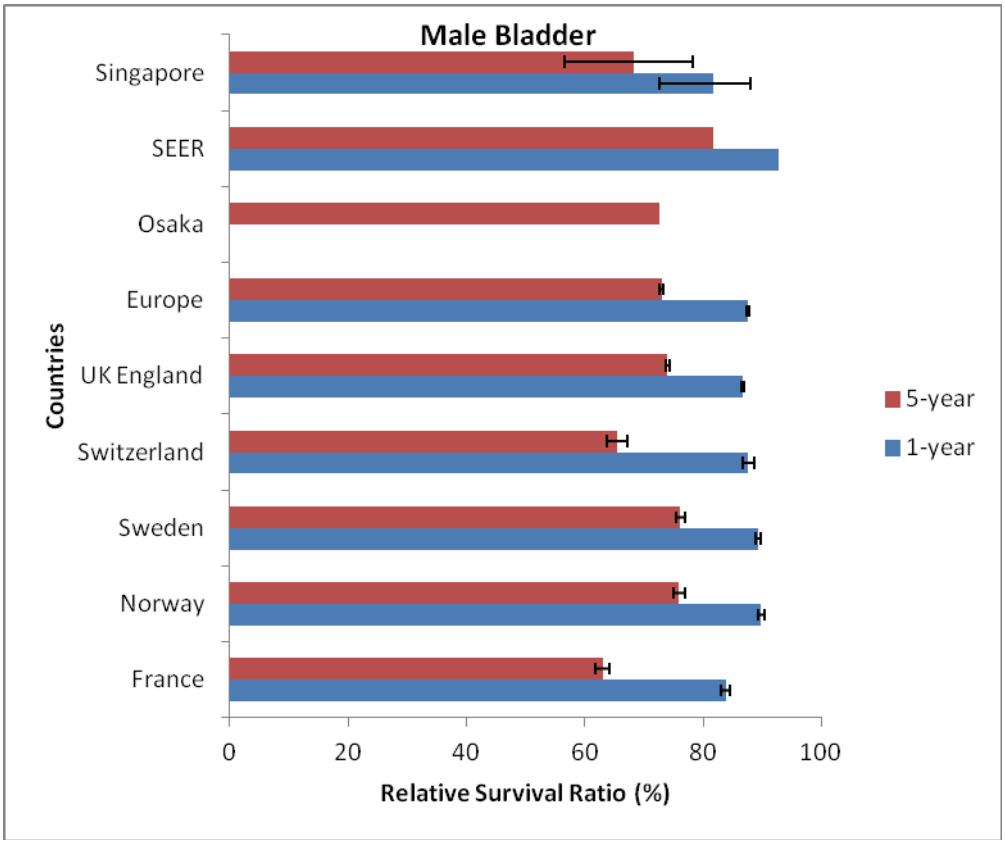
Contemporary research strongly suggests that all patients undergoing radical cystectomy for bladder cancer should undergo concomitant extended PLND. Radical cystectomy with pelvic lymph node dissection (PLND) is the preferred treatment for invasive bladder cancer.[125] It not only results in the best disease-free term survival rates, but also provides the most accurate disease staging and most effective local symptom control. Recent investigations have demonstrated a clinical benefit to

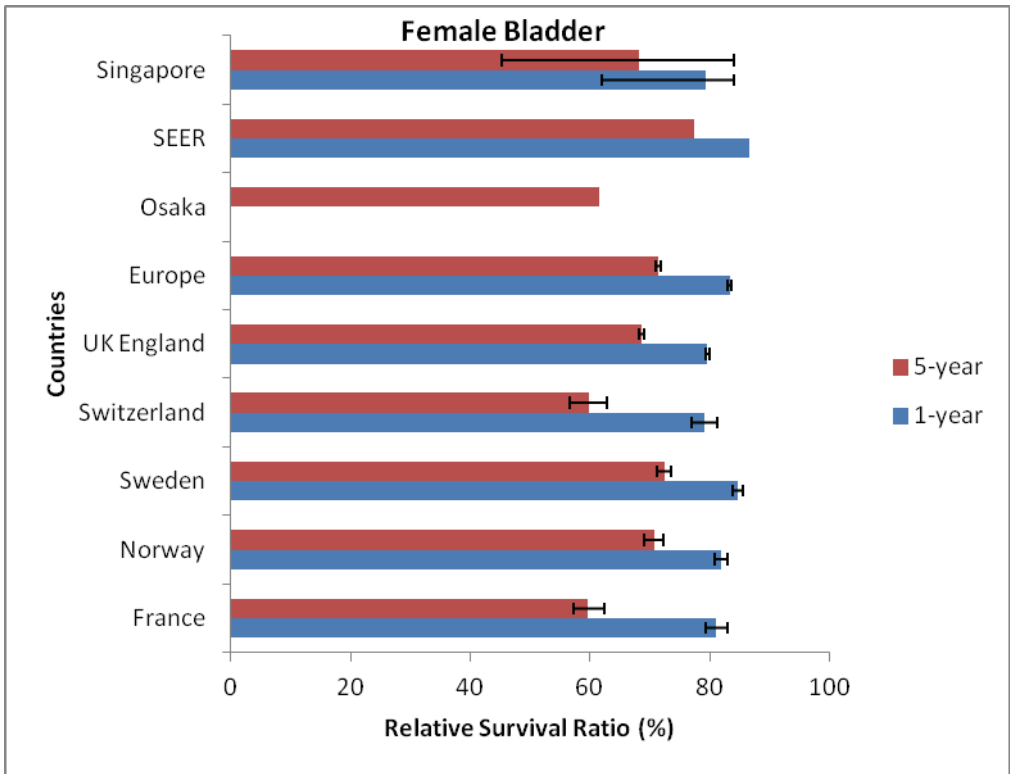
performance of an extended PLND, including all lymphatic tissue to the level of the aortic bifurcation.





1- and 5-year age standardised relative survival in selected countries





Age standardised observed survival and relative survival of bladder cancer by calendar period and gender

Calendar Period	Males							
	ASOS (%)				ASRS (%)			
	1yr	3yr	5yr	10yr	1yr	3yr	5yr	10yr
1973-1977	48.3 (30.8-63.7)	32.7 (18.0-49.3)	25.2 (12.7-41.4)	-	51.3 (32.3-68.2)	38.8 (20.3-61.1)	32.6 (15.3-59.8)	-
1978-1982	64.4 (48.2-75.5)	45.6 (30.1-58.8)	36.9 (22.5-50.8)	-	68.2 (51.0-80.3)	55.3 (35.9-72.6)	50.8 (29.0-74.6)	-
1983-1987	74.3 (60.4-83.0)	55.6 (41.4-66.5)	44.1 (30.4-56.0)	25.2 (14.2-38.8)	78.6 (63.9-87.9)	65.3 (48.3-78.9)	57.4 (38.7-74.9)	41.5 (20.9-86.5)
1988-1992	80.2 (69.3-86.7)	59.6 (47.9-68.6)	49.6 (37.6-59.3)	36.5 (23.9-48.1)	84.8 (73.3-91.8)	69.9 (56.0-80.9)	64.7 (48.3-79.0)	76.8 (46.3-110.4)
1993-1997	78.9 (69.6-84.8)	62.0 (51.6-70.1)	52.3 (41.9-60.9)	39.5 (29.6-48.5)	83.0 (73.1-89.3)	72.4 (60.1-82.1)	68.7 (54.5-81.0)	79.9 (55.9-105.0)
1998-2002	79.8 (71.6-85.3)	63.1 (53.9-70.2)	55.9 (46.5-63.4)	40.1 (30.6-48.5)	83.2 (74.7-88.9)	71.0 (60.6-79.2)	69.0 (57.2-78.9)	66.9 (49.1-84.9)
2003-2007	85.4 (79.4-89.5)	72.4 (64.1-78.1)	65.0 (56.4-71.3)	47.6 (38.5-55.3)	88.6 (82.4-92.9)	80.4 (71.2-87.0)	78.1 (67.6-86.1)	72.1 (56.8-86.4)
Calendar Period	Females							
	ASOS (%)				ASRS (%)			
	1yr	3yr	5yr	10yr	1yr	3yr	5yr	10yr
1973-1977	52.1 (27.9-72.3)	41.7 (19.9-63.3)	38.1 (17.5-59.7)	-	54.4 (29.1-75.6)	47.7 (22.1-73.3)	48.8 (21.2-78.3)	-
1978-1982	53.1 (32.3-72.0)	-	-	-	55.8 (33.9-75.7)	-	-	-
1983-1987	51.1 (28.0-67.7)	38.0 (18.9-57.4)	30.2 (13.2-49.0)	-	52.9 (29.0-70.2)	42.5 (21.3-64.2)	35.2 (15.4-57.8)	-
1988-1992	68.7 (49.0-81.4)	46.0 (24.4-62.8)	37.5 (17.5-54.6)	28.9 (11.6-45.2)	71.0 (50.6-84.2)	51.1 (27.4-70.0)	44.7 (21.1-66.0)	42.4 (16.7-70.5)
1993-1997	73.9 (50.1-85.8)	52.2 (29.6-68.6)	42.2 (21.3-58.5)	32.4 (14.0-49.4)	76.5 (52.1-88.8)	57.5 (33.0-75.6)	47.9 (24.1-67.6)	42.0 (17.3-69.6)
1998-2002	75.4 (57.4-84.5)	63.7 (45.1-76.1)	60.3 (41.6-73.1)	44.8 (24.7-61.4)	77.2 (58.8-86.6)	68.8 (48.9-82.3)	68.6 (47.5-83.4)	55.4 (29.9-79.4)
2003-2007	77.9 (61.1-87.1)	66.4 (49.2-77.3)	57.9 (40.7-69.8)	45.8 (29.1-58.6)	80.2 (63.0-89.6)	71.8 (53.5-83.7)	66.0 (46.7-79.9)	60.1 (37.6-79.2)

ASOS: Age standardised observed survival
ASRS: Age standardised relative survival
-: the estimates were not computed due to the absence of cases in one or more age groups.

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APPENDIX A

Relative Survival and Observed Survival by Period, Site and Age Group

RELATIVE SURVIVAL AND OBSERVED SURVIVAL BY PERIOD, SITE AND AGE GROUP — SINGAPORE MALES, 1973-2007

SITE	Age Group	Relative Survival (%)																											
		1973 - 1977				1978 - 1982				1983 - 1987				1988 - 1992				1993 - 1997				1998 - 2002				2003 - 2007			
		1 yr	3 yr	5yr	10 yr	1 yr	3 yr	5yr	10 yr	1 yr	3 yr	5yr	10 yr	1 yr	3 yr	5yr	10 yr	1 yr	3 yr	5yr	10 yr	1 yr	3 yr	5yr	10 yr	1 yr	3 yr	5yr	10 yr
Tongue	15-44	100.3	74.0	74.6	75.9	75.7	56.9	57.4	49.1	38.8	39.1	39.4	31.1	72.8	63.5	50.5	51.8	69.4	46.8	47.0	28.7	91.5	44.9	34.6	21.3	77.4	68.8	69.0	69.8
	45-54	66.0	21.9	*	*	69.3	41.4	42.4	*	51.0	52.1	30.3	23.9	49.5	26.6	19.6	15.0	58.1	50.9	43.6	46.2	77.8	57.7	58.5	61.4	85.9	50.9	41.6	24.8
	55-64	45.9	10.5	11.1	13.0	51.5	36.7	19.8	7.0	56.7	22.6	8.0	0.5	74.9	37.1	38.8	36.2	51.2	19.1	15.3	5.9	69.9	41.1	34.5	23.9	73.4	55.5	48.7	38.6
	65-74	49.3	31.4	35.6	*	73.4	22.0	24.8	15.3	49.9	21.5	24.6	*	46.0	29.4	20.2	7.9	62.3	38.4	24.0	15.4	64.9	42.7	47.4	68.2	59.8	37.6	40.4	20.0
	75+	47.4	30.0	*	*	47.3	45.6	17.5	*	56.3	15.1	20.2	*	25.8	6.9	9.3	*	26.2	15.9	4.0	*	71.5	42.9	50.4	*	42.7	20.1	20.2	26.7
	All ages	53.5	28.0	*	*	60.5	37.0	25.9	*	52.7	24.8	21.2	*	49.1	26.7	23.4	*	49.3	29.5	20.1	*	71.4	44.4	45.7	*	62.3	40.4	38.6	30.3
Salivary gland	15-44	100.1	74.5	75.1	75.8	100.2	100.7	101.1	102.8	100.2	100.6	90.1	91.3	92.9	93.2	93.5	68.1	100.2	95.2	95.5	86.8	100.1	96.1	87.1	88.0	100.1	100.4	100.6	86.9
	45-54	80.8	51.5	52.3	*	100.7	71.0	49.1	52.7	100.7	82.6	84.0	91.4	100.6	77.0	78.3	59.2	93.6	78.4	67.3	59.9	100.4	82.6	75.8	78.8	92.3	78.7	56.5	44.6
	55-64	77.7	50.9	53.0	*	74.7	*	4.7	2.9	68.0	58.6	60.6	28.7	101.8	56.1	38.5	43.2	101.5	72.5	75.9	49.5	101.3	104.4	72.5	81.6	93.2	73.1	61.1	40.8
	65-74	39.6	*	*	*	80.8	*	*	*	105.2	*	*	*	52.6	38.9	44.4	*	51.5	40.6	31.3	50.9	70.4	49.8	55.6	45.7	84.7	80.1	76.4	59.8
	75+	69.1	57.8	*	*	72.2	12.0	*	*	118.5	*	*	*	69.9	17.9	22.7	*	44.8	40.8	*	*	94.5	115.5	28.9	*	88.0	72.2	57.4	61.7
	All ages	66.1	*	*	*	80.7	*	*	*	99.6	*	*	*	77.5	45.1	44.2	*	69.5	56.4	*	*	90.2	88.6	56.4	*	89.6	77.5	66.7	56.1
Nasopharynx	15-44	81.5	50.3	40.3	35.6	81.6	51.0	42.3	31.3	87.3	55.7	44.4	37.0	90.9	67.8	56.8	43.9	91.0	73.1	61.8	50.4	92.4	77.4	67.7	53.9	95.8	83.0	72.7	59.2
	45-54	70.6	37.0	29.1	19.1	80.4	47.2	32.8	19.6	75.9	48.8	32.0	18.5	84.1	57.8	45.3	35.2	85.6	67.2	56.0	36.7	88.2	71.5	60.8	45.9	91.6	76.6	68.8	52.7
	55-64	54.7	25.1	17.2	18.1	70.6	43.2	23.5	12.6	65.3	39.2	31.4	23.0	78.0	50.8	40.0	20.9	86.4	63.5	50.7	31.2	82.6	61.9	51.0	38.8	85.4	70.0	58.3	41.2
	65-74	45.3	14.1	8.7	*	64.6	28.1	31.5	*	69.0	39.5	23.7	10.3	60.1	34.0	22.7	4.4	73.9	56.4	47.6	28.3	74.8	51.0	41.3	16.3	76.5	62.8	43.4	32.6
	75+	22.3	29.5	*	*	40.9	11.2	15.6	*	46.7	9.7	12.9	*	42.6	26.7	27.2	*	51.8	20.5	26.5	34.2	67.7	42.1	34.1	8.8	62.9	37.9	25.5	30.5
	All ages	58.5	32.6	*	*	70.0	38.6	30.8	*	71.4	41.4	31.0	*	74.1	50.0	40.3	*	80.2	59.4	50.7	37.3	82.6	62.9	53.0	35.5	84.4	68.8	56.5	45.0
Oesophagus	15-44	8.6	8.6	*	*	34.4	3.4	3.4	*	68.8	20.8	*	20.9	38.8	3.0	3.0	*	56.5	16.5	16.6	*	86.3	42.7	42.9	43.5	58.8	24.3	24.4	24.7
	45-54	29.3	8.3	8.5	*	19.8	5.3	5.5	6.0	38.0	12.7	12.9	13.9	17.3	4.1	2.0	1.2	29.2	20.4	*	0.9	44.8	25.5	20.8	*	36.8	22.1	14.7	8.4
	55-64	14.9	2.0	2.1	*	19.8	6.6	2.2	0.5	22.3	7.9	3.5	*	22.5	7.2	3.7	4.2	27.4	11.9	7.5	4.9	45.1	15.1	7.8	4.8	35.0	13.8	9.6	8.1
	65-74	10.4	1.0	1.2	*	16.3	4.3	2.0	2.9	17.4	7.0	4.4	4.4	24.9	7.2	4.1	2.4	26.9	9.5	6.5	5.0	32.8	11.1	6.5	5.8	29.9	7.5	3.4	2.2
	75+	7.6	1.1	1.7	*	10.2	6.5	6.1	16.1	14.8	4.3	2.4	7.2	15.3	5.2	4.2	0.4	7.4	1.1	1.4	1.6	27.0	12.0	15.3	25.3	18.8	7.7	9.1	10.7
	All ages	12.8	2.7	*	*	17.0	5.5	3.8	*	23.8	8.0	*	*	21.6	5.9	3.7	*	23.7	9.4	*	*	39.1	16.2	13.6	*	30.7	11.9	9.3	8.3
Stomach	15-44	34.7	14.0	9.1	*	47.6	28.4	22.8	23.3	44.8	19.7	14.1	12.8	38.9	29.8	19.6	14.4	57.1	32.3	25.9	17.9	62.2	48.3	47.1	42.8	61.6	39.2	32.6	30.8
	45-54	27.2	9.1	5.2	4.5	38.2	16.6	13.4	6.9	44.5	29.0	24.3	13.7	51.6	34.9	23.7	19.1	60.0	41.1	34.6	29.6	56.4	38.6	32.3	29.3	58.9	37.3	34.8	28.8
	55-64	21.3	8.9	7.3	1.8	31.5	14.1	11.1	8.5	39.8	22.8	19.9	13.2	44.1	24.7	21.7	15.8	47.8	30.2	26.9	25.4	60.4	39.2	36.4	25.2	65.8	40.3	34.7	31.3
	65-74	14.4	6.7	6.4	4.9	18.3	7.9	7.2	3.0	34.1	15.0	12.6	11.3	31.8	17.8	13.2	13.0	43.4	24.5	20.6	16.7	49.1	31.0	28.0	27.1	56.4	33.4	26.6	24.9
	75+	8.8	1.8	1.4	*	16.3	5.3	3.9	*	20.3	9.6	8.6	*	28.8	17.1	17.1	20.5	27.4	15.3	13.5	10.6	33.0	21.2	20.4	26.8	39.3	22.4	15.1	17.4
	All ages	17.3	6.6	5.2	*	25.2	11.1	9.0	*	33.4	17.2	14.6	*	36.6	22.1	18.0	16.6	42.7	25.7	22.0	18.5	48.8	32.2	29.6	27.9	54.2	32.7	26.5	25.1
Colon	15-44	78.8	50.2	45.1	37.5	61.8	44.2	42.8	34.6	80.2	60.0	47.8	48.7	74.5	59.8	50.8	46.7	85.5	72.9	62.7	57.2	84.2	69.0	66.0	62.2	83.0	70.4	64.7	62.1
	45-54	60.5	47.0	42.0	43.4	76.7	53.9	41.4	33.5	67.9	44.1	39.0	34.0	76.8	54.8	50.8	46.8	79.5	63.3	57.1	54.4	86.0	72.8	57.4	51.6	80.8	66.7	61.4	57.9
	55-64	52.0	32.7	29.8	14.1	61.8	48.3	36.0	25.9	76.4	53.8	42.4	41.4	71.2	54.9	48.4	44.7	80.8	63.3	53.9	49.0	80.8	64.6	55.3	49.5	84.7	69.1	61.9	57.2
	65-74	40.6	28.3	24.5	29.8	57.5	38.4	31.2	41.8	58.6	41.8	38.7	36.0	69.6	54.9	45.8	53.0	74.9	55.9	49.3	50.2	72.7	59.3	50.7	44.8	77.3	61.0	54.4	50.8
	75+	23.2	19.5	11.7	*	17.0	11.0	9.5	3.7	53.1	39.2	32.9	153.2	64.3	52.7	48.8	62.1	61.3	51.2	55.8	65.8	59.3	53.5	52.6	58.5	66.6	55.3	53.6	50.0
	All ages	43.3	30.5	25.5	*	49.3	35.0	28.0	25.6	63.7	45.4	38.5	71.9	69.6	54.6	48.2	52.5	73.6	58.3	54.1	55.4	73.1	61.1	54.2	51.9	76.7	62.5	57.5	53.7
Rectum	15-44	59.7	24.1	13.5	*	71.0	31.8	27.7	15.5	71.7	42.0	22.0	15.9	76.4	51.4	45.6	39.5	85.9	60.4	49.8	42.3	90.1	69.8	62.0	52.5	88.4	71.2	59.6	58.5
	45-54	59.6	41.9	31.8	*	68.9	43.3	36.4	21.3	67.2	37.8	29.4	19.5	75.2	43.9	35.6	29.0	81.2	56.0	44.4	35.0	88.4	69.0	54.8	50.1	85.3	69.7	59.8	54.0
	55-64	51.3	24.0	18.5	9.4	65.2	35.5	27.9	27.4	73.1	51.5	36.7	32.6	75.2	50.2	40.3	34.7	80.9	62.2	47.7	40.9	88.4	69.8	61.6	50.9	85.2	64.2	56.9	52.3
	65-74	42.2	16.9	17.6	*	60.4	34.5	23.9	9.5	68.8	44.7	32.1	16.7	66.2	44.9	39.1	29.6	68.5	51.5	44.0	37.2	78.7	58.0	48.3	39.4	79.6	61.4	52.4	47.1
	75+	38.8	36.9	34.0	*	60.9	44.7	48.0	154.3	53.1	34.7	31.1	40.3	71.3	43.4	30.5	69.5	62.3	49.4	49.6	61.7	67.0	55.5	58.8	66.2	69.3	52.2	45.6	45.7
	All ages	46.6	27.8	23.9	*	63.4	38.5	33.6	57.4	65.2	42.3	31.8	27.5	71.5	46.0	36.9	43.0	72.3	54.5	46.9	45.2	79.5	62.1	56.1	52.0	79.2	61.0	52.8	49.5

* refers to cells where estimates are not computed due to insufficient sample size
Estimates for "all ages" are age standardised
Sites which have insufficient sample size for all cells are excluded from this appendix

RELATIVE SURVIVAL AND OBSERVED SURVIVAL BY PERIOD, SITE AND AGE GROUP — SINGAPORE MALES, 1973-2007

SITE	Age Group	Relative Survival (%)																											
		1973 - 1977				1978 - 1982				1983 - 1987				1988 - 1992				1993 - 1997				1998 - 2002				2003 - 2007			
		1 yr	3 yr	5yr	10 yr	1 yr	3 yr	5yr	10 yr	1 yr	3 yr	5yr	10 yr	1 yr	3 yr	5yr	10 yr	1 yr	3 yr	5yr	10 yr	1 yr	3 yr	5yr	10 yr	1 yr	3 yr	5yr	10 yr
Liver	15-44	1.7	0.7	0.3	*	1.7	0.6	0.6	0.6	5.0	2.4	2.4	2.5	14.6	2.9	0.2	0.2	18.3	6.7	3.2	*	32.2	19.8	13.3	10.5	40.8	26.2	23.5	19.8
	45-54	1.4	0.5	0.4	*	1.6	0.8	0.5	0.5	4.3	1.5	0.7	0.3	12.5	4.6	3.7	3.0	20.5	10.2	7.6	3.5	24.6	16.2	11.8	9.9	38.1	24.9	18.1	16.3
	55-64	0.9	0.7	0.5	*	2.6	0.6	0.5	0.2	5.3	1.5	0.5	0.3	11.1	2.8	2.5	*	12.2	5.5	5.8	3.2	31.7	15.8	11.1	11.0	36.9	20.4	15.5	13.1
	65-74	0.5	0.3	0.3	*	1.7	0.6	0.3	0.3	2.3	1.1	0.7	0.0	7.4	1.1	0.4	0.3	11.0	3.3	1.8	0.2	22.5	11.1	7.3	6.0	32.2	16.7	10.1	6.7
	75+	0.2	*	0.1	*	1.6	0.9	*	*	2.1	0.9	0.7	*	5.2	1.9	0.9	0.0	9.0	3.0	*	*	13.8	8.5	8.1	*	23.8	13.0	8.1	8.5
	All ages	0.7	*	0.3	*	1.8	0.7	*	*	3.4	1.2	0.7	*	8.7	2.3	1.4	*	12.3	4.8	*	*	23.0	12.6	9.4	*	32.1	18.1	12.6	10.8
Pancreas	15-44	18.4	*	*	*	33.7	8.1	8.1	*	23.0	23.1	23.3	*	10.1	0.6	0.1	0.0	27.9	3.4	*	3.4	28.0	17.9	18.0	*	41.1	18.6	14.7	9.1
	45-54	2.8	2.9	3.0	*	6.5	*	2.7	3.0	15.9	6.4	2.4	2.4	9.1	4.5	4.6	5.0	23.4	9.7	5.1	5.5	14.2	7.4	3.8	4.0	29.3	8.3	8.3	8.7
	55-64	2.3	2.6	*	*	8.8	*	*	*	11.8	3.9	*	*	12.9	4.2	0.9	*	14.2	3.4	3.6	4.4	24.8	11.2	7.6	*	21.6	3.5	3.0	2.4
	65-74	4.6	5.5	6.5	9.7	3.1	0.4	0.2	0.3	4.6	*	*	0.8	13.7	8.3	9.3	*	8.9	4.7	3.9	*	9.9	5.2	3.5	2.2	15.5	3.9	1.9	2.5
	75+	3.5	5.1	*	*	0.2	0.3	0.2	*	4.9	6.5	0.2	*	8.8	4.4	3.0	*	6.9	2.9	3.6	9.2	6.0	3.1	2.4	4.7	9.2	5.3	6.5	7.3
	All ages	4.5	4.0	*	*	6.1	*	*	*	9.0	*	*	*	11.3	5.2	4.3	*	12.6	4.4	*	*	14.0	7.1	5.2	*	18.5	5.7	5.2	5.1
Larynx	15-44	60.2	35.2	6.5	*	72.8	48.2	48.6	50.4	74.7	32.5	28.1	28.8	93.3	69.5	40.9	42.0	90.1	80.3	74.5	61.0	91.8	78.5	78.9	71.1	100.2	68.4	68.7	63.4
	45-54	80.6	55.8	46.4	51.1	73.4	43.6	33.6	15.7	75.6	50.5	36.0	24.7	79.0	39.9	32.4	29.2	94.0	80.4	74.3	71.7	86.4	79.1	80.0	66.8	93.6	77.3	69.2	55.0
	55-64	73.1	45.5	38.2	32.0	72.1	39.8	32.2	19.8	75.7	43.0	40.0	40.3	81.4	56.5	47.2	36.1	84.7	62.9	52.7	47.5	84.4	71.3	65.2	57.3	81.0	64.6	58.0	50.6
	65-74	55.1	28.6	22.8	*	59.4	35.1	28.4	28.5	66.9	42.5	33.5	22.5	79.9	63.6	57.4	32.2	80.5	60.8	46.2	45.7	87.0	63.6	55.7	38.1	88.4	71.0	68.0	54.5
	75+	65.9	34.7	21.8	*	48.9	44.6	35.9	*	50.5	24.6	33.4	*	50.8	51.0	38.2	17.4	63.3	44.8	48.3	39.4	74.0	51.2	42.7	50.4	78.0	63.5	57.1	56.6
	All ages	65.8	38.0	27.7	*	61.9	40.8	33.5	*	65.8	37.6	34.9	*	72.7	55.9	45.3	29.2	78.8	60.4	53.7	48.5	82.9	64.7	58.7	51.8	85.1	67.9	62.7	54.9
Lung	15-44	26.9	15.7	8.7	8.8	30.7	12.1	6.7	6.9	37.1	13.6	11.7	9.1	26.2	13.4	9.8	6.9	42.7	12.7	8.0	6.7	44.5	15.3	14.5	11.6	55.5	26.8	18.7	16.4
	45-54	16.2	4.7	3.5	2.8	20.6	8.8	7.8	7.6	23.4	7.9	5.8	5.2	29.0	9.1	7.5	5.7	39.1	12.5	9.7	8.1	47.3	21.8	17.9	13.9	48.0	19.4	13.6	8.8
	55-64	13.8	4.0	2.5	2.7	16.7	6.1	3.9	1.2	19.4	4.8	3.4	2.6	23.1	9.0	5.9	4.0	34.6	13.6	9.6	6.3	36.4	15.0	11.7	7.2	41.6	18.1	13.3	10.2
	65-74	12.3	3.5	2.7	*	12.5	3.4	2.5	1.9	16.7	4.4	3.7	2.7	17.6	6.7	5.1	3.9	24.6	9.0	6.5	4.2	26.3	9.6	6.7	5.0	29.8	10.7	7.5	6.2
	75+	7.0	1.7	2.7	*	8.1	2.9	1.7	1.6	8.6	1.7	0.7	*	11.3	2.6	2.2	5.7	17.0	6.9	4.5	7.0	16.1	7.5	6.4	9.0	18.7	6.6	5.1	5.6
	All ages	12.6	4.1	3.2	*	14.4	5.1	3.5	2.7	17.2	4.8	3.6	*	19.0	6.8	5.1	4.9	27.7	10.1	7.1	6.1	29.5	12.1	9.7	8.2	33.3	13.4	9.6	8.0
Bone	15-44	79.4	54.4	47.1	47.6	81.8	57.7	49.3	41.1	81.6	62.3	57.7	58.5	78.1	70.4	64.9	59.9	83.4	57.4	54.6	50.4	83.7	75.9	72.4	73.1	97.1	80.5	80.7	81.4
	45-54	50.0	50.7	51.5	*	100.8	102.8	46.3	48.7	100.9	41.1	22.5	1.7	86.6	87.7	89.0	*	84.8	48.3	34.4	25.5	84.4	85.3	86.2	89.3	92.3	84.6	85.4	88.5
	55-64	103.0	61.3	67.1	*	102.4	108.8	69.2	42.5	*	103.9	72.0	*	101.3	104.7	*	127.2	12.2	1.3	1.4	*	42.3	43.0	*	25.3	59.8	60.8	62.0	*
	65-74	23.5	27.6	*	*	105.2	14.4	*	*	36.0	1.6	*	*	44.3	25.3	*	*	52.2	57.7	66.8	*	72.0	23.5	25.3	37.8	102.7	84.3	59.1	76.4
	75+	*	*	*	*	*	*	*	*	*	*	*	*	17.8	*	*	*	*	*	*	*	109.7	*	*	*	35.4	39.9	45.3	*
	All ages	*	*	*	*	*	*	*	*	*	*	*	*	69.2	*	*	*	*	*	*	*	76.4	*	*	*	80.9	72.1	68.3	*
Connective tissue	15-44	78.9	64.4	64.7	*	61.0	51.6	42.6	36.5	77.6	63.3	63.5	64.5	62.1	44.6	38.6	34.8	90.4	74.3	74.6	72.0	85.6	63.1	63.3	57.1	86.6	61.9	56.4	50.6
	45-54	100.9	33.9	*	*	52.0	31.2	31.9	*	76.2	47.9	49.2	53.2	80.4	72.9	59.3	63.5	86.5	41.4	37.1	15.0	82.2	71.0	71.7	74.9	88.8	77.7	71.6	60.9
	55-64	65.6	54.8	58.2	*	78.3	57.0	60.6	36.9	73.6	45.6	10.1	7.2	87.7	81.7	84.8	60.5	73.3	56.2	41.0	46.9	73.0	62.6	64.5	67.1	80.6	74.3	76.3	66.0
	65-74	82.8	70.5	83.9	*	42.4	34.6	23.1	5.7	39.7	33.5	39.5	*	47.0	27.3	30.6	12.1	50.6	26.9	29.5	39.5	58.0	40.4	35.1	10.5	80.0	60.3	50.0	*
	75+	61.4	85.0	122.2	*	112.6	157.0	51.3	154.1	38.4	*	*	*	60.6	84.4	*	*	39.3	51.6	20.6	*	88.5	54.3	29.4	60.0	67.5	51.7	67.8	88.0
	All ages	78.2	61.3	*	*	66.6	60.6	41.9	*	63.5	*	*	*	67.4	59.3	*	*	71.0	52.2	44.6	*	77.3	58.6	54.6	53.3	81.7	65.4	63.5	*
Skin (inc.melanoma)	15-44	42.1	42.2	42.3	*	77.8	57.5	57.8	58.3	82.5	51.9	52.2	53.0	24.4	24.5	24.5	15.8	45.5	31.3	*	*	100.2	100.6	101.0	*	75.7	75.9	56.5	46.1
	45-54	*	*	*	*	28.7	*	*	*	*	102.7	106.0	*	100.6	*	*	7.2	73.6	24.1	0.0	*	100.4	43.0	43.4	*	90.2	90.9	67.5	69.1
	55-64	102.1	*	*	*	48.7	23.4	25.2	*	77.8	26.4	*	*	101.4	86.4	52.9	*	101.3	4.1	*	4.7	84.8	40.6	*	*	85.7	77.9	58.8	*
	65-74	64.4	40.7	*	*	75.3	10.9	*	*	105.6	73.6	85.7	*	93.3	27.5	31.4	14.0	103.8	51.8	38.2	*	83.7	34.0	37.0	*	77.5	45.7	50.2	67.5
	75+	115.3	*	*	*	41.0	*	*	*	0.1	*	*	*	39.8	47.3	*	*	28.2	36.2	20.1	*	116.0	140.8	91.3	204.7	108.6	101.2	76.7	99.7
	All ages	62.2	*	*	*	57.7	*	*	*	*	*	*	*	69.5	*	*	*	73.6	31.6	*	*	95.9	70.5	*	*	85.2	76.4	60.4	*

* refers to cells where estimates are not computed due to insufficient sample size
Estimates for "all ages" are age standardised
Sites which have insufficient sample size for all cells are excluded from this appendix

RELATIVE SURVIVAL AND OBSERVED SURVIVAL BY PERIOD, SITE AND AGE GROUP — SINGAPORE MALES, 1973-2007

SITE	Age Group	Relative Survival (%)																									
		1973 - 1977				1978 - 1982				1983 - 1987				1988 - 1992				1993 - 1997				1998 - 2002				2003 - 2007			
		1 yr	3 yr	5yr	10 yr	1 yr	3 yr	5yr	10 yr	1 yr	3 yr	5yr	10 yr	1 yr	3 yr	5yr	10 yr	1 yr	3 yr	5yr	10 yr	1 yr	3 yr	5yr	10 yr	1 yr	3 yr	5yr	10 yr
Prostate	15-54	11.5	3.55	3.65	*	11.37	4.42	*	0.00	10.55	4.4	1.0	*	16.3	10.2	10.4	*	16.4	8.1	3.9	0.1	17.7	15.6	13.6	*	18.9	17.7	16.7	12.4
	55-64	13.1	12.24	12.13	7.76	16.14	10.87	9.49	2.31	17.52	10.8	7.7	7.3	19.1	14.6	10.9	5.1	20.8	15.0	13.1	9.6	21.7	19.1	17.0	16.9	22.8	21.1	20.5	18.5
	65-74	23.9	19.05	12.90	*	21.06	14.48	11.28	9.83	22.36	17.0	12.8	8.1	24.6	19.7	14.3	7.9	26.1	21.5	18.7	15.6	27.6	23.6	21.6	16.7	28.3	26.5	25.3	22.4
	75+	22.1	18.53	11.37	*	24.94	19.04	0.17	1.37	20.86	16.9	15.6	14.2	24.8	20.6	18.7	15.6	25.1	22.8	21.2	20.4	26.7	22.2	19.9	17.5	26.7	23.7	22.2	21.9
	All ages	70.6	53.4	40.0	*	73.51	48.81	*	13.51	71.28	49.2	37.0	*	84.9	65.1	54.4	*	88.5	67.4	56.8	45.8	93.7	80.5	72.2	*	96.6	89.0	84.7	75.2
Testis	15-44	45.9	46.1	46.4	47.2	75.4	54.5	54.7	55.7	94.1	80.4	67.2	68.1	92.7	90.3	87.5	75.9	96.2	94.3	92.2	90.5	98.5	95.6	92.7	88.4	96.7	96.9	97.1	97.9
	45-54	100.7	*	102.8	109.3	100.7	102.3	104.6	108.9	78.1	79.3	80.6	86.3	100.6	102.1	88.8	93.4	100.5	88.5	89.8	94.9	91.5	76.1	76.9	79.9	92.4	93.1	94.0	81.7
	55-64	9.0	9.2	9.8	12.1	102.0	*	*	0.0	76.0	40.1	42.9	*	62.5	64.6	45.1	55.6	72.8	52.7	54.2	35.3	83.1	72.7	61.0	67.1	83.3	84.8	87.1	97.8
	65-74	104.7	*	*	*	17.5	*	*	*	104.1	113.7	125.2	*	60.1	65.6	25.7	36.0	39.1	41.2	43.6	61.8	101.9	106.8	113.3	135.3	*	104.5	109.8	*
	75+	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	109.4	*	*	*	1.4	*	*	*
	All ages	49.0	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	97.7	*	*	*	*	*	*	*
Bladder	15-44	64.3	54.8	46.8	47.9	93.1	85.2	85.9	88.5	81.0	81.5	69.3	53.1	95.8	85.6	86.2	80.8	97.6	82.9	83.3	84.8	84.0	81.3	81.7	80.1	100.1	96.8	97.1	91.1
	45-54	73.6	56.3	50.1	36.5	82.6	66.2	60.8	41.5	92.0	82.4	75.8	66.8	90.1	85.4	81.8	72.7	90.7	86.7	85.3	87.6	94.7	89.8	88.5	80.9	90.1	84.8	84.4	76.0
	55-64	70.5	53.9	48.2	59.4	67.5	47.1	41.0	28.6	79.7	72.0	65.4	45.6	81.9	66.0	62.4	53.0	91.8	78.9	72.9	64.2	90.4	78.8	71.6	57.5	93.0	87.2	84.4	75.0
	65-74	38.3	27.5	22.4	*	66.0	51.5	51.2	66.5	82.2	63.8	54.4	46.9	84.0	69.8	61.8	60.8	78.4	63.9	55.1	49.6	80.1	65.4	62.5	62.5	87.4	78.0	72.6	66.3
	75+	36.7	26.8	19.7	*	59.0	53.9	45.7	*	68.1	50.5	43.4	19.5	83.1	62.9	57.2	112.5	73.9	67.3	68.7	118.5	75.8	60.2	62.3	69.8	82.8	71.7	71.3	69.4
	All ages	51.3	38.8	32.6	*	68.2	55.3	50.8	*	78.6	65.3	57.4	41.5	84.8	69.9	64.7	76.8	83.0	72.4	68.7	79.9	83.2	71.0	69.0	66.9	88.6	80.4	78.1	72.1
Kidney	15-44	56.4	46.4	37.2	*	86.5	65.9	66.4	67.8	54.4	45.9	35.1	8.4	63.3	63.6	63.9	65.1	87.8	74.7	70.1	59.1	81.5	67.9	54.7	47.4	88.4	81.0	77.5	63.0
	45-54	64.0	45.4	46.5	*	75.5	51.2	40.1	38.3	65.4	62.6	55.4	52.6	83.5	63.0	60.1	58.5	77.4	65.3	55.9	49.1	84.0	67.7	66.9	57.6	80.9	68.9	64.2	59.4
	55-64	49.4	33.3	31.7	*	47.5	46.4	27.9	26.8	55.1	35.4	23.9	13.7	61.4	52.7	39.4	33.9	61.5	38.4	40.1	30.4	75.1	66.7	59.7	59.3	74.7	66.8	59.3	56.1
	65-74	16.3	9.9	9.9	19.1	42.4	33.0	29.1	23.9	47.5	29.1	23.0	21.3	54.6	46.7	43.8	36.0	68.1	57.0	42.7	35.2	72.4	60.2	62.9	70.9	77.8	67.5	62.7	50.5
	75+	39.1	*	*	*	95.2	128.7	117.5	*	56.1	41.1	40.0	61.6	48.9	24.9	27.3	18.3	42.9	25.9	15.7	10.5	54.5	49.7	42.4	35.5	63.9	57.4	53.0	46.0
	All ages	39.1	*	*	*	65.9	68.3	58.4	*	54.4	39.2	32.9	34.1	58.6	44.9	41.4	35.1	61.8	45.9	37.8	30.3	69.9	60.1	56.1	54.7	74.2	65.5	60.3	52.4
Thyroid	15-44	94.4	94.9	95.4	97.3	90.7	81.3	81.7	83.1	100.2	97.3	97.7	93.5	94.7	95.0	95.4	96.4	98.3	96.7	92.5	93.6	100.2	100.5	100.9	102.0	95.8	94.7	93.7	93.0
	45-54	40.0	40.8	41.8	44.8	49.9	36.9	28.4	*	94.6	88.4	90.4	77.2	88.6	78.6	79.8	78.6	92.6	89.2	85.4	90.3	97.7	98.6	99.7	99.1	98.3	99.1	100.1	103.7
	55-64	51.5	54.7	58.1	*	72.8	51.8	55.2	*	78.0	81.5	73.5	47.3	72.4	70.7	65.0	56.7	94.4	93.9	92.3	108.6	92.6	84.1	74.2	64.7	92.9	95.1	94.5	82.9
	65-74	49.0	53.8	*	*	20.1	22.6	15.9	*	69.0	78.8	*	15.9	66.3	64.2	63.3	*	62.4	47.3	53.3	30.6	67.7	64.8	70.8	59.1	74.0	68.3	54.2	33.8
	75+	60.5	*	*	*	34.5	26.6	14.3	*	19.6	25.3	*	*	62.7	59.9	78.3	*	41.0	36.2	29.7	*	79.3	76.4	99.1	97.0	60.1	44.1	39.1	32.9
	All ages	62.3	*	*	*	58.0	48.2	44.5	*	77.0	78.7	*	*	78.8	76.0	77.6	*	81.3	76.5	74.6	*	88.7	86.2	88.8	84.4	86.2	83.2	79.4	72.4

* refers to cells where estimates are not computed due to insufficient sample size
Estimates for "all ages" are age standardised
Sites which have insufficient sample size for all cells are excluded from this appendix

RELATIVE SURVIVAL AND OBSERVED SURVIVAL BY PERIOD, SITE AND AGE GROUP — SINGAPORE FEMALES, 1973-2007

SITE	Age Group	Relative Survival (%)																											
		1973 - 1977				1978 - 1982				1983 - 1987				1988 - 1992				1993 - 1997				1998 - 2002				2003 - 2007			
		1 yr	3 yr	5yr	10 yr	1 yr	3 yr	5yr	10 yr	1 yr	3 yr	5yr	10 yr	1 yr	3 yr	5yr	10 yr	1 yr	3 yr	5yr	10 yr	1 yr	3 yr	5yr	10 yr	1 yr	3 yr	5yr	10 yr
Tongue	15-44	100.2	19.4	*	*	89.1	72.6	73.0	*	100.1	47.0	37.1	37.7	46.2	34.6	23.0	23.2	87.8	32.2	32.3	32.5	80.1	80.2	80.4	80.8	88.5	66.0	66.2	48.7
	45-54	100.7	101.6	102.3	110.1	82.5	62.8	63.7	66.6	38.6	24.9	25.2	26.3	87.8	42.0	42.3	6.0	65.7	66.1	66.7	47.6	68.4	54.4	54.7	38.0	100.2	69.5	60.9	53.6
	55-64	32.4	*	8.8	10.8	72.6	49.3	4.7	4.9	64.7	66.5	51.4	*	65.4	27.7	28.4	31.4	45.1	45.9	46.7	34.8	100.6	90.1	91.4	96.6	83.7	45.7	46.4	48.7
	65-74	104.0	56.2	34.5	*	87.1	36.9	*	*	51.5	41.6	46.0	*	52.3	55.7	29.7	38.0	89.9	78.3	84.0	106.1	88.9	23.5	24.9	16.1	89.6	72.0	75.0	45.0
	75+	106.1	52.7	*	*	1.7	1.8	2.2	*	14.1	*	*	*	60.1	44.2	*	*	66.5	76.5	66.1	*	77.7	49.6	46.6	33.9	38.1	34.0	32.1	22.4
	All ages	87.5	*	*	*	58.6	35.2	*	*	45.5	*	*	*	61.4	42.8	*	*	69.8	65.7	64.5	*	85.3	54.1	54.0	47.0	74.5	54.2	53.6	40.6
Salivary gland	15-44	80.2	80.5	80.8	81.6	100.1	91.8	83.3	33.7	100.1	81.1	81.4	70.2	100.1	92.9	93.1	81.1	100.1	93.7	88.3	88.8	100.1	100.2	93.9	94.4	100.1	95.2	95.4	96.0
	45-54	100.7	53.9	54.5	*	100.5	102.0	103.8	108.2	100.4	89.1	90.2	45.4	77.0	49.2	49.8	51.7	91.3	81.7	67.7	70.0	76.5	76.8	66.4	51.8	100.2	100.7	101.2	103.0
	55-64	81.1	83.8	87.7	*	101.9	105.0	35.5	25.9	101.5	76.1	79.6	91.8	84.5	72.1	40.0	33.6	89.3	90.6	92.6	99.6	91.9	93.2	94.7	82.8	85.9	65.3	66.4	70.3
	65-74	103.2	110.9	73.4	*	104.3	81.3	25.7	3.3	83.8	66.7	72.0	60.7	81.4	55.6	37.3	47.0	63.6	66.7	71.3	36.1	90.8	61.6	49.9	59.7	82.8	72.6	75.1	88.1
	75+	14.1	*	*	*	117.4	*	*	*	74.3	89.5	126.3	*	65.0	52.1	45.4	105.2	45.8	*	*	13.9	83.6	94.4	118.2	*	93.1	86.4	97.7	132.8
	All ages	70.3	*	*	*	106.8	*	*	*	88.3	79.2	92.3	*	78.1	60.2	45.7	63.7	70.2	*	*	52.0	87.9	82.9	85.1	*	89.8	79.9	84.2	99.3
Nasopharynx	15-44	81.3	59.0	44.2	39.5	89.0	62.2	48.1	35.9	86.9	65.5	55.6	46.9	90.9	75.2	65.8	55.2	95.5	76.3	64.7	48.7	95.3	88.5	79.1	70.1	97.5	91.0	77.6	64.1
	45-54	72.1	30.9	20.3	17.3	85.8	64.6	52.1	30.6	87.1	62.7	42.6	20.9	87.1	60.1	49.5	42.6	96.5	84.4	67.2	55.3	94.1	79.1	70.8	60.4	97.9	88.5	81.7	72.2
	55-64	72.7	45.2	32.5	5.8	77.6	45.6	37.3	21.2	87.7	57.3	37.2	17.1	87.5	72.0	48.1	34.3	89.2	71.0	66.0	57.8	95.0	87.8	82.2	66.0	96.6	85.6	74.3	54.6
	65-74	69.1	22.1	23.9	*	83.7	33.4	17.8	24.2	85.4	59.2	49.3	12.0	86.7	63.4	40.5	12.9	86.9	76.7	56.8	51.7	84.8	67.6	43.8	27.7	90.4	58.0	47.1	24.2
	75+	59.1	79.8	*	*	37.4	1.8	0.8	*	53.4	42.0	12.1	*	63.6	28.6	*	*	62.1	25.9	12.7	*	68.6	30.3	29.0	*	77.8	46.4	38.7	29.0
	All ages	72.4	46.8	*	*	77.8	44.9	33.8	*	82.1	58.7	42.2	*	84.9	63.1	*	*	87.9	69.6	56.5	*	89.2	74.4	64.3	*	93.2	76.6	66.1	50.6
Oesophagus	15-44	6.1	6.1	6.1	*	30.2	30.4	*	0.2	27.7	*	*	*	65.8	66.0	*	*	*	100.5	53.0	*	16.5	*	*	16.5	84.6	37.5	*	*
	45-54	15.3	2.0	*	*	33.6	11.8	12.0	*	30.3	*	0.1	0.1	41.6	28.4	28.7	*	37.7	*	12.1	*	75.2	41.8	42.1	*	100.2	100.6	45.9	47.1
	55-64	28.9	11.4	8.9	10.6	27.3	10.5	6.1	7.0	32.7	18.5	19.0	21.3	36.1	10.7	11.1	5.4	33.5	20.8	0.9	0.0	38.4	22.5	16.6	*	54.2	28.5	29.1	31.1
	65-74	14.8	8.1	8.9	*	20.1	7.5	4.1	0.7	30.1	12.0	8.3	*	30.9	9.4	8.2	2.3	42.1	16.3	17.5	3.0	46.8	26.7	21.4	11.9	39.8	14.0	9.6	9.1
	75+	4.7	*	*	*	23.0	6.7	*	*	22.8	11.5	11.1	*	22.1	4.4	5.2	9.7	16.5	*	2.1	1.8	20.4	10.3	12.3	*	25.8	11.1	7.6	11.7
	All ages	14.6	*	*	*	24.9	10.1	*	*	28.4	*	*	*	33.2	14.5	*	*	*	*	11.0	*	38.5	*	*	*	49.4	28.5	*	*
Stomach	15-44	35.2	9.3	5.9	*	24.3	11.4	7.2	6.3	48.6	29.2	27.6	14.3	43.5	24.4	21.9	21.1	48.0	29.1	21.0	18.6	45.9	30.8	27.9	23.0	51.8	29.4	28.2	22.0
	45-54	34.5	23.0	16.4	11.0	36.9	21.3	18.7	9.6	48.9	27.5	21.4	18.7	61.7	39.2	32.6	31.7	57.0	34.7	26.6	18.8	59.1	37.5	30.7	22.4	56.7	40.2	32.6	28.7
	55-64	23.5	8.9	6.2	5.3	35.1	17.8	15.4	10.2	42.9	23.6	19.6	13.8	42.4	22.0	18.8	13.4	61.5	41.1	31.5	23.5	55.1	39.0	34.7	30.8	62.0	34.6	30.9	24.4
	65-74	21.1	9.8	7.8	9.4	28.6	13.3	9.5	5.5	35.4	22.3	15.5	14.6	43.8	23.5	17.4	18.5	42.2	25.2	21.7	14.5	54.9	33.9	27.5	22.0	61.8	37.0	34.1	28.8
	75+	11.3	5.1	0.7	*	20.3	11.8	6.8	0.8	10.1	3.3	2.4	2.3	24.5	14.5	12.8	14.9	30.4	20.6	20.3	25.9	30.5	20.4	16.3	9.8	45.3	25.6	17.7	22.5
	All ages	21.4	9.8	6.3	*	28.4	14.7	11.0	5.8	32.3	18.2	14.2	11.3	40.0	22.5	18.5	18.1	45.4	28.9	24.1	20.7	47.7	31.4	26.3	20.6	55.7	33.0	28.0	25.5
Colon	15-44	65.2	36.9	37.1	*	61.0	46.5	38.8	36.3	76.2	47.0	42.4	41.1	75.2	61.4	47.2	42.0	78.7	58.0	50.3	46.9	91.0	69.1	59.7	59.0	89.7	68.6	58.7	55.1
	45-54	60.6	46.1	38.6	25.3	76.0	54.2	41.2	31.3	73.2	52.4	47.9	43.4	86.3	63.1	54.0	51.3	77.7	65.4	55.8	51.7	81.1	64.4	58.6	56.0	87.4	71.0	63.1	60.4
	55-64	53.3	37.6	34.6	40.0	65.4	43.4	34.4	38.7	68.7	43.7	41.4	38.1	75.1	57.5	51.3	43.9	78.4	66.1	58.8	52.6	79.3	60.3	50.6	43.9	84.8	70.1	62.8	56.5
	65-74	46.6	37.6	32.4	15.9	49.0	33.4	32.6	28.2	64.1	46.0	35.3	34.3	72.4	54.1	43.6	39.5	76.3	58.5	53.6	50.8	75.1	59.3	51.2	45.4	82.7	66.4	59.0	54.2
	75+	24.0	20.2	21.0	*	28.4	18.9	13.6	25.5	43.6	34.4	33.3	45.1	60.8	53.3	48.2	50.3	62.8	54.2	48.4	52.5	62.0	50.4	46.7	33.3	68.0	55.2	49.4	53.1
	All ages	44.6	33.5	30.7	*	50.9	34.9	29.0	30.8	61.2	42.9	38.1	39.9	71.5	56.2	48.2	45.2	73.2	59.8	53.3	51.6	74.1	58.2	51.3	43.8	80.0	64.7	57.5	55.2
Rectum	15-44	59.8	28.9	20.7	21.2	60.9	27.4	21.6	16.4	70.9	30.2	28.2	25.6	79.1	60.4	49.1	45.4	88.7	69.5	54.7	50.7	82.4	59.6	52.1	44.8	84.3	65.3	62.0	55.2
	45-54	51.7	19.0	19.3	18.4	69.2	45.0	34.8	26.9	75.4	45.9	36.9	29.0	84.9	61.8	44.6	33.8	77.8	61.2	58.6	50.6	86.0	71.3	68.1	53.0	88.3	74.8	64.9	55.3
	55-64	55.6	32.7	30.3	30.5	68.1	39.9	26.0	19.2	78.5	57.9	46.8	35.0	81.2	54.3	42.2	34.7	82.8	63.5	54.2	49.6	85.8	68.6	57.8	46.9	84.7	68.6	61.8	56.9
	65-74	45.0	19.7	19.0	*	62.2	38.8	31.8	21.5	72.4	45.1	33.4	27.6	77.7	48.5	35.9	30.0	79.9	67.0	61.7	54.3	80.0	63.7	55.9	52.5	83.7	68.3	64.1	61.5
	75+	38.8	22.2	14.5	24.5	50.0	30.2	19.7	38.2	55.2	36.6	33.9	10.1	56.8	38.7	32.6	34.4	66.7	56.7	51.1	41.0	69.1	56.5	51.6	39.5	73.4	54.5	47.4	52.8
	All ages	47.5	24.0	20.4	*	60.8	36.5	26.6	26.1	69.1	44.6	36.7	24.3	73.4	49.4	38.3	33.9	77.1	62.7	56.0	48.7	79.1	63.4	56.3	47.0	81.6	64.9	58.7	56.7

* refers to cells where estimates are not computed due to insufficient sample size
Estimates for "all ages" are age standardised
Sites which have insufficient sample size for all cells are excluded from this appendix

RELATIVE SURVIVAL AND OBSERVED SURVIVAL BY PERIOD, SITE AND AGE GROUP — SINGAPORE FEMALES, 1973-2007

SITE	Age Group	Relative Survival (%)																									
		1973 - 1977				1978 - 1982				1983 - 1987				1988 - 1992				1993 - 1997				1998 - 2002				2003 - 2007			
		1 yr	3 yr	5yr	10 yr	1 yr	3 yr	5yr	10 yr	1 yr	3 yr	5yr	10 yr	1 yr	3 yr	5yr	10 yr	1 yr	3 yr	5yr	10 yr	1 yr	3 yr	5yr	10 yr	1 yr	3 yr	5yr	10 yr
Liver	15-44	15.6	6.6	0.3	*	27.5	11.6	11.6	*	12.0	5.2	5.2	3.2	16.5	0.1	*	0.1	25.6	8.3	*	*	55.9	29.7	29.7	*	66.0	34.2	29.0	23.8
	45-54	4.8	3.2	1.6	*	6.8	2.2	2.3	*	5.0	*	0.6	0.6	16.7	6.6	*	6.8	10.8	7.2	7.2	*	39.7	23.0	16.3	5.3	41.3	23.2	23.3	23.7
	55-64	4.4	3.0	2.1	*	13.2	13.6	9.3	4.4	2.7	0.7	0.7	0.1	4.2	0.3	0.3	0.3	11.8	5.8	2.5	2.7	35.6	18.1	15.9	*	35.5	26.1	17.1	11.7
	65-74	1.3	0.8	0.7	*	2.1	0.6	0.7	0.5	2.9	1.8	1.5	2.0	7.2	3.2	3.4	3.5	7.9	3.6	1.9	2.3	22.8	11.2	7.7	4.6	38.8	22.0	14.8	12.8
	75+	*	*	*	*	0.4	*	*	*	0.7	*	*	*	6.8	1.0	*	*	8.5	3.1	1.4	*	7.5	3.2	2.4	*	23.3	9.8	5.6	4.9
	All ages	3.1	*	*	*	6.5	*	*	*	3.1	*	*	*	8.2	2.1	*	*	10.6	4.7	*	*	25.6	13.2	10.6	*	35.7	20.4	14.7	12.3
Pancreas	15-44	44.4	10.4	10.5	10.5	0.7	0.7	0.7	0.7	21.0	21.0	21.1	21.2	25.5	9.9	9.9	10.0	10.9	11.0	11.0	11.0	61.9	28.6	28.7	28.8	59.7	49.0	49.1	49.4
	45-54	4.2	*	0.1	0.1	1.6	1.6	*	1.7	35.7	13.6	13.8	*	24.4	16.7	12.9	13.6	10.6	1.4	1.4	1.2	23.8	14.1	*	6.7	46.2	18.8	18.9	*
	55-64	10.1	*	*	*	9.3	4.7	4.8	*	15.7	3.4	3.6	1.3	8.3	1.7	0.5	*	19.1	8.4	8.6	*	24.9	9.1	5.1	*	26.6	9.7	6.5	4.8
	65-74	2.6	1.0	1.1	*	18.2	11.6	13.0	*	15.6	4.9	5.5	7.7	8.5	1.4	1.0	1.4	5.2	2.6	2.8	*	12.7	5.4	4.1	*	23.2	8.6	6.8	5.3
	75+	0.8	*	*	*	1.2	*	*	*	2.3	0.3	*	*	13.6	2.5	*	*	5.9	2.5	3.0	*	3.1	1.2	1.5	2.8	10.7	2.7	1.3	2.8
	All ages	6.9	*	*	*	8.0	*	*	*	14.5	5.4	*	*	13.0	4.2	*	*	9.6	4.3	4.6	*	17.5	7.7	*	*	25.7	11.2	9.5	*
Larynx	15-44	100.2	41.9	*	*	28.2	28.3	28.5	*	100.2	100.4	100.7	102.7	100.2	*	*	31.0	52.4	52.5	52.7	*	*	*	100.2	101.1	100.1	100.3	*	100.6
	45-54	100.5	77.0	59.2	*	52.9	12.2	12.4	7.9	59.3	60.2	38.4	*	100.3	101.0	102.3	107.9	100.3	101.0	55.7	57.8	100.2	100.6	101.0	102.5	100.2	100.6	101.1	102.8
	55-64	72.5	37.3	27.0	20.9	64.9	41.6	33.7	39.8	101.3	68.3	47.6	39.9	89.6	78.7	61.1	56.2	101.0	88.0	77.8	63.5	59.3	60.2	43.6	39.2	100.5	101.8	104.0	111.4
	65-74	82.3	90.4	101.4	*	103.0	110.5	76.7	12.0	67.3	55.7	37.6	30.0	84.4	50.8	36.2	14.8	79.2	60.4	38.5	19.5	81.5	84.3	78.0	45.0	90.9	85.5	67.6	34.7
	75+	*	*	*	*	59.0	19.8	*	*	81.3	56.9	40.5	*	53.6	32.9	32.7	*	81.6	37.9	10.1	0.3	68.5	53.4	42.6	60.2	56.8	45.0	37.4	70.0
	All ages	59.6	*	*	*	70.2	50.8	*	*	80.5	62.6	45.2	*	79.7	*	*	*	85.6	64.5	42.4	*	*	*	64.1	58.9	85.0	80.3	*	75.4
Lung	15-44	32.9	18.1	18.2	*	28.4	12.5	12.5	12.8	34.3	15.6	15.6	8.8	46.9	21.5	17.7	6.5	41.8	17.6	15.5	10.8	55.7	18.0	14.7	11.0	64.6	31.9	14.6	12.1
	45-54	25.1	11.7	10.5	8.4	20.7	4.8	2.3	1.2	29.5	13.1	9.6	10.1	31.1	7.7	7.0	4.4	45.4	20.5	11.0	7.6	59.0	31.6	26.4	19.3	58.1	25.3	16.3	11.0
	55-64	14.5	5.7	5.4	5.7	19.0	8.9	6.6	4.9	19.0	10.9	6.0	4.1	30.4	13.5	13.2	8.9	42.3	13.3	10.5	7.1	42.8	18.3	12.7	7.5	57.6	27.8	19.7	13.2
	65-74	10.5	2.8	2.6	3.0	16.6	5.7	3.4	1.2	18.9	4.2	3.7	3.2	21.2	7.1	4.7	2.5	31.2	11.3	9.3	4.3	30.3	13.3	9.1	6.5	44.2	21.5	17.4	14.0
	75+	10.5	5.1	3.0	*	7.9	2.8	2.0	*	7.8	2.0	2.2	0.1	8.0	2.2	1.3	*	14.3	4.7	2.1	0.6	15.7	7.1	6.3	5.8	23.9	8.3	5.2	7.4
	All ages	14.7	6.3	5.4	*	15.9	6.0	4.3	*	18.1	7.0	5.3	3.7	22.5	8.2	6.9	*	31.3	11.4	8.1	4.7	34.2	15.2	11.6	8.4	44.5	20.3	14.1	11.4
Bone	15-44	68.2	45.6	45.6	*	90.1	84.6	67.2	67.5	96.0	79.3	75.1	68.3	88.1	73.0	68.8	57.9	85.8	77.5	77.6	70.6	83.6	71.2	66.1	56.3	95.1	82.9	83.1	72.6
	45-54	39.4	*	*	*	*	*	*	*	100.5	59.1	*	*	53.2	29.4	13.3	*	60.8	61.2	61.9	63.1	84.2	66.1	5.4	5.5	100.2	78.5	78.9	*
	55-64	*	*	*	*	21.5	22.1	*	*	101.1	103.8	106.8	*	45.2	46.0	47.0	51.4	74.6	75.6	76.8	82.6	100.4	101.6	73.1	76.3	71.9	19.6	8.8	9.2
	65-74	*	*	*	*	77.9	29.9	*	*	102.0	*	*	*	6.7	7.0	7.3	*	102.7	109.0	*	132.4	*	102.5	108.6	*	101.7	35.4	36.9	42.3
	75+	*	*	*	*	*	*	*	*	*	*	*	*	116.6	*	*	*	49.5	69.9	97.3	*	85.8	7.6	*	19.9	77.8	0.0	*	*
	All ages	*	*	*	*	*	*	*	*	*	*	*	*	60.9	*	*	*	77.5	79.6	*	*	*	74.0	*	*	90.0	47.8	*	*
Connective tissue	15-44	79.0	79.1	79.2	46.4	80.8	56.0	49.7	40.4	85.1	65.1	65.3	65.6	88.4	72.4	67.0	55.7	82.0	68.0	64.1	59.5	92.8	80.3	72.5	68.4	91.1	80.5	73.8	74.2
	45-54	86.1	70.6	71.6	*	51.1	51.7	39.6	41.6	76.7	63.3	64.1	67.2	88.7	56.6	57.1	44.3	71.5	56.1	56.5	58.2	77.5	70.2	70.6	58.8	62.5	59.5	59.8	56.3
	55-64	58.2	44.0	45.3	*	73.0	61.3	41.6	28.7	71.5	73.2	74.9	53.8	100.9	80.0	82.3	73.7	80.9	82.4	84.7	82.8	72.7	73.6	74.7	68.1	73.1	62.6	63.6	58.2
	65-74	44.1	50.7	54.0	*	37.3	40.9	46.8	*	103.3	88.8	99.1	80.6	94.5	73.4	23.5	31.7	69.0	43.7	36.3	39.4	57.4	47.8	49.9	47.3	74.3	52.5	55.2	65.6
	75+	*	*	*	*	118.8	79.0	*	165.5	59.2	77.4	116.4	*	26.5	29.7	25.0	*	64.1	4.2	*	*	48.1	37.6	24.8	*	59.4	64.0	58.6	63.6
	All ages	57.8	*	54.7	*	70.7	56.6	*	*	80.8	73.0	81.0	*	83.6	65.5	53.9	*	74.9	55.2	*	*	72.7	64.7	61.4	*	74.6	65.3	63.4	64.6
Skin (inc.melanoma)	15-44	100.2	51.8	52.0	*	100.2	100.6	101.2	*	100.2	68.9	69.0	70.2	43.0	27.3	27.4	17.0	91.9	61.4	45.3	*	88.0	77.4	59.7	45.1	100.1	90.8	91.0	91.3
	45-54	100.5	68.6	0.0	*	100.6	101.9	16.7	*	32.9	33.3	33.9	*	34.3	9.5	*	9.8	100.3	56.2	*	*	85.9	86.4	48.5	*	66.6	32.0	23.9	24.4
	55-64	85.2	19.5	0.0	*	9.1	*	*	*	101.8	104.6	108.2	*	78.7	10.5	*	11.5	86.8	62.3	63.7	*	100.4	70.2	61.5	44.9	82.4	68.8	69.7	42.2
	65-74	69.2	*	*	*	31.9	*	*	*	55.5	58.4	*	*	73.8	43.0	17.2	*	68.5	72.4	77.1	*	101.6	88.8	93.0	110.0	75.8	78.6	63.9	52.5
	75+	106.8	128.9	0.1	*	75.9	93.4	125.6	*	90.9	57.6	*	*	84.2	49.4	59.0	*	65.5	21.8	26.8	34.9	87.5	39.4	48.3	80.3	80.6	51.3	26.9	57.3
	All ages	91.8	*	*	*	64.1	*	*	*	78.8	66.7	*	*	60.9	27.0	*	*	77.3	52.7	*	*	92.9	74.4	63.2	*	83.1	68.2	60.7	57.1

* refers to cells where estimates are not computed due to insufficient sample size
Estimates for "all ages" are age standardised
Sites which have insufficient sample size for all cells are excluded from this appendix

RELATIVE SURVIVAL AND OBSERVED SURVIVAL BY PERIOD, SITE AND AGE GROUP — SINGAPORE FEMALES, 1973-2007

SITE	Age Group	Relative Survival (%)																									
		1973 - 1977				1978 - 1982				1983 - 1987				1988 - 1992				1993 - 1997				1998 - 2002				2003 - 2007			
		1 yr	3 yr	5yr	10 yr	1 yr	3 yr	5yr	10 yr	1 yr	3 yr	5yr	10 yr	1 yr	3 yr	5yr	10 yr	1 yr	3 yr	5yr	10 yr	1 yr	3 yr	5yr	10 yr	1 yr	3 yr	5yr	10 yr
Female breast	15-44	84.6	68.7	57.8	49.0	90.5	67.6	58.5	44.9	91.6	69.6	61.1	49.5	95.4	79.4	67.2	57.5	95.2	85.3	75.5	64.3	97.7	89.4	80.6	70.5	98.5	92.2	87.5	80.0
	45-54	83.8	54.2	48.5	42.7	83.2	61.7	51.3	44.7	89.3	71.5	58.7	46.7	94.1	80.3	71.6	58.5	96.2	86.4	79.3	70.2	96.6	88.2	82.0	71.6	97.5	91.4	86.0	78.9
	55-64	80.4	58.0	46.2	27.5	81.6	50.1	40.0	31.0	86.5	66.8	57.3	47.0	90.0	72.6	61.6	42.9	95.4	82.4	74.3	60.4	95.5	85.7	79.8	66.0	96.0	87.7	80.7	73.0
	65-74	79.5	67.7	60.0	69.5	81.0	62.1	52.1	45.9	85.7	70.0	59.4	46.5	91.4	76.1	67.6	60.4	92.2	81.5	73.6	60.8	93.9	85.4	77.8	65.3	94.9	86.0	78.1	69.5
	75+	81.6	46.0	38.3	25.5	84.5	65.7	56.4	79.5	75.4	66.2	46.9	47.0	79.3	67.8	57.9	55.2	79.2	71.0	75.6	68.7	91.1	75.4	69.8	56.8	88.4	75.0	64.8	56.9
	All ages	81.2	57.6	49.0	42.4	83.1	60.7	50.9	52.0	83.7	68.3	55.3	47.0	88.2	73.6	63.8	54.4	89.9	79.5	75.1	64.4	94.1	83.2	76.6	64.1	93.8	84.3	76.4	68.5
Cervix	15-44	86.6	69.8	61.8	56.4	84.3	65.0	60.5	55.4	90.7	73.2	64.8	61.8	90.6	73.0	66.3	63.1	89.7	78.8	73.9	70.2	94.8	84.6	81.8	77.5	92.8	83.2	83.4	81.4
	45-54	79.7	56.1	51.8	49.2	80.3	61.6	52.9	45.2	81.8	58.1	49.7	43.9	89.2	73.6	65.2	57.1	88.0	71.8	66.1	60.7	89.6	76.0	66.7	61.1	93.6	79.5	74.8	68.9
	55-64	75.6	51.5	42.0	38.2	75.4	53.1	44.8	37.0	84.8	61.2	51.6	46.2	87.4	68.3	59.3	42.5	85.2	65.7	59.4	48.7	83.2	67.0	61.2	55.7	87.3	70.1	66.8	57.1
	65-74	63.9	42.0	36.9	41.1	75.8	51.8	47.4	40.9	76.9	39.6	27.8	25.5	79.9	52.3	50.6	40.0	77.8	61.4	52.9	44.0	81.7	61.8	56.4	48.0	78.9	64.2	59.8	48.8
	75+	60.9	37.3	38.9	36.6	66.8	34.8	24.4	17.5	69.6	43.4	37.4	53.7	66.9	38.4	37.6	23.0	76.8	54.0	47.6	31.5	67.5	56.0	55.5	56.6	65.0	39.2	32.7	30.0
	All ages	75.0	53.5	47.8	45.5	77.6	55.1	48.2	41.6	82.2	57.2	48.2	47.1	84.2	63.1	57.5	47.5	84.3	67.9	61.6	53.4	85.0	70.9	66.1	61.3	85.1	69.9	66.6	60.5
Corpus uteri	15-44	83.5	64.5	58.0	59.4	93.8	84.0	84.4	79.6	92.2	79.0	76.5	67.6	93.4	90.9	91.2	87.9	96.6	92.9	89.8	88.0	96.2	91.4	87.6	84.4	99.1	97.3	95.3	93.8
	45-54	77.0	65.2	63.3	67.2	86.3	76.0	70.8	66.9	90.1	84.5	83.6	79.6	95.0	89.4	87.9	85.7	95.8	89.3	85.1	82.0	96.0	90.4	86.2	82.5	95.4	90.2	88.4	87.6
	55-64	69.0	50.5	43.8	49.6	76.7	62.4	54.8	50.9	82.3	69.7	70.1	64.8	84.4	73.3	70.1	63.4	90.0	77.1	72.5	74.8	90.7	78.7	76.8	73.2	92.9	84.1	79.6	76.4
	65-74	47.1	26.6	28.9	20.2	78.3	77.7	86.4	23.3	85.1	65.7	62.8	59.9	82.6	70.3	61.8	52.1	81.5	62.8	65.1	65.5	79.8	67.4	61.0	60.6	89.7	75.2	71.2	66.5
	75+	92.1	57.2	70.8	*	68.4	23.0	30.3	66.7	69.6	66.3	57.3	75.6	45.8	28.1	29.1	51.0	79.0	67.4	34.4	17.4	72.3	63.2	54.8	30.3	74.4	49.2	48.9	55.5
	All ages	71.3	48.3	50.7	*	77.1	58.6	60.8	51.4	81.0	70.0	66.3	68.5	74.6	62.5	59.4	60.9	85.5	72.7	62.0	57.3	83.2	73.2	67.7	59.0	87.3	73.1	70.4	70.0
Ovary	15-44	83.8	67.7	64.6	57.6	83.4	66.9	64.9	59.8	89.5	72.3	71.8	68.1	93.3	84.2	79.7	78.1	93.3	87.1	84.2	80.0	95.8	87.1	84.6	80.3	95.2	88.6	82.7	78.7
	45-54	75.2	53.4	44.6	*	67.0	49.7	43.7	40.3	72.9	56.3	53.7	48.3	81.9	64.3	57.3	47.0	85.9	72.0	64.3	56.8	86.8	72.0	64.8	53.5	91.2	75.9	66.7	61.9
	55-64	62.9	46.3	41.1	28.9	56.6	35.6	32.9	32.3	72.1	45.4	39.7	36.8	82.2	64.1	55.2	49.4	83.8	57.8	50.9	40.2	83.7	67.2	55.7	51.8	88.4	68.5	60.9	51.8
	65-74	42.9	36.7	41.0	*	52.4	33.1	32.5	14.3	51.1	38.7	30.6	24.3	61.2	54.5	46.9	47.5	73.1	59.0	50.3	45.6	80.5	51.1	41.6	35.4	74.0	51.2	41.1	32.3
	75+	26.9	*	*	*	48.6	32.5	32.9	*	33.1	15.5	20.2	*	48.2	34.9	42.8	33.6	34.3	33.7	35.2	28.5	52.3	29.0	23.3	24.9	54.1	40.3	35.4	40.1
	All ages	49.6	*	*	*	56.2	37.8	36.3	*	56.0	38.0	35.3	*	67.0	54.3	51.2	46.0	67.3	54.9	50.1	43.2	74.9	53.4	45.3	41.4	75.1	57.6	50.0	45.8
Bladder	15-44	100.1	100.6	101.3	*	100.2	*	*	*	73.5	45.7	45.8	*	100.1	82.9	83.2	84.1	84.9	69.9	70.1	70.7	83.4	61.0	61.1	61.4	91.4	91.6	91.7	92.1
	45-54	52.6	53.4	54.3	*	27.8	3.6	0.1	*	72.3	29.8	30.3	*	64.4	47.8	48.3	50.6	78.2	66.4	67.1	55.0	94.6	83.2	83.7	70.6	76.9	71.6	67.6	69.0
	55-64	41.4	33.3	35.0	*	59.0	44.3	46.0	38.6	54.2	50.7	52.5	59.1	86.3	63.8	47.8	46.5	85.2	64.5	66.0	65.2	78.9	67.1	68.2	67.0	82.6	74.7	67.1	66.9
	65-74	52.0	44.8	33.9	0.1	52.1	39.4	30.2	20.9	58.6	54.9	42.5	30.5	56.4	35.2	33.9	22.4	75.6	53.5	42.0	33.6	87.6	80.6	81.1	72.2	78.4	69.7	63.0	54.0
	75+	57.0	47.1	59.8	*	57.9	54.9	43.8	66.5	33.1	28.0	13.7	0.0	69.3	50.7	42.2	45.7	67.9	49.4	26.4	19.6	56.7	54.2	51.9	21.7	78.8	66.9	61.3	49.5
	All ages	54.4	47.7	48.8	*	55.8	*	*	*	52.9	42.5	35.2	*	71.0	51.1	44.7	42.4	76.5	57.5	47.9	42.0	77.2	68.8	68.6	55.4	80.2	71.8	66.0	60.1
Kidney	15-44	24.4	24.5	24.6	24.8	71.1	71.3	71.7	72.7	81.2	81.4	81.7	27.5	68.9	54.2	41.5	41.9	77.8	66.7	51.4	51.8	78.9	72.1	72.2	67.4	86.1	83.1	80.4	65.6
	45-54	82.6	44.0	44.7	*	51.8	44.0	34.6	36.5	67.5	58.7	59.4	61.9	93.6	46.3	39.3	25.7	84.0	84.6	79.6	82.3	70.4	62.3	54.1	48.7	87.1	79.6	75.4	69.1
	55-64	26.7	17.0	17.6	*	45.4	47.2	27.5	31.1	43.5	44.9	39.0	20.6	90.0	85.2	87.7	73.2	70.6	57.7	52.2	44.6	85.3	67.1	63.3	59.8	86.6	74.5	69.0	65.1
	65-74	57.0	41.3	2.9	*	33.8	3.9	4.7	*	59.0	29.0	24.6	*	67.7	52.0	43.0	46.1	78.0	57.3	53.8	42.8	69.8	52.9	47.6	20.2	72.0	60.1	46.2	44.3
	75+	57.5	35.8	44.4	*	5.7	8.3	10.8	23.8	57.9	38.6	58.3	167.6	65.7	57.9	63.3	200.5	42.0	19.7	18.6	15.0	54.0	30.8	28.9	15.0	53.3	42.4	41.7	5.7
	All ages	51.0	33.3	24.9	*	33.1	24.7	20.0	*	57.7	42.7	45.8	*	75.4	60.8	58.6	94.4	66.6	50.4	46.1	40.5	69.5	52.2	48.3	34.5	72.7	62.2	56.0	42.3
Thyroid	15-44	95.9	93.3	86.0	83.6	98.1	96.1	96.4	95.7	99.5	99.8	100.0	100.8	99.6	99.8	99.5	99.3	99.3	98.6	98.4	98.5	100.1	99.9	99.6	98.3	100.1	99.6	99.7	98.3
	45-54	84.2	76.1	77.1	80.9	79.0	79.9	80.9	70.5	95.0	95.9	96.9	101.2	95.7	92.2	90.1	93.0	95.4	94.6	93.9	90.3	98.0	98.4	94.6	90.5	98.3	98.1	95.1	95.1
	55-64	75.9	67.4	55.5	49.8	70.0	72.5	60.1	39.7	72.6	69.7	67.5	64.5	89.7	89.1	87.3	83.7	95.2	97.1	90.3	81.4	90.8	84.7	81.3	78.1	97.3	93.7	93.6	89.6
	65-74	41.0	36.7	41.5	*	58.9	32.7	27.8	14.1	65.0	52.2	55.8	*	67.6	54.7	53.8	29.0	82.0	84.2	82.8	49.5	81.6	73.6	65.6	59.6	82.9	74.1	67.6	51.7
	75+	106.9	127.1	0.4	*	31.3	27.7	*	*	30.4	27.8	33.4	*	23.3	17.2	20.2	16.9	40.9	39.8	49.5	92.6	70.7	64.0	45.4	20.0	49.2	40.0	39.9	24.8
	All ages	80.3	78.4	57.2	*	71.8	66.1	*	*	76.5	73.2	74.5	*	79.8	75.7	75.1	69.3	86.1	86.5	85.9	82.9	90.0	86.2	80.5	74.0	88.6	84.6	82.8	76.3

* refers to cells where estimates are not computed due to insufficient sample size
Estimates for "all ages" are age standardised
Sites which have insufficient sample size for all cells are excluded from this appendix

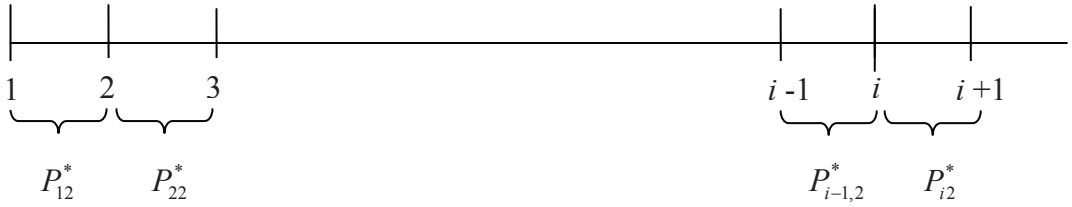
APPENDIX B

Computation of the Expected Survival Rate, Confidence Interval, and Age Standardised Estimate

(A) Computation of the Expected Survival Rate

The Ederer II method is outlined below:

Suppose that we want to estimate the cumulative expected survival from the start of follow-up to the end of the i^{th} sub-interval (in our case, one interval length is one year). Then, we calculate ${}_1P_i^* = \prod_{j=1}^{i} P_{j2}^*$,which is the i^{th} year cumulative survival proportion, where $P_{j2} = \sum_{h=1}^{l_j} \frac{P_j^*(h)}{l_j}$ is the average of the one-year expected survival probabilities of the patients alive at the start of the j^{th} interval. $P_j^*(h)$ is the expected survival probability of the h^{th} patient in the j^{th} interval; and l_j is the number of patients in the j^{th} interval.



The *i*-year cumulative expected survival is then = P_{12}^* x P_{22}^* x … x $P_{i-1,2}^*$ x P_{i2}^*

(B) Computation of the Confidence Interval

(i) Working on the assumption that the estimated survival rate is normally distributed, the 2-sided 100(1-α)% confidence interval for cumulative relative survival can be computed as

$$\hat{CSR} \pm z_{\alpha/2} SE(\hat{CSR})$$

SE($\hat{CSR}$) is the standard error for cumulative relative survival using Greenwood's formula

Note: This computation method can also be applied to interval-specific relative survival or the cumulative observed survival.

(ii) In the event that the upper and lower bounds are out-of-range (i.e. exceed the range of 0 and 1), the complementary log-log transformation is used.

Then, the 2-sided 100(1-α)% confidence interval for cumulative relative survival can be written as

$$\frac{1}{Expected\ Survival\ Rate}\{\log(-\log(\text{Cumulative OSR})) \pm z_{\alpha/2}SE(\log(-\log(\text{Cumulative OSR})))\}$$

Using Taylor series, the standard error of the complementary log-log transformed observed survival rate can be approximated by $\frac{SE(OSR)}{OSR * \log(OSR)}$ [1]

(C) Computation of the Age Standardised Estimate

The procedure to obtain age-standardised survival estimates is shown below.

Suppose there are J age classes and K population strata.

Cumulative i-year age-standardised relative survival estimates for the k^{th} population stratum are formulated as:

$$ASRS_{ik} = \sum_{j=1}^{J} \frac{M_j}{M} R_{ijk},$$

where R_{ijk} is the cumulative relative survival estimate at the end of the i^{th} year of follow-up for age class j and k^{th} population stratum;

$M_j = \sum_j m_{jk}$ is the number of patients in age class j;

$M = \sum_j M_j$ is the total number of patients, summed across all age classes.

M_j and M are independent of population strata.[2]

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