RESEARCH COMMUNICATION

Survival Analysis of 2003-2005 Data from the Population-based Cancer Registry in Macao

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Abstract

Aim: Macao Cancer Registry was established in 2003. It is population-based and has been collecting cancer reports from all possible settings where pathological and management services are available. To get a better idea over the prognosis and survival of all and major cancer sites, a survival analysis was here performed to estimate the relative survival rates of cancers diagnosed and registered during 2003 to 2005 with a follow-up of vital status till 31 Dec, 2008. Methods: 3,244 cancer cases diagnosed and registered during 2003-2005 in Macao Cancer Registry were considered for analysis. Cases of in-situ carcinoma, extreme age and poor data quality were deliberately excluded, leaving 2,623 newly diagnosed cancers eligible. Vital status of registered cases through 31 December 2008 was confirmed by matching with death certificates and review from the Hospital Information System (HIS) of the only public hospital. Observed survival rates were calculated using a Life Table method, and relative survival rates were examined using an algorithm written in SAS by Paul Dickman with minor adaptations. Apart from general relative survival rates, specific rates by sex and age strata were also estimated. Results: 3-year and 5-year relative survival rates of all cancers were 61% and 56% respectively for both sexes; (54% and 47%, respectively, for males and 68% and 64%for females). The 3-year relative survival rates for major cancer sites ranged from 21% to 90%, with lung cancer showing the lowest and female breast cancer the highest. 5-year relative survival rates for major cancer sites ranged from 18% to 85%, with liver cancer showing the lowest and again female breast cancer the highest. Female cancer patients had higher relative survival than males across the 5-year follow up period, with a sex difference of nearly 15%. Conclusion: Comparison of survival rates from this first trial in Macao, deriving survival statistics from population-based cancer registration, with other Asian countries/cities, like Taiwan, Singapore and Japan, showed Macao and Taiwan to have the closest estimates for 3-year relative survival. Random variation was found to exist in the stratification of sex and age in certain cancer sites due to scarce case numbers in the subgroups. It is important to note that the 3-year survival rates are relatively more consistent and reliable than 4-year or 5-year ones. Promotion of reporting cancer stage by physicians as well as improvement in data quality of cancer registration are essential to allow further informative statistics derived from the cancer registry with reference to cancer prevention.

Keywords: Relative survival - population-based cancer registry data - Macao

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Introduction

Macao is one of the two special administrative regions of the People's Republic of China. It lies on the western side of the Pearl River Delta, bordering Guangdong province in the north and facing the South China Sea in the east and south. The average mid-year resident population in 2003-2005 of Macao is 475 thousands, with 52% females and 48% males; 18% of the population were aged 0-14 and 7.4% were 65 years and above. 95% of Macao's population is Chinese; another 2% is of Portuguese and/or mixed Chinese/Portuguese descent.

Macao is served by one major public hospital, the Hospital Conde S. Januário (CHCSJ), and two major private hospitals. They are the Kiang Wu Hospital and the Macao University of Science and Technology Hospital, which has only been recently established in 2006. Pathological units and services are only available in Hospital Conde S. Januário and Kiang Wu Hospital. The public hospital provides free health and medical services for pregnant women, elderly people over 65, children under 10, primary and secondary school students, civil servants, and patients suffering from contagious diseases, cancer and psychiatric disorders. Destitute individuals or families, drug addicts and prisoners are all beneficiaries of free medical care. The government subsidized the "Hospice and Palliative Centre", which was established by the Social. Welfare Bureau, the Health Bureau and the Kiang Wu Hospital, and started providing hospice care to terminal patients in 2000. In addition to hospitals, Macao also has 6 health centers providing free basic medical care to all local residents.

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Cancer has been the top leading cause of death in Macao since 2001, claiming nearly 500 deaths every year. To systematically monitor and track the trend of cancer incidence and mortality, and provide a solid basis for establishing preventive measures on cancer control, the Health Bureau of Macao established the population-based Cancer Registry in 2003. Data registered are mainly reports submitted by the two local hospitals, Hospital Conde de S. Januário (CHCSJ) and Kiang Wu Hospital, which are the only two establishments where advanced and accurate pathological diagnosis can be obtained. Hence, their reporting cases almost cover all the possible cancer cases occurring in Macao. For annual analysis purpose, information on cancer-caused death certificates is also registered in the system.

Since the establishment of the registry in 2003, around 1000 incident cases and 500 dead cases of cancer are registered every year. The average annual incidence and mortality of cancer in 2003-2005 is 202 and 81 per 100,000 persons, respectively. Data of cancers occurred in Macao population has been accumulating. However, there has not been any information on cancer survival statistics in Macao. To fill the gap in information and knowledge and for getting a better idea over the prognosis and survival of all cancers sites and major cancer sites of Macao, a survival analysis is performed to estimate the survival probability of cancers diagnosed and registered during 2003 to 2005 with a follow-up of vital status till 31 Dec, 2008.

Materials and Methods

Data sources and collection

All cancer cases recruited in this study were those diagnosed during 2003-2005 and registered in the Macao Cancer Registry. All of them meet the criteria of reportable cancers, which were coded as C00~C97, D00~D09, D30 and D32~D33 according to the International Classification of Diseases 10th Edition (ICD-10), or those that are classified as primary malignant tumours and in situ tumours of all sites, as well as benign tumours of the central nervous system and urinary system according to the International Classification of Oncology 3rd Edition (ICD-O-3). There were 3244 cases of them and were followed up for vital status through 31 December, 2008.

Among the 3,244 registered cases, a total of 450 cases were ineligible and excluded from the analysis; 2 cases (0.2%) with unknown age; 194 Death Certificate Only cases (DCO, 6 %) due to unverifiable date of diagnosis; 253 cases (7.8%) reported by pathology and outpatient departments with undetermined vital status due to insufficient identifiable information for matching with death certificate or being tracked by the electronic medical records. A total of 2794 cases were eligible for the analysis. After the preliminary analysis, an exclusion criterion was set to increase validity and statistical precision in analysis. In situ carcinomas (n=90), young patients aged below 20 (n=33), too old patients aged over 89 (n=39), and sites with count less than 3 were excluded, resulting in 2623 cases for analysis. These 2623 cases consist of registered invasive carcinomas, benign CNS tumours and benign urinary tumours diagnosed between 2003 and 2005 with patients' age between 20 and 89 at date of diagnosis.

Survival matching (confirmation of vital status)

Death certificate is one of the reporting sources of the registered cases in the Macao Cancer Registry, and is collected at the end of each calendar year. In the analysis for the annual reporting of the registry, death cases which fulfill the definition of reportable case are extracted and registered. Besides, existing cancer registered cases in the registration system were also matched with the death certificates. Vital status of the registered cancer cases will then be confirmed and updated in the registration system, together with their dates of death, if a registered case is found matched with the identity information (including name, age or date of birth and sex) in the death certificate. Vital status of cases registered before 2008 were confirmed by death certificates. To check and confirm the vital status through 31 December 2008, registered cases were also screened through the Hospital Information System (HIS) of the only public hospital (CHCSJ) which collects copies of death certificates from the Death Registry and inputs the date of death into the corresponding records of the patients. 3244 registered cases, which were not confirmed dead by death certificates, were all screened by HIS for date of death with their identity information. Medical records of 253 cases could not be found from the HIS and were not eligible for analysis. Cases could not be confirmed of their vital status were usually those with indistinguishable identity on death certificates and occupy a small proportion among all death cases. Over 90% of the death cases could be matched with the registered cases in the Macao Cancer Registry.

Relative Survival

Relative survival is adopted to measure and represent the survival probability of cancer. It is a net survival measure representing cancer survival in the absence of other causes of death. Relative survival is defined as the ratio of the proportion of observed survivors in a cohort of cancer patients to the proportion of expected survivors in a comparable set of cancer free individuals (formula 1). The formulation is based on the assumption of independent competing causes of death. A major advantage of relative survival is that information on cause of death is not

Table 1. Sex Distribution of Eligible Cases by Year of Diagnosis

Year of Diagnosis	Male		Female		Both sexes	
	N	%	N	%	N	%
2003	467	50.2%	448	49.8%	915	34.9%
2004	427	49.7%	407	50.3%	834	31.8%
2005	437	48.5%	437	51.5%	874	33.3%
2003-2005	1331	50.7%	1292	49.3%	2623	100.0%

Table 2. Comparison of Most Frequent Cancer Sites Among Eligible and Ineligible Cases

Rank	Eligible cases (n=2623)			Ineligible cases due to incomplete information (n=253)		
	Cancer site	ICD-10	Proportion	Cancer site	ICD-10	Proportion
1	Lung	C33-C34	14.6%	Breast	C50	12.6%
2	Breast	C50	12.3%	Prostate	C61	12.2%
3	Colon	C18	10.2%	NPC	C11	9.5%
4	Nasopharynx	C11	7.6%	Colon	C18	8.7%
5	Stomach	C16	5.8%	Stomach	C16	7.1%
6	Prostate	C61	5.4%	Skin	C44	5.5%
7	Rectum & Anus	C19-C21	5.2%	Thyroid	C73	5.1%
8	Liver	C22	4.3%	Lung	C33-C34	4.7%
9	Urinary Bladder	C67	3.1%	Rectum & Anus	C19-C21	3.9%
10	Cervix uteri	C53	2.7%	Cervix uteri	C53	2.8%
	Others		28.9%	Others		28.0%

required, thereby circumventing problems when death certificates are inaccurate or unavailable.

Relative survival can be estimated by cohort, period, and complete approach. The relative survival ratio (RSR) adjusts for the general survival rate of the population for that race, sex, age, and date at which the age was coded. It is usual to estimate the expected survival proportion from nationwide (or state-wide) population life tables stratified by age, sex, calendar time, and, where applicable, race. Death number of all causes and population statistics of 2003-2005 are obtained from the Statistics and Census Service of Macao.

Formula 1: Relative Survival Ratio (RSR) = Observed Survival Rate / Expected Survival Rate

The cumulative relative survival ratio can be interpreted as the proportion of patients alive after i years of follow-up in the hypothetical situation where the cancer in question is the only possible cause of death.

The survival duration of each case was determined as the time difference (in months) between the date of initial diagnosis until the date of death, date of loss to follow-up, or the closing date for follow-up whichever occurred first. Observed survival rates were calculated using a Life Table method, and relative survival rates were examined by the method using an algorithm written in SAS by Paul Dickman (http://www.pauldickman.com/rsmodel/) with minor adaptations. Even the cases diagnosed in 2005 can have a complete follow-up of 3 years till the end of 2008, thus 3-year survival rates can be calculated for each cancer by the cohort approach. Only some of the early diagnosed patients reported in 2003 and 2004 can be followed up for more than 3 years, so 4-year and 5-year survival rates can only represent some cancers and not all of them. The RSR confidence limits were derived by dividing the observed survival limits by the corresponding expected survival rate. The estimation of confidence limits of the observed survival rates was implemented using Paul Dickman's method [http://www.pauldickman.com/rsmodel/sas_colon/]. Expected survival rates were the average survival rates of 2003 to 2005 of all causes of death of the general Macao population.

Results

Data profile

Among the eligible 2623 cancer cases, 35%, 32% and 33% were diagnosed in 2003, 2004 and 2005 respectively. Males and females were nearly equal in proportion (Table 1). The median age at diagnosis was 61 years and the age distribution among the 5-year age groups was nearly the same for three calendar years. 935 (35%) out of 2623 cases have information on summary staging, the rest were not reported with stage. Most frequent cancer sites among eligible cases are lung, breast and colon etc., which are similar to the leading sites in the annual report of the registry (Table 2).

General survival of all sites

The overall relative survival ratios with their 95% confidence intervals (95% CI) of all cancer cases are summarized in Table 3 and Figure 1. The interval-specific RSR of the 1st year is usually the lowest. Interval-specific RSR of the subsequent intervals generally rises and attains a stable level. Conversely, the cumulative RSR is decreasing across time span.

Relative survival of all sites by sex and age groups

3-year RSR for all sites for both sexes is 61%, while 54% and 68% for males and females respectively. 5-year

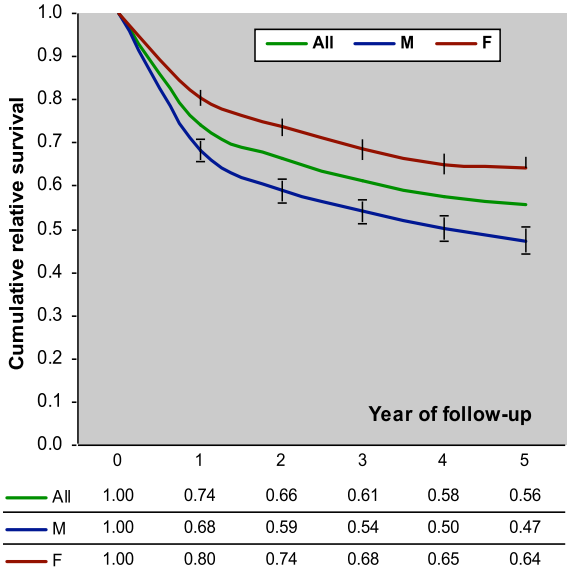

Figure 1. Survival Curves by Sex of All Cancers Registered in Macao 2003-2005 (Follow-Up to 31 Dec, 2008)

Table 3. Life Table Estimated Survival of All Cancers Registered in Macao 2003-2005 by Sex (Follow-Up to 31 Dec, 2008)

Follow-up Year	Cases	Deaths	Withdrawals	Persons at Risk at start of interval	Interval- specific observed survival	Cumulative observed survival	Cumulative RSR	
	N	D	W	N'	p	cp	cr	(95% CI)
All								
1	2623	709	0	2623	0.7297	0.7297	0.74	(0.72, 0.76)
2	1914	232	0	1914	0.8788	0.6413	0.66	(0.64, 0.68)
3	1682	149	0	1682	0.9114	0.5844	0.61	(0.59, 0.63)
4	1533	91	526	1270	0.9283	0.5426	0.58	(0.56, 0.60)
5	916	91	439	697	0.9555	0.5184	0.56	(0.54, 0.58)
Male								
1	1331	443	0	1331	0.6672	0.6672	0.68	(0.66, 0.71)
2	888	136	0	888	0.8468	0.5650	0.59	(0.56, 0.62)
3	752	76	0	752	0.8989	0.5079	0.54	(0.51, 0.57)
4	676	50	234	559	0.9106	0.4625	0.50	(0.47, 0.53)
5	392	23	176	304	0.9243	0.4275	0.47	(0.44, 0.50)
Female								
1	1292	266	0	1292	0.7941	0.7941	0.80	(0.78, 0.83)
2	1026	96	0	1026	0.9064	0.7198	0.74	(0.71, 0.76)
3	930	73	0	930	0.9215	0.6633	0.68	(0.66, 0.71)
4	857	41	292	711	0.9423	0.6251	0.65	(0.62, 0.68)
5	524	8	263	393	0.9796	0.6123	0.64	(0.61, 0.67)

Table 4. Summary Table of the Estimated 3-Year and 5-Year Survivals of Major Sites Registered in Macao 2003-2005 by Sex (Follow-Up to 31 Dec, 2008)

Major cancer sites	3-year RSR	95% CI	N (3-year)	5-year RSR	95% CI	N (5-year)
			Both Sexes			
Lung C33-C34	0.24	(0.20, 0.29)	111	0.21	(0.16, 0.25)	45
Liver C22	0.29	(0.20, 0.37)	34	0.21	(0.13, 0.30)	16
Colorectal C18-C21	0.60	(0.55, 0.65)	264	0.54	(0.48, 0.59)	135
Colon C18	0.56	(0.50, 0.63)	165	0.49	(0.42, 0.56)	76
Rectum Anus C19-C21	0.68	(0.59, 0.75)	99	0.62	(0.52, 0.71)	59
Nasopharynx C11	0.81	(0.74, 0.86)	168	0.74	(0.67, 0.81)	103
All cancer sites C00-C80	0.61	(0.59, 0.63)	1682	0.56	(0.54, 0.58)	916
			Males			
Lung C33-C34	0.21	(0.16, 0.27)	70	0.19	(0.14, 0.25)	26
Liver C22	0.26	(0.17, 0.36)	23	0.18	(0.10, 0.28)	9
Colorectal C18-C21	0.64	(0.56, 0.71)	128	0.56	(0.47, 0.64)	67
Colon C18	0.60	(0.50, 0.68)	84	0.54	(0.43, 0.63)	41
Rectum Anus C19-C21	0.74	(0.60, 0.84)	44	0.61	(0.44, 0.75)	26
Nasopharynx C11	0.79	(0.71, 0.85)	116	0.70	(0.61, 0.78)	70
Prostate C61	0.89	(0.80, 0.95)	123	0.79	(0.65, 0.89)	51
All cancer sites C00-C80	0.54	(0.51, 0.57)	752	0.47	(0.44, 0.50)	392
			Females			
Lung C33-C34	0.29	(0.22, 0.38)	41	0.23	(0.16, 0.32)	19
Liver C22	0.37	(0.19, 0.54)	11	0.29	(0.14, 0.47)	7
Colorectal C18-C21	0.57	(0.50, 0.64)	136	0.52	(0.44, 0.60)	68
Colon C18	0.53	(0.44, 0.62)	81	0.45	(0.35, 0.55)	35
Rectum Anus C19-C21	0.63	(0.51, 0.74)	55	0.63	(0.51, 0.74)	33
Nasopharynx C11	0.83	(0.71, 0.91)	52	0.84	(0.71, 0.92)	33
Female Breast C50	0.90	(0.86, 0.93)	301	0.85	(0.80, 0.89)	167
All cancer sites C00-C80	0.68	(0.66, 0.71)	930	0.64	(0.61, 0.67)	524

RSR for all sites for both sexes is 56%, while 47% and 64% for males and females respectively. Female cancer patients were having higher probability of survival than males across the 5-year follow up period, with a difference of around 15% (Table 3, Figure 1). This corresponds to the annual mortality rate summarized in the annual cancer report, in which there is always a higher mortality rate among males than females.

By dividing the cancer cohort into the following age groups: 20-49 years old (young adults), 50-69 years old (mature adults) and 70-89 years old (elderly), the eldest group has the poorest survival in both sexes (Figure 2). Female patients of major cancer sites showed a better survival than males. The difference was mostly remarkable in young ages with a value up to 20% in the 20-49 age-groups. The difference gradually decreased as age increased with no remarkable difference above age 70.

Relative Survival of Major Cancer Sites

According to data from Macao cancer registry, major

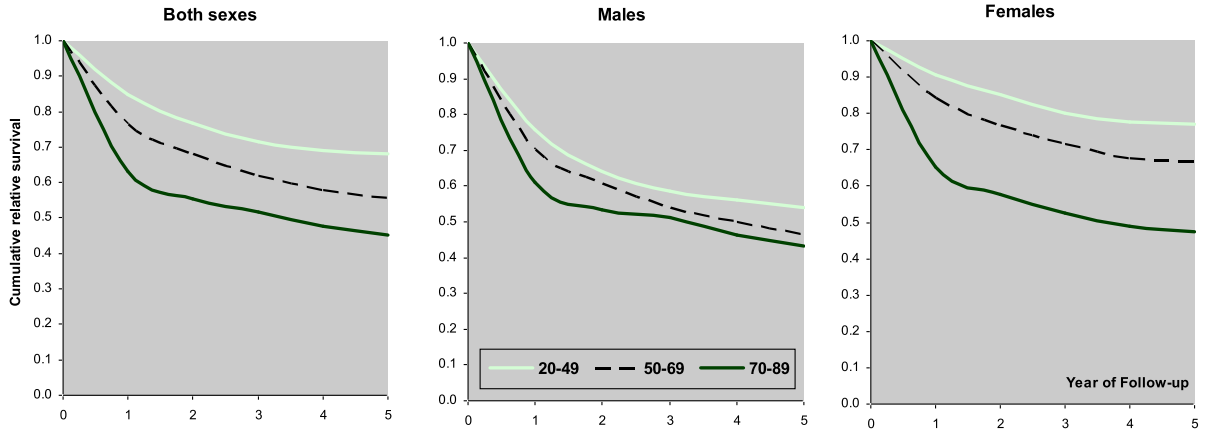

Figure 2. Survival Curves by Sex and Age Groups of All Cancers Registered in Macao 2003-2005 (Follow-Up to 31 Dec, 2008)

sites with leading incidence in 2003-2005 were selected for investigation of their survival rates. These sites include lung (C33-C34), liver (C22), colorectal (C18-C21), female breast (C50), prostate (C61) and nasopharynx (C11). Cancer cases belong to the above selected sites and eligible for survival analysis accounted for 1562, 52% males and 48% females, and occupy 60% of all eligible cases.

3-year RSR and 5-year RSR for mentioned major sites of both sexes ranged from 24% to 81% and 21% to 74% respectively, with lung the lowest while nasopharynx the highest. For the males, 3-year and 5-year RSR for mentioned major sites ranged from 21% to 89% and 18% to 79% respectively, with lung the lowest and prostate the highest. For the females, 3-year and 5-year RSR for mentioned major sites ranged from 29% to 90% and 23% to 85% respectively, with lung the lowest and breast the highest. The point and interval estimates of 3-year and 5-year RSR for each major cancer site by sex were shown in Table 4 and Figure 3.

Discussion

This is the first report on survival statistics of the registered cases of Macao Cancer Registry ever since its establishment. Information on survival statistics was not available before this study, so it is important to compare the survival rates of Macao with that of other cities to check for their validity (see Table 5). It is found that Macao and Taiwan got the closest estimate in the 3-year RSR (Macao Cancer Registry), (Taiwan Cancer Registry) of all sites. It showed that there were similar estimates for major cancer sites, such as colorectal, prostate and female breast. Slight differences were found in the sites of lung, liver and all sites. The overall estimates showed that Macao cases diagnosed in 2003-2005 got slightly higher 3-year survival rates than the Taiwan cases

Table 5. Comparison Of 3-Year and 5-Year Survival Rates of Macao with Neighbouring Asian Countries/Cities

Major cancer sites	Macao (2003-2005)[1] 3-year RSR	Taiwan (2002-2006)[2] 3-year RSR	Macao (2003-2005)[1] 5-year RSR	Taiwan (2002-2006)[2] 5-year RSR	Japan (1993-1996)[3] 5-year RSR	Singapore (1988-1992)[4] 5-year RSR	Singapore (1998-2002)[5] 10-year RSR
Male							
Lung	0.21	0.15	0.20	0.11	0.20	0.06	0.05
Liver	0.26	0.30	0.18	0.21	0.20	0.03	0.06
Colorectal	0.64[a]	0.65[a]	0.56[a]	0.58[a]			0.41[a]
Colon	0.60		0.54		0.72	0.50	
Rectum & Anus	0.74		0.61		0.66	0.44	
Nasopharynx	0.79	0.72	0.70	0.62	NA	0.47	0.32
Prostate	0.89	0.85	0.79	0.80	0.63	0.57	0.45
All sites	0.54	0.47	0.47	0.41	0.49	0.31	0.31
Female							
Lung	0.29	0.23	0.23	0.15	0.28	0.07	0.07
Liver	0.37	0.32	0.30	0.22	0.21	0.02	0.018
Colorectal	0.57[a]	0.66[a]	0.52[a]	0.60[a]			0.40[a]
Colon	0.53		0.45		0.67	0.52	
Rectum & Anus	0.63		0.63		0.65	0.49	
Nasopharynx	0.83	NA	0.84	NA	NA	0.56	0.43
Female Breast	0.90	0.90	0.85	0.84	0.85	0.71	0.64
All sites	0.68	0.63	0.64	0.57	0.59	0.48	0.44

1, from Macao Cancer Registry with follow-up to end of 2008; 2, from Taiwan Cancer Registry with follow-up to end of 2007; 3. from Japan Cancer Registry (Tsukuma et al., 2006); 4, from Singapore Cancer Registry with follow-up to end of 1997 (Chia et al., 2001); 5, from Singapore Cancer Registry with follow-up to end of 2005 (Lim et al., 2009); [a]colorectal; NA, not available

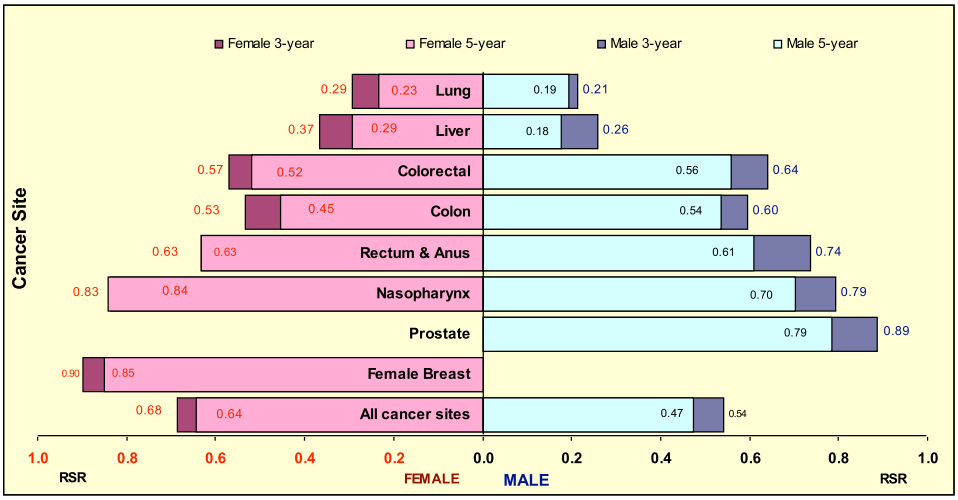

Figure 3. 3-Year & 5-Year Survival Rates by Sex of Major Sites Registered in Macao 2003-2005 (Follow-Up to 31 Dec, 2008)

diagnosed in 2002-2006. Greater differences exist in the 5-year survival rates of the two registries, except that of prostate and female breast (Table 5). Since, the number of cases having followed for over 3 years was quite small in the patient pool of Macao, such difference maybe due to random variation instead of reflecting the true trend. 5-year relative survival rates for all sites of Macao was very near to that of the cancers diagnosed in 1999-2003 of the Nordic countries, particularly of Finland (Storm et al., 2010), (Storm et al., 2010), which has been known for having the longest history of cancer registry practice. Similarly, 5-year relative survival rates for colorectal and prostate cancers which are of increasing significance in Macao were very close to that of the cancers diagnosed in 1995-1999 of the European countries (Berrino et al., 2007), showing that cancers of Macao have been following the path and trend of development of the western countries.

Larger differences were showed when comparing the Macao estimates with that of Japan and Singapore (Table 5). Since the calendar years in which patients were diagnosed were very far ahead in Japan and Singapore, patients from Macao and that of Japan or Singapore were indeed diagnosed from different era (Chia et al., 2001), (Tsukuma et al., 2006), (Lim et al., 2009). There may be the period effect resulted from incomparability of disease classification, treatment services and medical technology, thus lowering the comparability among the cities.

Since the cancer cases in this study were followed up to the end of 2008, all of the eligible cases in analysis have completed a follow-up of 3 years. However, only those cases diagnosed before 2005 were potential to be recruited in the estimation of the 4th and 5th year of survival rates. Besides, as time goes by, the number of cases under observation is gradually decreasing with deaths and withdrawals. Usually, the number of cases entered into the 4th or 5th year of follow-up has been reduced to a smaller one, particularly with the minor cancer sites or when data being stratified by sex and age groups. Thus, survival rates were estimated up to the 3rd year only when they were stratified simultaneously by sex and age. Even when the 4-year and 5-year survival rates are available, it is important to note that the 3-year survival rates are relatively more consistent and reliable than the 4-year or 5-year ones.

Special attention should be drawn on the number of cases in the stratum and careful interpretation for estimates from a scarce case number should be observed, as it is hard to differentiate whether the estimate reflects a real phenomenon or it is just out of random variation.

The overall estimates of survival rates for all cancer sites diagnosed in 2003-2005 showed a sex difference with a higher survival rate of females than males, indicating that there is a better prognosis of cancer for females rather than males. This is consistent to the findings in the annual reports of Macao Cancer Registry that females have lower mortality rates of cancer than males (Macao Cancer Registry). Survival statistics of other neighboring cities/countries also showed broadly similar results as shown in Table 5 (Chia et al, 2001), (Tsukuma et al., 2006), (Lim et al., 2009), (Taiwan Cancer Registry).

The sex-specific cancers like female breast cancer and prostate cancer of males showed high survival rates due to their good prognosis in nature. Certain cancer sites with occurrence in both sexes also showed higher survival rates in females, such as lung, liver and nasopharynx; while colorectal cancers showed a higher survival rate in males rather than in females.

Data in Macao Cancer Registry were mainly from two local hospitals, which are the only two settings in Macao that provide qualified morphological verification for cancer suspect cases. Though some cancer suspect cases may seek confirmative or diagnostic examination outside Macao, such as from clinical settings of neighboring cities like Hong Kong and cities of Guangdong Province, most of them would still return to seek clinical management in Macao as cancer clinical management is totally free for all residents in local government hospital. Then, clinical physicians can still report those cases and amend for the registry through reporting forms and cases will not be lost track. If cancer cases were diagnosed and managed outside Macao, cancer cases with fatal consequences will not be lost if death certificates have to be issued to them in Macao as matching with Death Registry is performed every year. Still, there may be cancer cases of local residents that are

not diagnosed, managed or issued death certificate and become missed in the registry, but the number is believed to be negligible.

To measure the survival time and the survival probability within the observation period, date of incidence (which marks the starting point), date of death (which marks the end point) and vital status during the observation period are highly significant to ensure precise estimation. Tracking and matching with medical records and death certificates is thus essential in the process. Matching will be of greater ease and accuracy if a unique identifier, such as an identification number, is provided for each reported case. Meanwhile, only the name, sex and date of birth of patient are used as criteria of matching and may result in some rare episodes of match-fail if information is unclear or incomplete.

Due to the incomplete identification information, vital status of 253 cases could not be tracked and verified from the electronic medical records. Investigating these 253 cases, it showed that distribution of cancer sites of these cases were quite different from that of the eligible cases (Table 2). Cancers of good prognosis, such as female breast, prostate and rectum occupied the largest proportion of the ineligible cases, while lung and liver ranked the top in the composition of the eligible cases. There can be the possibility of underestimating the survival rates when excluding them from analysis. Thus, it is worthy to request from reporting physician and update the identification information of these 253 cases in order to have them matched with the medical records for vital status and included into later analysis.

Apart from reporting on the identification information, information on cancer stage or degree of spread at diagnosis should be promoted and encouraged to allow further investigation of the survival rates. Since survival is dependent of the cancer stage, stage-specific cancer survival would be of high value of reference. At the time being, only around 30% of the registered cancer cases were reported with information on cancer stage. This low reporting percentage on cancer stage restricted further stratification and adjustment of the survival estimates. Thus, promotion of reporting by physicians with stage information as well as improvement in data quality of cancer registration is essential to allow further usage of the registered data and a clearer picture of the trend in incidence, mortality and survival of cancers occurring in Macao.

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