50 YEARS OF CANCER REGISTRATION

SINGAPORE CANCER REGISTRY

SINGAPORE CANCER REGISTRY
50TH ANNIVERSARY MONOGRAPH
1968 – 2017

MESSAGE FROM MINISTER FOR HEALTH

Cancer is the leading cause of death in Singapore and has significant societal and economic impact on the patients and their families, as well as the healthcare system. It is thus important that we remain steadfast in our journey to promote research, partnerships and public health initiatives to tackle this challenge. Through the years, the Singapore Cancer Registry has been an integral part of this journey.

Since its founding in 1968, the Registry has amassed a wealth of epidemiologic data that has allowed us to formulate evidence-based cancer-related policies, as well as develop and evaluate targeted control measures in Singapore. Its contributions to the research community have put Singapore on the international map for cancer research. I also want to thank our healthcare professionals who work tirelessly behind the scenes to put the data and publications together.

My heartiest congratulations to the Registry on its 50th Anniversary Monograph. Let us look to the next 50 years as we continue to advance our knowledge and expertise in cancer research and management.

Mr Gan Kim Yong
Minister for Health

MESSAGE FROM DIRECTOR OF MEDICAL SERVICES

The Singapore Cancer Registry is an indispensable source of information that informs our policies and approaches targeted to impact the incidence, prevalence and outcomes of cancers in Singapore. The data has impacted the way we have modelled our screening, early detection and management initiatives over the years. We owe the development of this valuable Registry to the foresight of the late Emeritus Professor K Shanmugaratnam fifty odd years ago. It is fitting, then, that we acknowledge this highly significant contribution as the Singapore Cancer Registry commemorates fifty years.

Associate Professor Benjamin Ong
Director of Medical Services
Ministry of Health, Singapore

FOREWORD

The late Professor Kanagaratnam Shanmugaratnam is fondly remembered as Singapore's "Father of Pathology". He is, in fact, more than that. He is also the "Father of the Singapore Cancer Registry", having had the foresight to see the need for accurate data on cancer cases in Singapore to inform policy decisions and biomedical research. He founded the Singapore Cancer Registry in 1968 and painstakingly guided not just data collection, but more importantly, the regular production of monographs. I represent the group of us who were privileged to have been his students and co-workers in this endeavour. We dedicate this commemorative monograph, reporting on fifty years of cancer incidence and survival in Singapore, to the fond memory of our mentor.

The first two monographs were produced in collaboration with the International Agency for Research on Cancer covering the period 1968 to 1977. Following that, he guided the production of a monograph once every five years, the last covering 1968 to 2002. These monographs put tiny Singapore on the world map of cancer epidemiology, and Prof Shanmugaratnam even became the President of the International Association of Cancer Registries in 1984 to 1988.

Prof Shanmugaratnam was particularly fond of the chapter on histology, painstakingly checking every table in the chapter. He also recognised the value of the detailed tables in the appendices consisting of age-specific incidence rates of individual cancer types by gender and ethnicity. These appendices have proved invaluable for epidemiological and clinical research and also in monitoring the outcomes of our cancer control policies at the national level.

Today, with fifty years of data, the Singapore Cancer Registry is a goldmine and this monograph, with complete appendices, will be a perpetual legacy of a man ahead of his time.

Professor Lee Hin Peng
Emeritus Professor, Saw Swee Hock School of Public Health
National University of Singapore

ACKNOWLEDGMENTS

We are indebted to our advisors whose expertise, professionalism and interest in this monograph have shone a light for us in our monograph production journey.

Prof Lee Hin Peng
Prof Chia Kee Seng
Prof Tan Puay Hoon
Prof Ian Cree

While this monograph commemorates the founding father of the Singapore Cancer Registry, we would also like to take the opportunity to pay tribute to other members of the pioneer team and numerous collaborators who had worked closely with Prof Shanmugaratnam. It was indeed a privilege for us to hear your personal stories with Prof Shanmugaratnam, and we would like to thank you for sharing them with us.

Prof Lee Hin Peng
Prof Chia Kee Seng
A/Prof Ivy Sng
Prof Tan Puay Hoon
A/Prof Adeline Seow
Prof Koh Woon Puay
Mrs Betty Quah
Mrs Alice Yap
Ms Sarjit Kuar
Mr Jalaludin S/O Peer Mohamed

Our gratitude also goes to the Ministry of Health for their support and guidance over the years. We would like to express our appreciation especially to the Registrar/Deputy Registrar of the National Registry of Diseases and our colleagues from the Epidemiology and Disease Control Division.

Prof John Lim
Mr Tong Ming Shen
Dr Derrick Heng
Dr Lyn James
Dr Marc Ho
Dr Lim Huai Yang

The exemplary dedication of the “alumni” team who had been involved in work relating to the Singapore Cancer Registry needs to be acknowledged as this monograph would not be possible without their hard work over many years.

Finally, we would like to reserve our special thanks and immense gratitude to the healthcare organisations and professionals for their contributions in terms of professional advice from the Singapore Cancer Registry Advisory Committee, cancer notifications and provision of access to medical records over the past fifty years. Your support has helped to make Prof Shanmugaratnam's vision for the Singapore Cancer Registry a reality.

Staff of the Singapore Cancer Registry, Health Promotion Board

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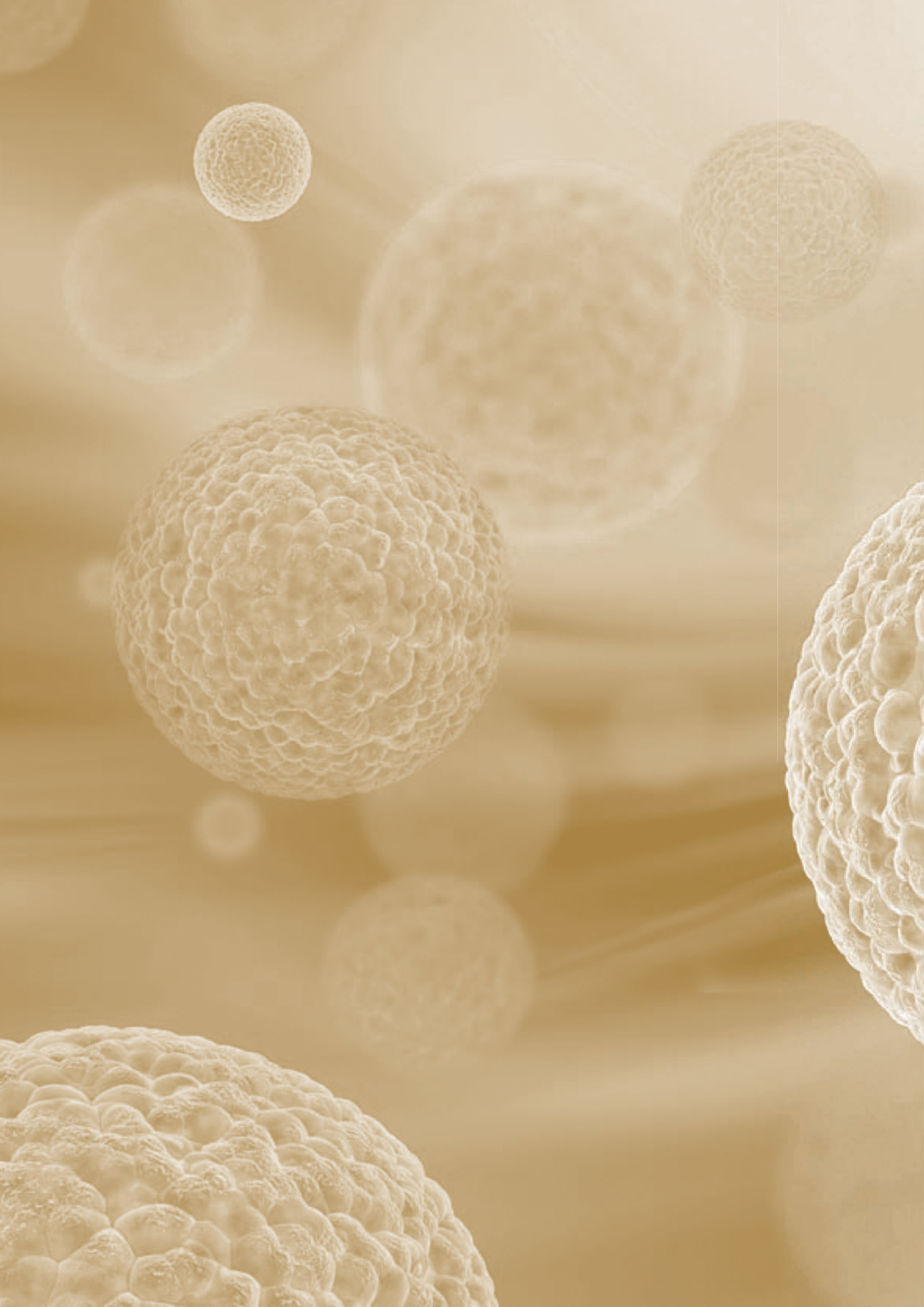
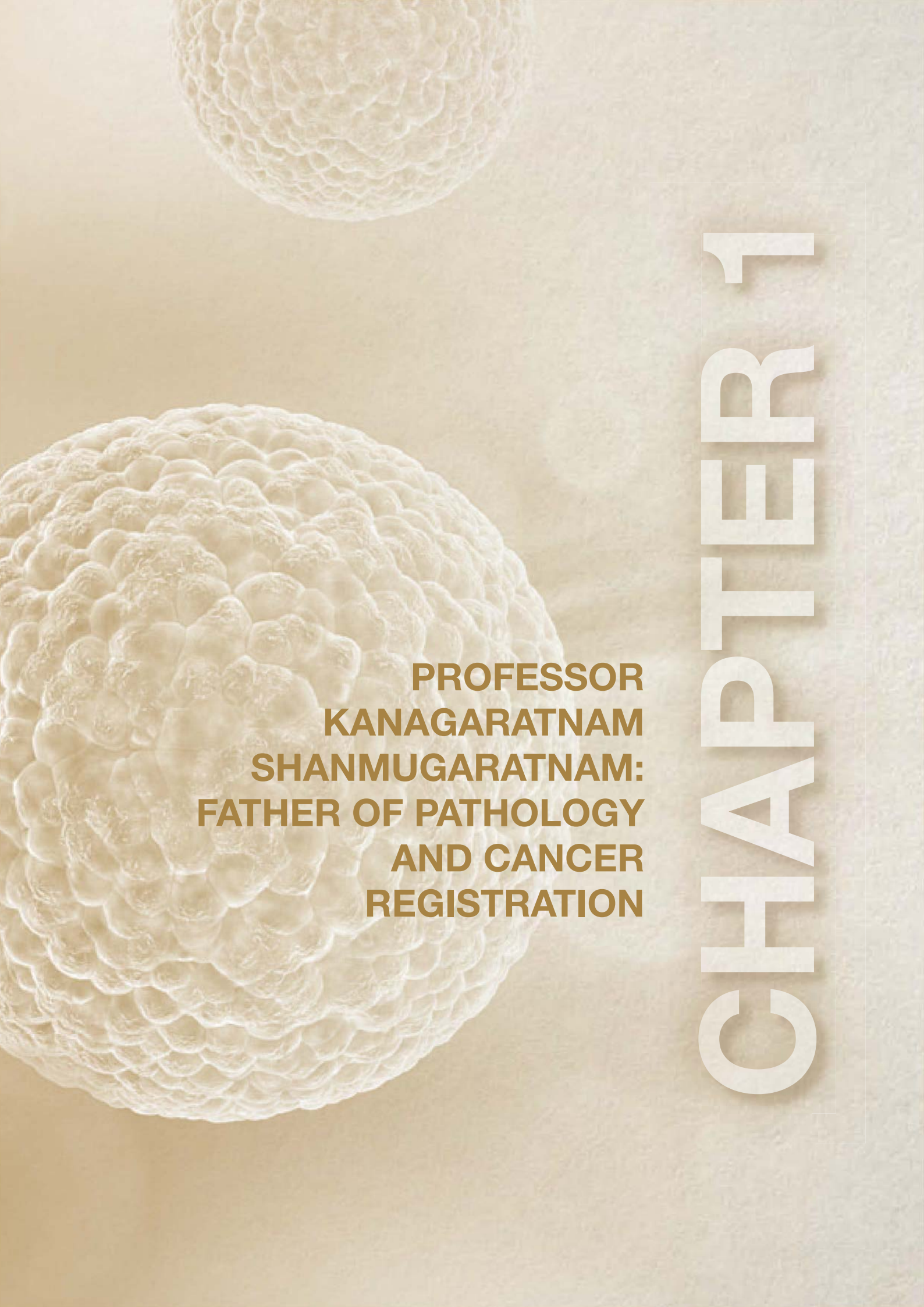




CHAPTER 1

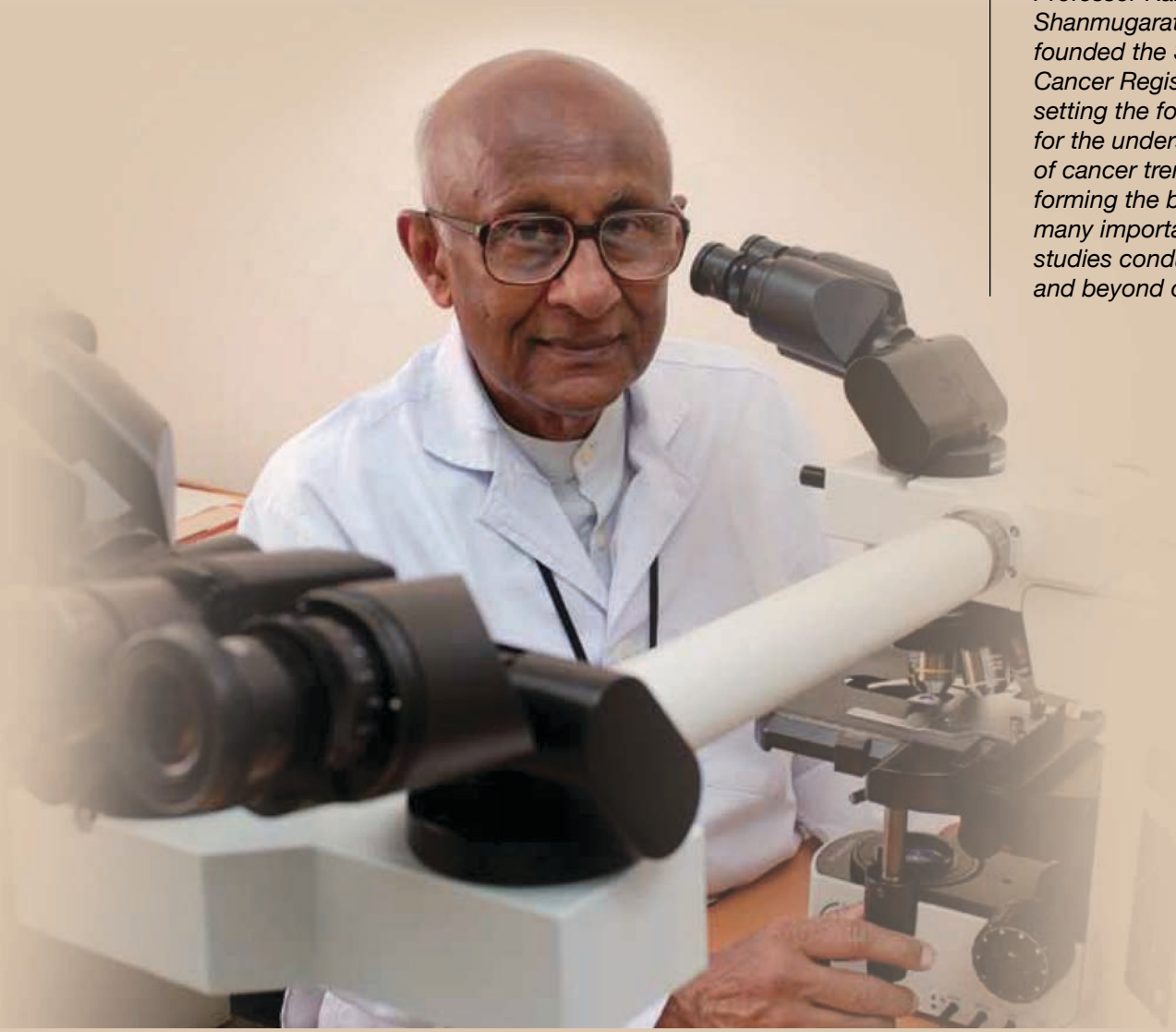
PROFESSOR KANAGARATNAM SHANMUGARATNAM: FATHER OF PATHOLOGY AND CANCER REGISTRATION

AHEAD OF HIS TIME

A giant of Singapore's medical profession, Prof Shanmugaratnam was not only a leading authority on pathology; his vision went far beyond the world under his microscope. A man of incisive intellect, he had the foresight to recognise the importance of cancer statistics for a greater understanding of disease trends on a national, and even global level.

Prof Shanmugaratnam's love for pathology began during the war years when the Japanese occupation of Singapore interrupted his studies at Singapore's King Edward VII College of Medicine. To avoid being conscripted into manual labour, Prof Shanmugaratnam and his fellow classmates had to find work. The Japanese Army Medical Corps had converted the College of Medicine building into bacteriology and serology laboratories and it was there that Prof Shanmugaratnam found employment as a laboratory technician. Under these unusual circumstances, the medical student developed an interest in laboratory work. After the war, he resumed his studies and graduated in 1947, joining the Government Medical Service as an assistant pathologist in 1948.

Singapore's 'Father of Pathology', the late Professor Kanagaratnam Shanmugaratnam, founded the Singapore Cancer Registry in 1968, setting the foundations for the understanding of cancer trends and forming the basis for many important research studies conducted here and beyond our shores.



Emeritus Professor K Shanmugaratnam (1921-2018)

Photo credit: NUS Yong Loo Lin School of Medicine

Setting up the Singapore Cancer Registry

It was while working at the Institute of Pathology (comprising the University and Government Departments of Pathology) that Prof Shanmugaratnam started a card index of all histologically diagnosed cancer cases in the Singapore population covering the period 1950-1967 in order to discern local disease patterns. This first pathology-based database – built together with his University colleague and long-standing collaborator, Prof Calum Muir [1] – set in motion the steps that would lead to the establishment of Singapore Cancer Registry (SCR) [1].

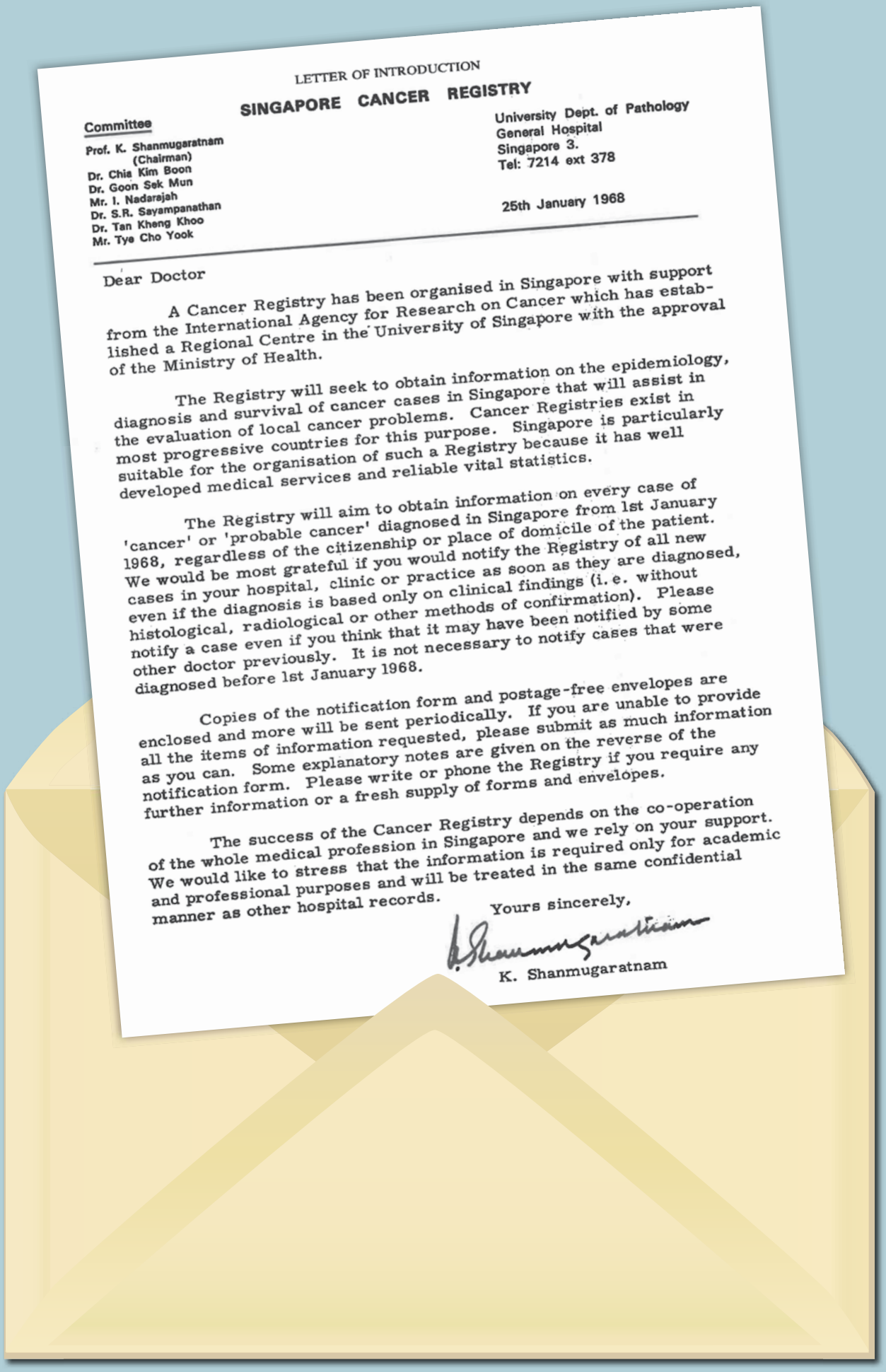
Then, the Institute of Pathology was the sole histopathology facility where diagnostic pathology of all government hospitals was done. This proved a critical advantage in the early days of the registry as it meant data of histologically confirmed cancer cases could be collected.

Beyond the matter of data collection, there were also logistical issues to be worked out in the lead-up to the formation of SCR. Many key questions had to be asked and resolved. Dr Ivy Sng, Adjunct Associate Professor at the National University of Singapore (NUS) and the former head of Histopathology at the Department of Pathology, Singapore General Hospital (SGH), recalls attending the inaugural meeting under the aegis of the International Agency for Research on Cancer (IARC) on Cancer Epidemiology and Registration in March 1971. The meeting was attended by Prof Shanmugaratnam and Prof Calum Muir together with the leading pathologists. “These formative meetings introduced the registry, its goals and where funding would come from,” she explains. Backed by funding and support from the IARC and later by annual donations from the Singapore Cancer Society and research grants from the University of Singapore, the SCR officially came into being [2].

This enlarged Prof Shanmugaratnam’s pathology-based database into a population-based registry, covering the whole population of Singapore. The SCR became Prof Shanmugaratnam’s lifetime passion and achievement, putting Singapore on the world map of cancer epidemiology. It drew attention from World Health Organisation (WHO), IARC and the International Association of Cancer Registries (IACR) of which Prof Shanmugaratnam was President from 1984 to 1988. Prof Shanmugaratnam also served as Head of the WHO International Reference Centre for the Histological Classification of Tumours of the Upper Respiratory Tract from 1972 to 1995.

Prof Shanmugaratnam (first row, fifth from left), A/Prof Ivy Sng (first row, fourth from right), Prof Calum Muir (last row, first from right)

[1] Prof Muir later moved to Lyon to work with the International Agency for Research on Cancer, a World Health Organisation agency.



LETTER OF INTRODUCTION

SINGAPORE CANCER REGISTRY

University Dept. of Pathology
General Hospital
Singapore 3.
Tel: 7214 ext 378

25th January 1968

Dear Doctor

A Cancer Registry has been organised in Singapore with support from the International Agency for Research on Cancer which has established a Regional Centre in the University of Singapore with the approval of the Ministry of Health.

The Registry will seek to obtain information on the epidemiology, diagnosis and survival of cancer cases in Singapore that will assist in the evaluation of local cancer problems. Cancer Registries exist in most progressive countries for this purpose. Singapore is particularly suitable for the organisation of such a Registry because it has well developed medical services and reliable vital statistics.

The Registry will aim to obtain information on every case of 'cancer' or 'probable cancer' diagnosed in Singapore from 1st January 1968, regardless of the citizenship or place of domicile of the patient. We would be most grateful if you would notify the Registry of all new cases in your hospital, clinic or practice as soon as they are diagnosed, even if the diagnosis is based only on clinical findings (i.e. without histological, radiological or other methods of confirmation). Please notify a case even if you think that it may have been notified by some other doctor previously. It is not necessary to notify cases that were diagnosed before 1st January 1968.

Copies of the notification form and postage-free envelopes are enclosed and more will be sent periodically. If you are unable to provide all the items of information requested, please submit as much information as you can. Some explanatory notes are given on the reverse of the notification form. Please write or phone the Registry if you require any further information or a fresh supply of forms and envelopes.

The success of the Cancer Registry depends on the co-operation of the whole medical profession in Singapore and we rely on your support. We would like to stress that the information is required only for academic and professional purposes and will be treated in the same confidential manner as other hospital records.

Yours sincerely,

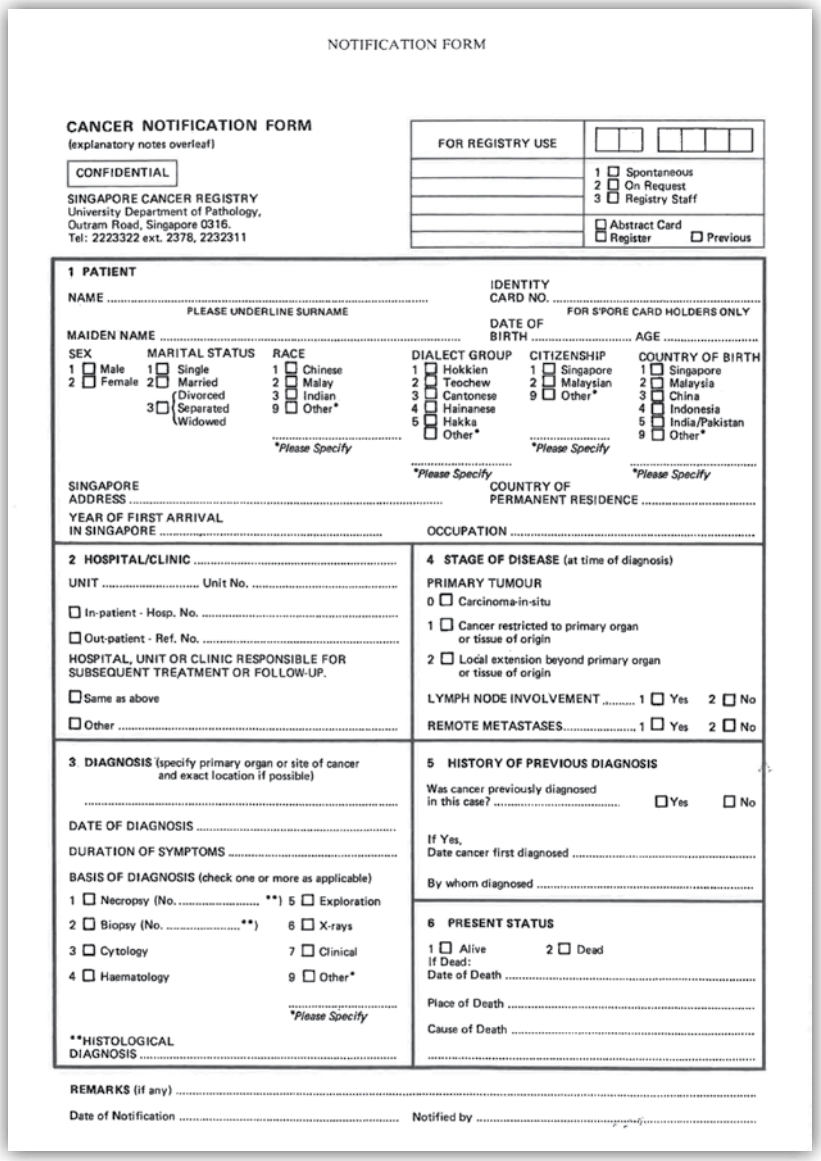
K. Shanmugaratnam

Building a legacy

Over the last fifty years since its founding, the SCR – a comprehensive, population-based national cancer registry – has captured data on all cancers by histological diagnosis as well as notification by doctors through clinical assessment. As the oldest disease registry in Singapore, it has collated millions of entries, and has become an invaluable resource for monitoring cancer trends, conducting clinical research, guiding health policy and maximising the efficient allocation of resources.

In its early days, the SCR was located in the University Department of Pathology then based at the General Hospital in Singapore. It subsequently was relocated to the National University Hospital Department of Pathology in 1985, where day-to-day operations were handled by two secretaries and one record searcher. The work was very manual, recounts Mrs Betty Quah, one of the pioneering members who joined in 1965 as secretary.

For one, letters of introduction had to be sent out to all doctors in Singapore to inform them about the registry, and request that they notify the registry of all cancers and probable cancers diagnosed from 1 January 1968. Each letter was accompanied by copies of notification forms and postage-free envelopes.



NOTIFICATION FORM

CANCER NOTIFICATION FORM
(explanatory notes overleaf)

CONFIDENTIAL

SINGAPORE CANCER REGISTRY
University Department of Pathology,
Outram Road, Singapore 0316.
Tel: 2223322 ext. 2378, 2232311

FOR REGISTRY USE

1 ☐ Spontaneous
2 ☐ On Request
3 ☐ Registry Staff

☐ Abstract Card
☐ Register ☐ Previous

1 PATIENT

NAME ..... IDENTITY CARD NO. .....
PLEASE UNDERLINE SURNAME — FOR S'PORE CARD HOLDERS ONLY

MAIDEN NAME ..... DATE OF BIRTH ..... AGE .....

SEX: 1 ☐ Male 2 ☐ Female

MARITAL STATUS: 1 ☐ Single 2 ☐ Married 3 ☐ (Divorced / Separated / Widowed)

RACE: 1 ☐ Chinese 2 ☐ Malay 3 ☐ Indian 9 ☐ Other* ..... *Please Specify

DIALECT GROUP: 1 ☐ Hokkien 2 ☐ Teochew 3 ☐ Cantonese 4 ☐ Hainanese 5 ☐ Hakka ☐ Other* ..... *Please Specify

CITIZENSHIP: 1 ☐ Singapore 2 ☐ Malaysian 9 ☐ Other* ..... *Please Specify

COUNTRY OF BIRTH: 1 ☐ Singapore 2 ☐ Malaysia 3 ☐ China 4 ☐ Indonesia 5 ☐ India/Pakistan 9 ☐ Other* ..... *Please Specify

SINGAPORE ADDRESS ..... COUNTRY OF PERMANENT RESIDENCE .....

YEAR OF FIRST ARRIVAL IN SINGAPORE ..... OCCUPATION .....

2 HOSPITAL/CLINIC .....

UNIT ..... Unit No. .....

☐ In-patient - Hosp. No. .....

☐ Out-patient - Ref. No. .....

HOSPITAL, UNIT OR CLINIC RESPONSIBLE FOR SUBSEQUENT TREATMENT OR FOLLOW-UP.

☐ Same as above

☐ Other .....

3 DIAGNOSIS (specify primary organ or site of cancer and exact location if possible)

.....

DATE OF DIAGNOSIS .....

DURATION OF SYMPTOMS .....

BASIS OF DIAGNOSIS (check one or more as applicable)

1 ☐ Necropsy (No. ..... **) 5 ☐ Exploration
2 ☐ Biopsy (No. ..... **) 6 ☐ X-rays
3 ☐ Cytology 7 ☐ Clinical
4 ☐ Haematology 9 ☐ Other* ..... *Please Specify

**HISTOLOGICAL DIAGNOSIS .....

4 STAGE OF DISEASE (at time of diagnosis)

PRIMARY TUMOUR
0 ☐ Carcinoma-in-situ
1 ☐ Cancer restricted to primary organ or tissue of origin
2 ☐ Local extension beyond primary organ or tissue of origin

LYMPH NODE INVOLVEMENT ..... 1 ☐ Yes 2 ☐ No

REMOTE METASTASES ..... 1 ☐ Yes 2 ☐ No

5 HISTORY OF PREVIOUS DIAGNOSIS

Was cancer previously diagnosed in this case? ..... ☐ Yes ☐ No

If Yes,
Date cancer first diagnosed .....

By whom diagnosed .....

6 PRESENT STATUS

1 ☐ Alive 2 ☐ Dead
If Dead:
Date of Death .....

Place of Death .....

Cause of Death .....

.....

REMARKS (if any) .....

Date of Notification ..... Notified by .....

There was also the challenge of the sheer amount of data that had to be compiled. These came from a variety of sources, Mrs Betty Quah explains. “We had to glean the information from the central pathology lab which was responsible for entering all histological records and diagnosis,” she shares. “There was a big ledger, the Master Histology, which compiled all histological diagnosis as well as the postmortem book.” Apart from these, data was also collected from cancer notification forms submitted by doctors, and hospital discharge forms from all government hospitals.

Identification of cancer cases and copying the details into the index cards were no easy tasks. “We had to manually collate all data and everything had to be painstakingly transferred to index and punch cards,” Mrs Quah adds. Mrs Alice Yap, who joined in 1968, remembers that these details were handwritten into two sets of records: index strips and index cards and stored into large rollers. Mr Jalaludin S/O Peer Mohamed, was the ‘keeper’ of these records, acting like a librarian to organise and access the data. “One roller set was organised by identification number, and the other was filed by alphabetical order,” he says.

Collection aside, sense had to be made of all the data. To do this, this wealth of information was entered into 80-column punch cards. These acted like early forms of data ‘disks’ and were used to encode information by punching holes into stiff paper cards. The data was then shipped to the IARC in Lyon to be read and tabulated by card reading machines.

And even before the data from all the incoming forms could be entered into the registry, they had to be checked for accuracy – a job that required medical knowledge. In the first two decades of the registry, most of this checking was done by Prof Shanmugaratnam himself.

The office of the Singapore Cancer Registry in the 1970s. The large roller sets were placed on the table.

From single cells to systems perspective

In 1974, Prof Lee Hin Peng joined the SCR. Then a young doctor in his 30s, Prof Lee's main area of interest was public health and infectious diseases. When Prof Shanmugaratnam asked him to work with him in cancer trends instead, Prof Lee – who is NUS Emeritus Professor of Public Health – saw the significance of the work. Registries are repositories for important data that can be applied to a wide range of uses.

From a policy point of view, such data are important for planning and administrative purposes, while from a medical one, they had countless applications as a research tool. "It was an exciting new field at the time and I wanted to be part of it," says Prof Lee, who went on to head the SCR after Prof Shanmugaratnam retired from its directorship in 2002.

Much of the work itself though, turned out to be far from invigorating. Prof Lee recalls how he was tasked with checking through notification forms to ensure that there were no glaring mistakes. For instance, the form could not indicate that a woman had prostate cancer or that lung cancer was found in the kidney. Although spending hours meticulously looking through forms was rather boring, Prof Lee stuck to the task. "Maybe it was a test," he jokes.

If it was, Prof Lee passed it. After several weeks, Prof Shanmugaratnam asked him to join him in looking at some epidemiological data. However, form checking was still to be an inevitable, recurring task and a rite undertaken by many who were involved in the work. As Prof Lee put it: "For every type of work, there is a laborious aspect to it, but it was what was required to build the registry."

He speaks admiringly of Prof Shanmugaratnam's instinct and vision for the work. "He was way ahead of his time," Prof Lee says. The seemingly 'old fashioned' strip index panels which Prof Shanmugaratnam used contained all the essential personal information of patients. Placed on a carousel, the strips could be rotated to retrieve basic information within seconds. This manual reference system predated the current database systems but made for quick referencing. They were also eminently reliable as they were not prone to failure due to power outages or system crashes. "This manual system was to become the conceptual framework for an eventual computer-based version, known as the CANREG, a cancer registration software produced by IARC," Prof Lee says.

Quite apart from his logical and meticulous approach to the building of the database, Prof Shanmugaratnam was unflagging in his dedication to gathering the data for it. As cancer notification was not mandatory at the time, he spent a lot of time coaxing his medical colleagues and hospital administrators to report cases. By this time in the 1970s and early 1980s, the number of private and public pathology labs had grown from beyond a single source. It was important for them to contribute their own cancer diagnoses to ensure a complete record. "Prof Shanmugaratnam was very active in engaging doctors, hospitals and pathology labs, making a lot of calls to garner support and doing what we call 'leather shoe epidemiology' to work the ground to build the registry," says Prof Lee.

All this effort came to fruition in 1983 when the data collected by the SCR led to the publication of Singapore's first two reports on cancer trends: Cancer Incidence in Singapore 1968-1977 and Trends in Cancer Incidence in Singapore 1968-1982.

Into the computing age

By the mid-1980s, some manual aspects of the work had eased. In the early 1980s, the SCR eventually acquired its own – albeit very basic – computing equipment. In fact, the programming systems in those early days of the computer could barely handle the SCR's large volumes of data. "It would crash once it reached 10,000 entries," laments Prof Chia Kee Seng with a wry smile. Prof Chia is Professor and Founding Dean at the Saw Swee Hock School of Public Health, NUS.

Roped in by Prof Lee, Prof Chia started getting involved in the registry in 1986. An occupational medicine specialist by training, Prof Chia was also interested in computers and was asked to develop the SCR's first digital database. He also set it up as a local area network instead of a single computer so work could be done concurrently.

Prof Chia encountered the leading pathologist as a medical student during his pathology module. He remembers Prof Shanmugaratnam's lectures being quite different from the norm as students were often engaged to share ideas and thoughts. Prof Chia's first personal encounter with Prof Shanmugaratnam was not very pleasant. Being colour blind, he approached Prof Shanmugaratnam with a medical letter informing him of the situation. He had a vague idea that it would confer him some special consideration during exams as he was not able to distinguish the colour red – a necessary ability to identify certain diseases under the microscope. According to Prof Chia, he was dismissed with a rather gruff: "So, what do you want me to do?" It was for this reason that Prof Chia was apprehensive when he was approached to help out in the registry. But he agreed because he reasoned that he could avoid Prof Shanmugaratnam since he would mainly be writing computer codes.

Writing computer codes was yet another tedious but important step in the registry's growth and Prof Chia would often code into exhaustion, starting early in the morning and working late into the evenings. Often, Prof Shanmugaratnam would come out from his office and the two would chat, breaking the monotony of the coding task. Whatever had transpired in the past was long forgotten.

Prof Chia notes that even with a computer, producing the monographs was still a laborious affair. With the computing power of the time, it took one year to just generate the appendices for the 1992 SCR monograph.

According to Prof Chia, these appendices – basically tables of numbers – spanned some 160 pages. "I picked up a mistake in the programming that resulted in some errors," Prof Chia remembers. However, this would have taken three to four weeks to rectify. Prof Chia decided it would save time if Prof Shanmugaratnam reviewed this version of the draft first.

He was awestruck when the elderly Professor actually spotted the errors amid a sea of tables and numbers, remarking that there was something not quite right with the numbers. Prof Shanmugaratnam's intuition for the work was remarkable, Prof Chia says in admiration. Even though as a pathologist, he was not trained to look at numbers, but he was nevertheless sharp enough to spot the errors.

This acuity is often remarked as one of Prof Shanmugaratnam's greatest traits, underpinned by a deeply humble, austere and private nature. Though a giant in his field, the unassuming gentleman disliked attention, was not one for small talk and had simple needs. "He ate an apple and cereal bar each day for lunch, that was all!" recollects Mr Jalaludin.

Together, these characteristics commanded the respect of all who had the privilege of working with him. His staff remember him fondly as a good boss with a fatherly temperament who took time to explain concepts to them. "He treated us like medical students and even called us 'registrars'," says Mrs Yap. "And if we didn't understand anything, he would hold roundtables to explain to us, drawing diagrams, going through histology. He didn't need to do it, but he wanted us to learn," she adds.

> **"Even though as a pathologist, he was not trained to look at numbers, but he was nevertheless sharp enough to spot the errors."**
>
> **— Professor Chia Kee Seng**

Growth and evolution

In 2001, a year before Prof Shanmugaratnam's retirement as director of SCR, the registry and its three decades of data were transferred to the Ministry of Health (MOH) and subsequently came under the purview of the Health Promotion Board's National Disease Registries Office (NDRO). By now, SCR had established itself as a leading resource for cancer trends. The SCR joined other disease registries such as those for heart attack, chronic kidney failure and stroke. Coming under the fold of NDRO conferred SCR with more resources, and operations became more sustainable and efficient. Apart from a dedicated team that performs field data collection, the registry is staffed by a group of epidemiologists and data managers.

Since its first IARC monograph covering the period 1968-1977, the SCR had gone on to publish, once every five years, detailed monographs on the incidence and trends of cancer and survival of cancer patients in Singapore, as well as contribute to the Cancer Incidence in Five Continents published by IARC and many other publications. Subsequently, the SCR also began publishing short condensed yearly reports, on top of the five-yearly monographs.

The current database in the registry is a veritable goldmine of useful data to support and stimulate research for cancer control. It has enabled many case-control studies to be conducted. For instance, it played a significant role in the Singapore Chinese Health Study, established between April 1993 and December 1998. The large cohort study of 63,000 Chinese studied the association between diet and cancers, including nasopharyngeal cancer, on which Prof Shanmugaratnam was a particular expert.

The work of SCR is today largely computerised and online – the records of cancer cases are maintained electronically and most data sources are obtained through online submission by the healthcare institutions. Ms Sarjit Kaur who joined SCR in year 2002, had the privilege of working with Prof Shanmugaratnam. "I looked up to him very much and would always try to get his attention, but he was a man of few words. Though he looked quite stern and had high expectations of us, he was actually a very gentle man," she says. At the time she joined the registry, the subject matter and work, she acknowledges, were not as manual, but still exacting as Prof Shanmugaratnam demanded no less then utmost scrupulous care. Accuracy was everything.

The pioneer team
Clockwise from top: Mr Jalaludin S/O Peer Mohamed, Mrs Alice Yap, Mrs Betty Quah, Ms Sarjit Kaur

> **"I looked up to him very much and would always try to get his attention, but he was a man of few words. Though he looked quite stern and had high expectations of us, he was actually a very gentle man."**
>
> **— Ms Sarjit Kaur**

Rigour and dedication

In 2007, the National Registry of Diseases Act (NRDA) was enacted to institute mandatory disease notification and the NDRO was renamed the National Registry of Diseases Office (NRDO). The Act was later updated in 2009, making cancer notification compulsory.

A/Prof Sng, although a member of the Advisory Committee of the SCR from 1972 – 2002, increased her involvement with the SCR to become its Visiting Consultant Pathologist, while still working as a Senior Consultant. She had relinquished her duties as administrative head of the Histopathology Section of the SGH Department of Pathology. "I decided to spend more time helping the cancer registry in the classification and coding of disease," she shares. It was an extension of her long professional association with Prof Shanmugaratnam and the registry. Not only did the two often consulted with each other on cases, as the Histopathology section of SGH received all pathology specimens for diagnosis from other government public hospitals including Tan Tock Seng Hospital, Kandang Kerbau Hospital, and Changi General Hospital before they set up their own pathology laboratories, she ensured that SCR received the data on cancer notification on a regular basis. She also contributed a chapter on blood cancers in the 2002 SCR monograph.

A/Prof Sng highlights the important role that the registry has played in driving good medical care. "Every country should have a registry because there must be a record before you can talk more generally about trends." As Prof Chia notes, "One of the greatest contributions of the registry is in terms of providing data to make better policy decisions." Prof Lee adds to this point: "By identifying trends and linkages we can develop a better understanding of cancer control, as well as evaluate the effects of drugs and treatments."

In many ways, these points dovetail with a pathologist's own professional goals: conducting a rigorous assessment of data to come to a diagnostic determination. Pathology, says A/Prof Sng, strives to understand the basis of disease from data that is gathered. It plays a crucial role in the diagnosis of illness, be it cancer or other diseases. As Prof Chia terms it: "Pathology is the quest for knowledge and the truth."

Prof Lee looks back on the five decades of work that have gone into building SCR with professional satisfaction. There is gratitude for all those who have contributed. From Prof Shanmugaratnam's guiding leadership, its dedicated staff, form-checking doctors and each and everyone in the medical community who sent in a notification, these efforts have driven SCR and its evolution. "There is a whole office built around the registry and its functions now," Prof Lee reflects. "When we started, we knew the drudgery of the work to collect the data was important to start building the registry. Good data was built on this type of work and with good data we've built a good registry."

All has been made possible because of Prof Shanmugaratnam. "He was the quintessential professional who could go beyond the narrow confines of his duties and expertise," says Prof Lee. "Indeed, he put Singapore on the world map of cancer epidemiology."

> **"He was the quintessential professional who could go beyond the narrow confines of his duties and expertise."**
>
> **— Professor Lee Hin Peng**

Recollections

A/Prof Adeline Seow

Associate Professor, Saw Swee Hock School of Public Health, NUS

Preparing the five-yearly cancer 'trends' monograph for the SCR was a particularly memorable experience for me as a young cancer epidemiologist, because Prof Shanmugaratnam would always ask to review all the tables in the histology chapter. For each primary site, I would show him the distribution of histological types, and he would point out which codes could be combined, and what terminology should be used in the report.

He was always patient and gracious when working through the data with me, knowing exactly what level of detail a non-pathologist would need to make sense of what we were doing. At the same time, he was razor-sharp in detecting discrepancies and expected the highest level of accuracy and attention to detail in the numbers that were being compiled. "You're responsible for the figures," he reminded me on one occasion, "… and answerable." Those are words that every aspiring epidemiologist needs to hear at least once in his/her career; and hearing them from someone with the wisdom and gravitas that Prof Shanmugaratnam had, left an indelible impression on me."

Prof Koh Woon Puay

Professor, Duke-NUS Medical School and Saw Swee Hock School of Public Health, NUS

I was asked by Prof Lee in 2003 to commit time to working in SCR, and also to be involved in the writing of the 2004 edition of the cancer trends monograph (which has become one of the publications I am most proud of). The work in SCR involved checking the accuracy of cancer notification forms submitted by doctors. I recalled filling out these forms after my ward work as a busy houseman years ago. As I spent a few afternoons a month checking these forms and correcting the errors in the SCR office, I certainly wished I had been more careful when I was filling the forms myself! Though this was a mundane task, it was necessary to do this to preserve the accuracy and quality of information in SCR.

As the youngest in the team, I learnt so much from A/Prof Seow (my senior), Prof Lee (my mentor), and of course, Prof Shanmugaratnam. When we were preparing the 2004 edition, after A/Prof Seow and I had categorised the cancers under different histological subtypes, I was tasked to check these with Prof Shanmugaratnam at NUS to make sure we had not made any mistakes in the categorisation. Prof was always very patient to sit down with me in his office and go through the work with me. Even though I was not a trainee in pathology, he taught me with care and passion to help me appreciate the intricate differences among different histological subtypes of cancer from the same site. Sometimes, he would even pull out slides from his boxes of collection to let me look at the different cancer tissues under the microscope and explain the differences to me.

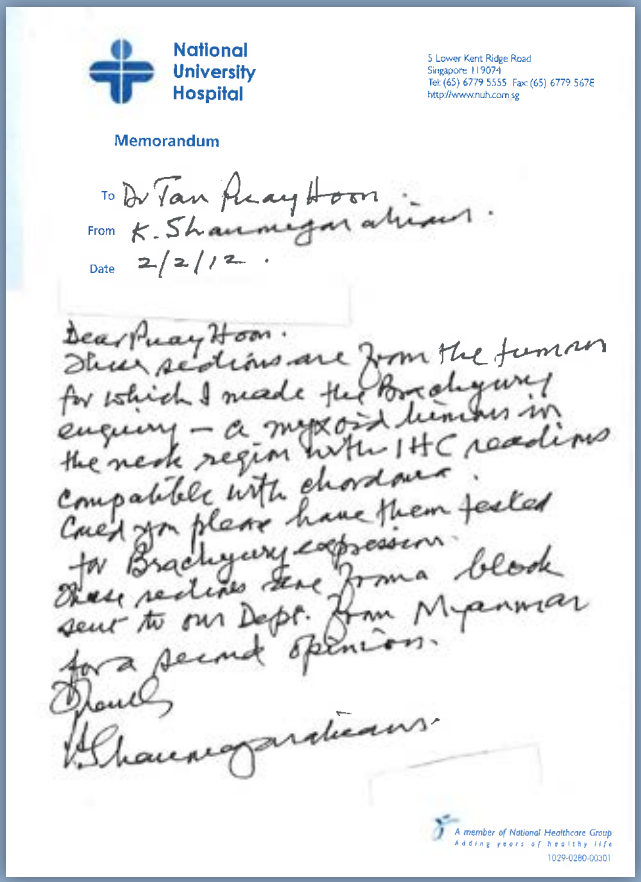
The classification of cancer widely used by cancer registries and by WHO today is the International Classification of Disease for Oncology, currently in its third revision (ICD-O-3), which was published in year 2000 by the WHO. Among the 7 internationally acclaimed editors listed on the cover of the book, Prof Shanmugaratnam is the only Asian. Prof had initially lent the book to me as reference for my work on the cancer trends monograph. After the monograph was completed, he gifted the book to me and at my request, he also autographed the book. Today, it still sits on the shelf in my office as my reference for classification of cancers in my research, and a precious reminder of the outstanding pathologist and great mentor in Prof Shanmugaratnam."

Prof Tan Puay Hoon

Chairman and Senior Consultant, Division of Pathology, SGH

I was a young medical student when I attended lectures delivered by Prof Shanmugaratnam. He struck me as an extremely articulate, erudite and imposing individual who drew natural respect from one and all. He was serious and somewhat stern when we were students, though in later years, he was more fatherly and mellow. As a trainee in SGH Pathology, I remember how he was very generous in loaning his teaching set of glass slides for us to practise for pathology examinations, even though we were not from his Department at NUS Pathology. He would go through our written answers and discuss cases with us.

As the 'go-to' pathologist, Prof Shanmugaratnam always had time for a challenging case and would offer constructive and helpful insights. He would pen his opinion in his characteristic cursive handwriting, providing a description of the case and why he arrived at a specific diagnosis – it was so educational just reading his note! His superlative intellect and continuous pursuit of knowledge were truly admirable. He brought Singapore pathology to the international arena with his involvement in the WHO tumour classifications. A modest and humble man, he was self-effacing and averse to public accolades. Prof Shanmugaratnam will always be an icon for the pathology and medical community in Singapore and beyond."



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http://www.nuh.com.sg

Memorandum

To Dr Tan Puay Hoon.
From K. Shanmugaratnam.
Date 2/2/12.

Dear Puay Hoon.
These sections are from the tumour for which I made the Brachyury enquiry – a myxoid tumour in the neck region with IHC readings compatible with chordoma.
Could you please have them tested for Brachyury expression.
These sections are from a block sent to our Dept. from Myanmar for a second opinion.
Thanks
K. Shanmugaratnam.

A member of National Healthcare Group
Adding years of healthy life
1029-0280-00001

A handwritten note from Prof Shanmugaratnam about a case in which he requested for a specific immunostain to be performed - he would always evaluate cases thoroughly and meticulously in order to arrive at an accurate diagnosis.

Singapore Cancer Registry:
Delivering value amid challenges

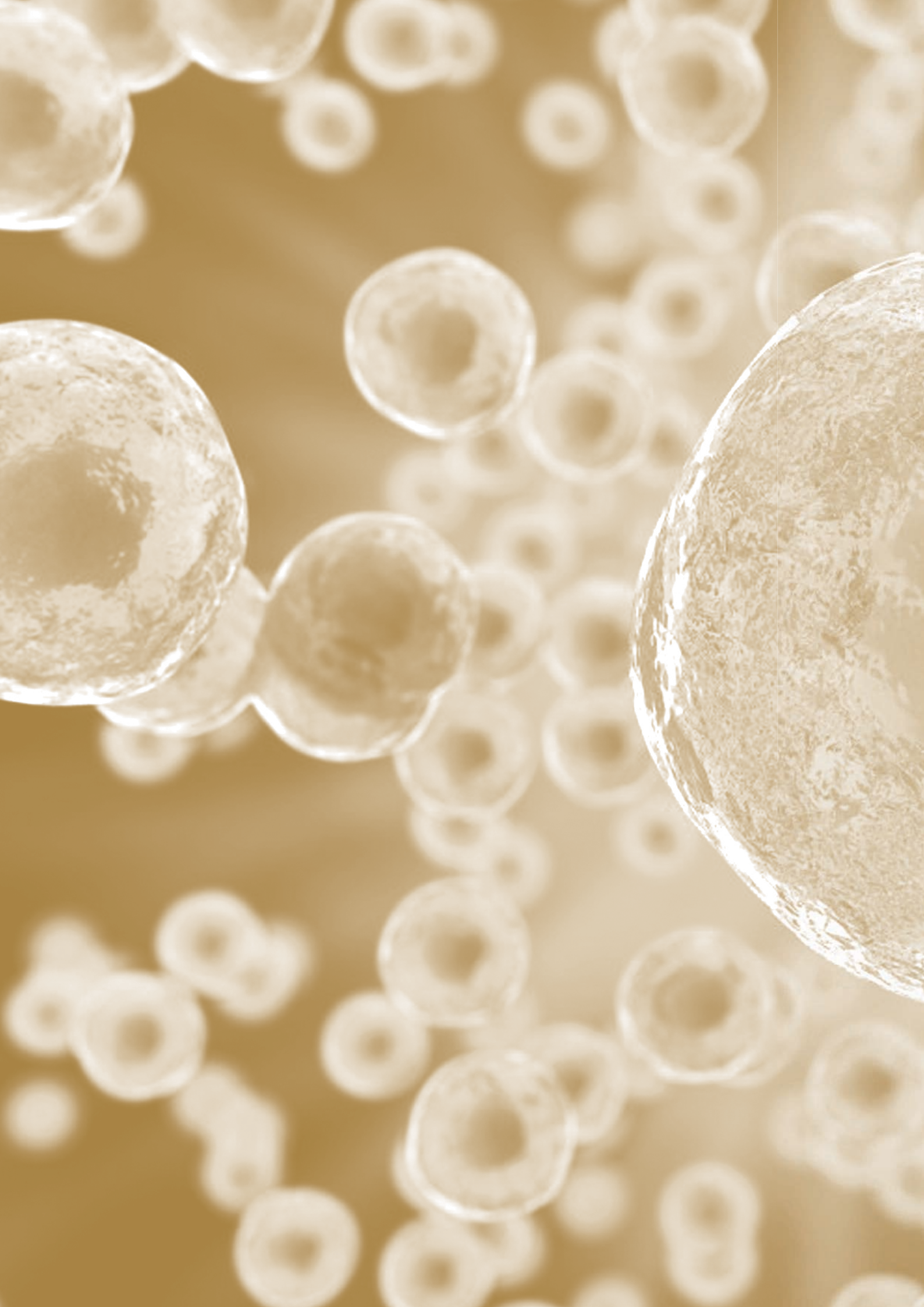
Prof Tan Puay Hoon
Chairman and Senior Consultant, Division of Pathology, SGH

Cancer diagnoses are not always straightforward. Pathologists may also vary in the manner in which they describe and classify tumours. Sometimes it can be challenging to allocate tumour codes from pathology reports. Standardised approaches to cancer classification, based on the latest WHO tumour classification guidelines, help in consistent coding. However, not everyone is immediately aware of latest updates in tumour classification of different organ systems, and it is therefore important that changes in classification should be promptly and effectively disseminated amongst the pathology community, as well as communicated to clinicians managing patients with these tumours. Coding systems need standardisation and should move in tandem with classification schemes. What we sometimes experience currently is an occasional disconnect between tumour coding and classification updates. Additionally, staging systems, while mostly similar in the majority of descriptive elements, have some differences, which may also lead to potential discordances.

Seated: Prof Shanmugaratnam, Standing from right to left: Prof Tan Puay Hoon, Dr Angela Chong

Cancer registries represent the source of cancer data for a country and it is imperative that categorisation of cancers is precise and consistent, so that accurate trends can be mapped, and healthcare strategies may be implemented to reduce the cancer burden for the population. Clinical diagnoses of cancer without histological confirmation should be minimised, as these represent best 'guesses' of cancer types; if they form a significant proportion of cancers in the registry, reliability of cancer data will be reduced.

Despite inevitable and evolving challenges, the SCR continues to play an essential role in maintaining accurate cancer data for Singapore, which can be harnessed for understanding cancer trends, improving treatment for ultimate cure, and reducing risks for cancer prevention.



CHAPTER 2

EVOLVING TRENDS IN CANCER CLASSIFICATION

The Pathologist's Perspective

Professor Tan Puay Hoon
Visiting Consultant Pathologist, Singapore Cancer Registry
Chairman and Senior Consultant, Division of Pathology, Singapore General Hospital, Singapore

Dr Ian A Cree
Head of WHO Classification of Tumours
International Agency for Research on Cancer, Lyon, France

Introduction

The classification of cancer can be considered as having begun, in rudimentary fashion, from the time of ancient Egypt, when records of bone tumours in mummies, as well as the earliest description of breast cancer, existed [3]. The word 'cancer' however, originates from the Greek word 'karkinos' or 'crab'. The word, used by Hippocrates, describes the appearance of the invading tumour front, which has a similar appearance to the crustacean.

As medical science evolved and human dissections in the early centuries led to greater understanding of cancer by anatomists and pathologists [4], it became possible to improve disease documentation based on macroscopic appearances of cancer and the organ systems that the cancer involved. The advent of the microscope and its increased availability in the mid-19th century allowed more detailed examination of cellular morphology. This had a critical role in shaping the emergence of pathology as a discipline and in propelling the growth of microscopic pathology that underpins the cellular basis of malignant neoplasia and histological recognition of cancer [4]. Today, cancer classification remains centred on a combination of macroscopic and microscopic assessment.

Why classify cancer?

Cancer, or malignant neoplasia, is a complex disease with multiple causes (aetiologies), diverse cell origins and protean morphological manifestations. Categorisation serves to allow the consistent recognition and diagnosis of specific tumour types, and importantly, is a key function for prognostication and optimised therapy.

Some cancers are low grade and indolent, and may not warrant radical treatment apart from complete removal. In contrast, high grade malignancies require more aggressive approaches, which may include chemotherapy and radiation, in addition to surgical resection. Accurate classification ensures the institution of appropriate treatment for patients, which is based on the results of randomised controlled trials and other studies across the world. If diagnosis differs between countries, then it is difficult to apply the results for cancer treatment worldwide. As a result, the need for an internationally accepted classification system is incontrovertible.

WHO recognised this need in 1956, through a resolution of the WHO Executive Board, endorsed by the World Health Assembly the following year. The first edition of the classification to be published as a series of books was produced by Dr Leslie Sobin between 1967 and 1981. At that time, the books were simple atlases, containing the name of the tumour type and a series of histological pictures. Over time, the books have evolved, with Dr Paul Kleihues taking the lead for the 3rd Edition, this was followed by Drs Hiroko Ohgaki, Sunil Lakhani, Fred Bosman and Elaine Jaffe for the 4th Edition. The new 5th Edition is run by Dr Ian Cree at

the IARC, a specialised agency of WHO in Lyon, with the help of a distinguished editorial board including Dr Tan Puay Hoon. The books now include many of the factors influencing cancer classification and go beyond histopathology to consider other facets of cancer classification, many of which alter the diagnosis and treatment of patients directly.

Factors influencing cancer classification

Cancer classification is now recognised as an intrinsically dynamic and continually evolving process, with factors that affect concepts around how specific tumours are regarded and hence classified. There are several views on how to classify cancer – whether based on aetiology [5], pathogenesis, morphology or its manifestations.

From a pathological perspective, identifying morphological changes in tumour specimens remains a fundamental tenet in evaluation, and forms the foundation of cancer classification. Morphological classification has been used by the WHO since the first series of the classification, with modifications through the years as new knowledge, tools and techniques emerge. Today, the 5th Edition WHO tumour classification books incorporate validated data from many modalities that enrich how various cancers are categorised.

There are multiple influences in cancer classification (Figure 2.1), of which ten factors are discussed below.

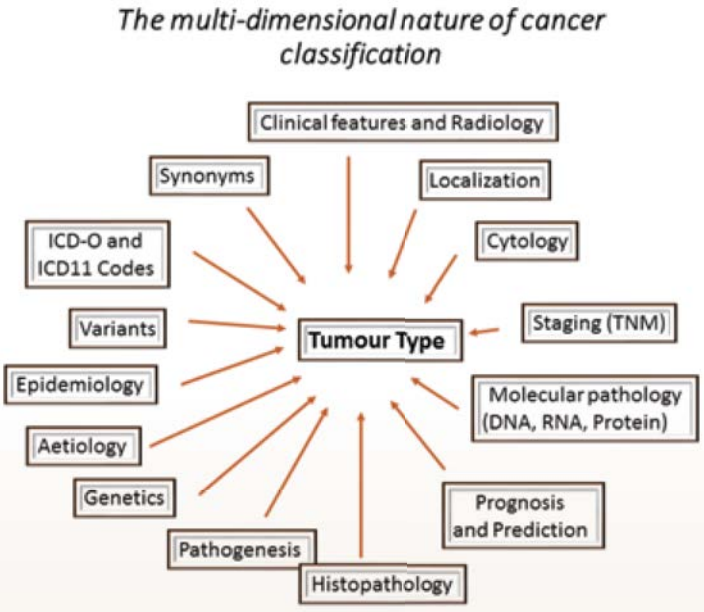


Figure 2.1. Cancer classification may be viewed from multiple dimensions, with the recognition of pathology changes remaining a key tenet of tumour categorisation.

1. Evolving concepts of disease

As scientific evidence about specific cancers emerges, it is natural that classification, terminology and therapy are modified based on new information. For instance, medullary carcinoma of the breast was a histological subtype of invasive breast carcinoma that contained a prominent lymphoplasmacytic infiltrate which could be so dense that a cursory glance would lead one to think of metastatic carcinoma involving a lymph node (Figure 2.2).

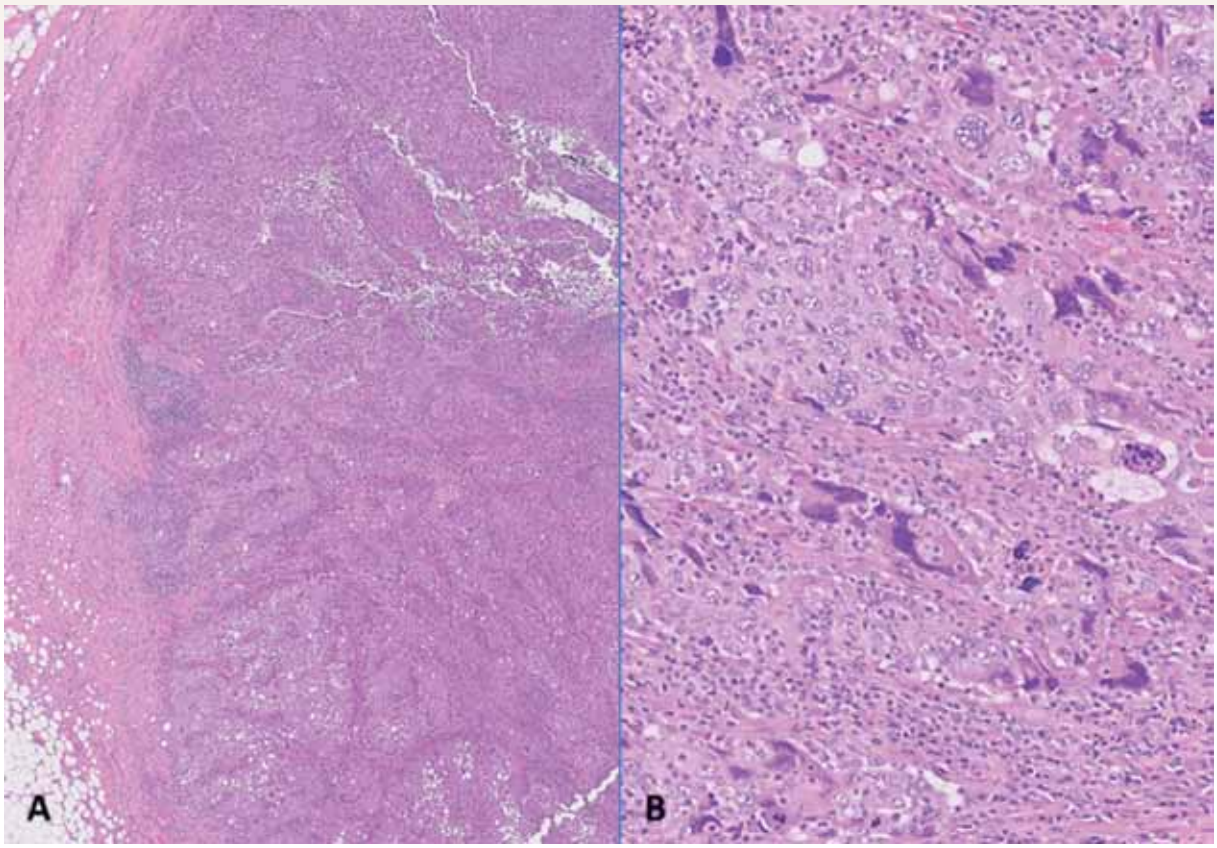


Figure 2.2. Breast carcinoma with medullary-like features, now currently regarded as part of the spectrum of invasive breast carcinomas that are enriched with tumour infiltrating lymphocytes. A. At low magnification, the tumour appears circumscribed and may be mistaken for metastatic carcinoma in a lymph node. B. At high magnification, malignant cells display marked nuclear pleomorphism including multinucleation, and are bathed in many lymphocytes and plasma cells.

Its recognition required fulfilment of strict histological criteria, to the degree that it became a vanishingly rare diagnosis – very few tumours would be considered as sufficiently characteristic. In acknowledgement of poor inter-observer reproducibility and challenges in applying the required microscopic criteria, the WHO working group recommended that medullary carcinoma, atypical medullary carcinoma and invasive carcinomas with medullary features be classified together as 'carcinomas with medullary features' [6].

It was not merely the challenge in histological diagnosis that led to a revised approach to the classification of breast cancers with medullary features. It was found that prominent lymphoplasmacytic infiltrates were associated with a better prognosis, and that these tumours tended to express basal-like features with about 13% harbouring *BRCA1* mutations [6]. The latest WHO classification of breast tumours (5th Edition) incorporates them under 'invasive carcinoma, no special type' as a morphologic subset with 'basal-like' or 'medullary-like' features, representing part of the spectrum of tumour infiltrating lymphocyte (TIL) rich breast cancers [7]. Most recently it has been recognised that many of the TILs present have a part to play in the immune response to breast cancers and there is gathering evidence of their role in determining the outcome of cancer treatment in many patients.

2. Recognition of new entities

New entities continue to be recognised when meticulous pathological assessment finds unique morphological features of tumours that have not been previously described, or when scientific research uncovers genetic information that refines or modifies classification.

One such entity is the 'tall cell carcinoma with reversed polarity' in the breast, previously documented under terminologies of 'breast tumour resembling the tall cell variant of papillary thyroid carcinoma' as well as 'solid papillary carcinoma with reverse polarity'. Both these entities have been united by a consistent observation of mutations of the *IDH2* and *PIK3CA* genes [8]. With multiple peer-reviewed scientific reports of its existence, this entity will be formally included in the WHO classification of breast tumours in 2019. The recognition of this lesion independently by two groups led to some complexities of nomenclature, one of which incorporated a reference to papillary thyroid carcinoma in its terminology. This is not without its dangers as this is a form of breast cancer that has no relationship to thyroid cancer. Names matter: at their best they have the ability to convey information about the diagnosis of a cancer and its likely behaviour to any doctor, while confusing names can lead to potential mismanagement of patients.

3. Information on biological behaviour

When clinical behaviour of tumours designated as cancers is found to be so indolent that the diagnosis causes unnecessary stress to patients, classification may be modified to reflect its biology. The multilocular cystic renal neoplasm of low malignant potential (Figure 2.3), a term used in the 2016 WHO classification of tumours of the urogenital tract, was previously referred to as the 'multilocular cystic renal cell carcinoma'. While lesional cells of this tumour are morphologically and immunohistochemically identical to those of conventional clear cell renal carcinoma, its histology is characterised by multiple thin-walled cysts lined by clear cells without any expansile clear cell nodules [9]. As recurrences or metastases have not been reported, there was a consensus to change its terminology and classification to that of a neoplasm of low malignant potential. Such amendments are not taken lightly, as there is significant impact on pathologic assessment, cancer registry data and medical insurance claims. Nevertheless, by making such changes, patients benefit from optimal treatment and are less likely to suffer the consequences of a diagnosis of cancer in their daily lives.

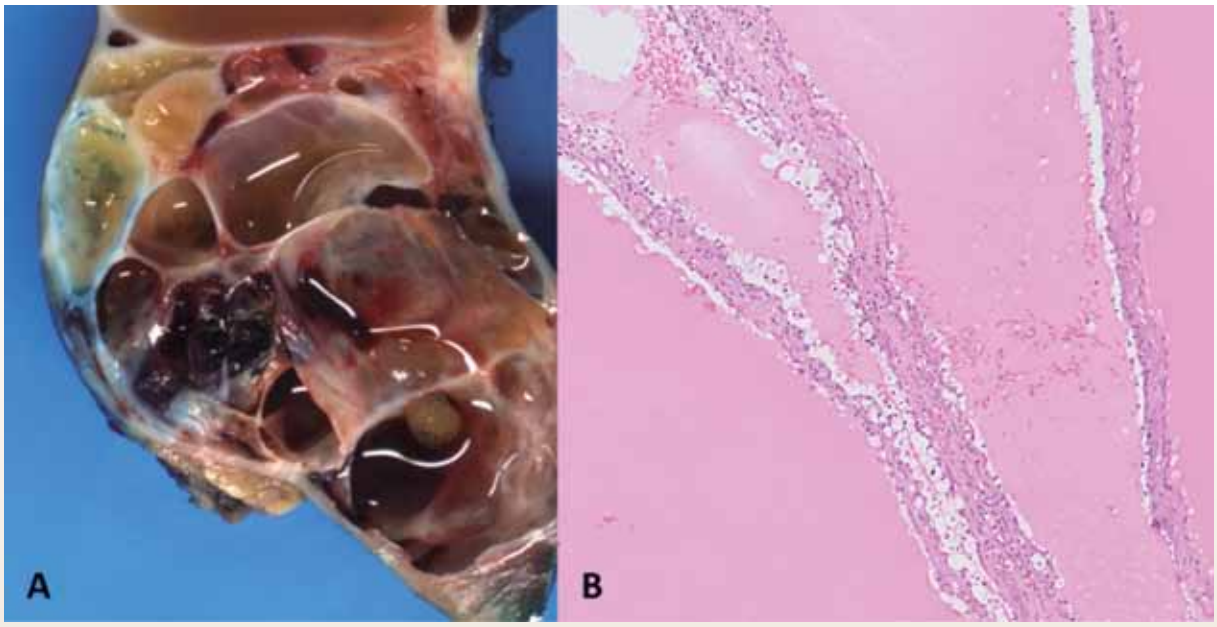


Figure 2.3. Multilocular cystic renal neoplasm of low malignant potential. A. Macroscopic appearance shows a multilocular cystic lesion with thin-walled cysts containing haemoserous clear fluid. B. Microscopy shows clear cells lining the cysts, with thin fibrous walls. The cysts contain pink proteinaceous material.

4. Availability of molecular pathology

Advances in molecular pathology in recent decades have revolutionised cancer diagnostics and therapeutics. Whereas traditional morphology is assisted by routine protein immunohistochemistry in classifying cancer, the availability of molecular tools that can drill right to the genetic basis of different cancers has resulted in a paradigm shift in how some cancers can be categorised from the molecular perspective.

In breast cancer, expression profiling recognised the intrinsic subtypes – luminal A, luminal B, HER2 enriched, normal breast-like and triple negative/basal-like [10]. This has deepened the understanding of the molecular heterogeneity of breast cancer, as well as allowed further stratification for novel therapeutic approaches [11], especially in triple negative breast cancer.

Similarly, in lung cancer, molecular studies have transformed the diagnosis of non-small cell lung cancers, in particular adenocarcinoma, whereby the presence of specific mutations (Figure 2.4) offers the option of targeted treatment [12].

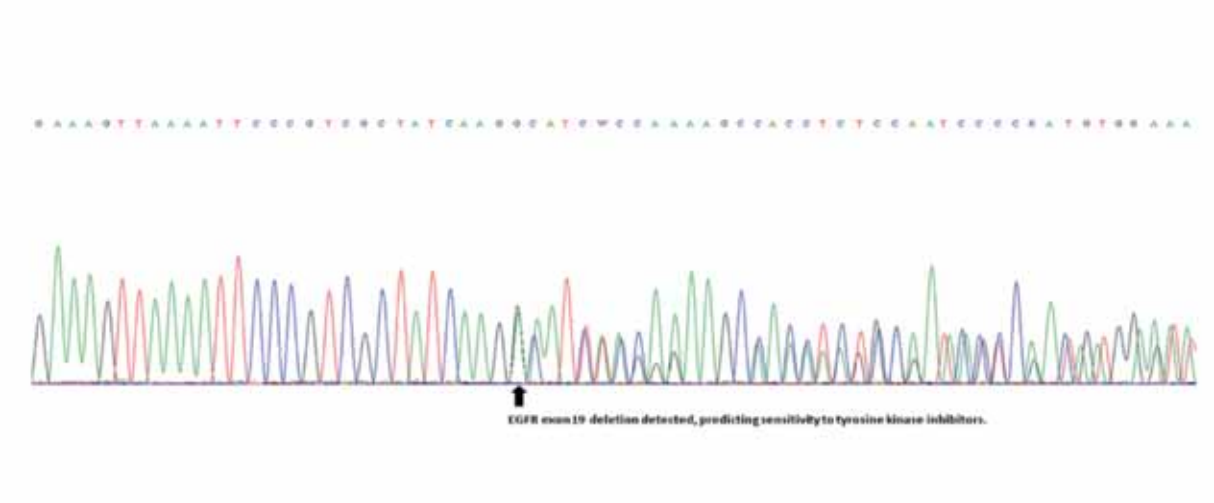


Figure 2.4. Lung adenocarcinoma subjected to molecular analysis shows an exon 19 mutation in the EGFR gene, predicting response to tyrosine kinase inhibitor therapy (courtesy of Dr Chan Kian Sing).

This is known as individualised or personalised medicine, in which cancers are treated according to the mutations present in key genes. In addition to lung cancer, such treatments are now available for melanoma, colorectal cancer and some breast cancers. Very rare cancers seem often to have arisen with highly specific mutations which as well as their use in diagnosis have therapeutic implications. One such example is a rare sarcoma called gastrointestinal stromal tumour (GIST) [13]. The plethora of new drugs and strategies available to treat patients is revolutionising the management of many cancer patients and has been likened to 'molecular chess' [14] in which the development of resistance to particular drugs can be countered by the use of others.

5. Screening and early disease

Population-based and opportunistic screening for early disease detection is available in many countries. In areas where screening for cervical cancer has been fully implemented, the rates of death due to this form of cancer have become significantly reduced. This contrasts with countries where the common causative virus serotypes (HPV 16 and 18) are common. The success of vaccination for the cancer-causing serotypes of HPV has resulted in the WHO advocating this (with screening) for elimination of cervical cancer as a public health concern [15].

For breast cancer, the advent of mammography has led to an increased incidence of breast ductal carcinoma in situ (DCIS), from 5% in the pre-mammographic era, to 26% of all breast cancers diagnosed currently in Singapore [16]. While the benefits of breast cancer screening are not in doubt, pathologic interpretation of early lesions, especially the closely related atypical ductal hyperplasia and low-grade DCIS, has raised issues of inter-observer reproducibility and concern for overdiagnosis of DCIS [17]. This has led to calls for removing the term 'cancer' from these lesions. Many breast cancer experts have opted to retain the nomenclature of DCIS – acknowledging that it is a heterogeneous disease, and classification can be improved by stratification into indolent and aggressive groups that can be treated differently. It is to be noted that even 'indolent' low grade DCIS may recur [18].

Colorectal cancer is the third cancer type commonly screened worldwide. This can be done using a variety of methods. The most common is the detection of blood in stool samples by chemical or immunohistochemical tests. Positive results are followed up by colonoscopy to identify tumours at an early stage of their development. This results in substantial reduction in risk of metastatic cancer in patients and is cost effective [19].

The detection of less common cancers remains an issue. For instance, the cost-effectiveness of lung cancer detection by spiral CT continues to be controversial. Developments in this area are occurring rapidly, with the possible development of blood tests for cancer an area of active research [20].

6. Standardisation and the role of international bodies

The role that international bodies such as the WHO play in standardising tumour classification cannot be overemphasised. Standardised nomenclature and universally accepted histological criteria for defining different cancer types are of paramount importance in ensuring cancer data are comparable across the world.

The WHO tumour classification series provides the definitive guide to cancer classification and continues to remain a global leader in charting the future for categorising cancers universally. International consensus through specialty professional societies can also help in disseminating cancer classification reviews and approaches. There needs to be a fine balance between morphological and molecular classification, as the latter may not be readily available in less developed countries.

7. Aetiology, pathogenesis, clinical manifestations

The taxonomy of cancers can be seen from multiple viewpoints, so aetiology, pathogenetic mechanisms and clinical manifestations remain important facets of classification. Take the recent shift towards acknowledging sun exposure as a key aetiological factor for the classification of melanocytic tumours of the skin. This has led to the grouping of these neoplasms based on whether sun exposure has been intermittent or of a more chronic nature [21], related to an understanding of the histopathology, genetics and aetiology of melanoma.

Although these characteristics are integral to the comprehensive pathology of cancer and can sometimes be used to affirm diagnostic categorisation, morphology remains the cornerstone of cancer recognition and classification by pathologists, refined through the years with knowledge gleaned about aetiology, pathogenesis and clinical symptomatology.

8. Biopsy modalities

Preoperative core biopsy diagnosis of cancer is the current gold standard in the workup of lesions discovered in many organs such as the breast, as it allows therapeutic planning and proper patient counselling. The limited nature of the core biopsy sample (Figure 2.5) has imposed challenges in cancer classification.

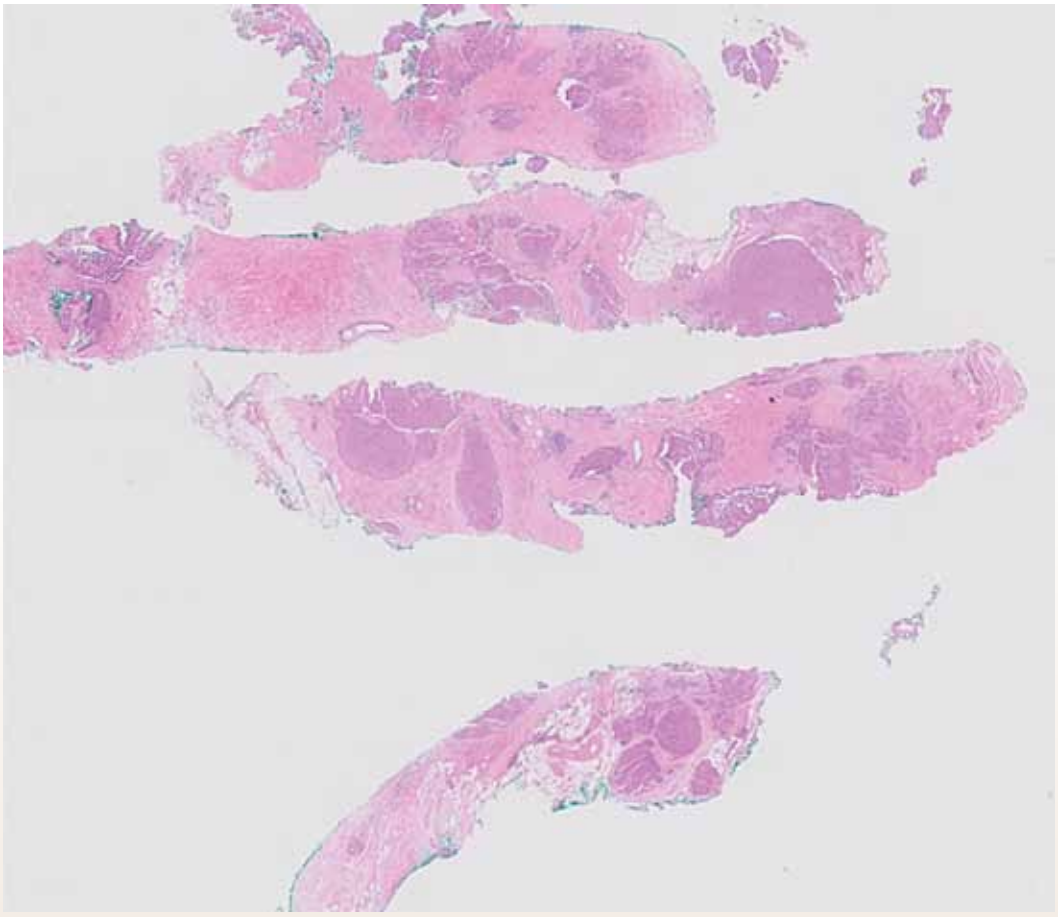


Figure 2.5. Core biopsy of a breast tumour shows several tissue fragments containing solid islands of tumour cells, diagnosed as solid-papillary carcinoma with both in situ and invasive forms. Tumour classification may be challenging in limited core biopsy material.

Apart from insufficient material to accurately grade cancers, cancer type cannot be concluded even with the assistance of adjunctive immunohistochemistry in some instances, with the final diagnosis requiring complete excision of the tumour for histological evaluation.

The widespread reliance on core biopsies for cancers that may be subjected to chemotherapy without upfront tumour resection has led to some tumour types (such as non-small cell lung cancer) being accorded unique terminology for sub-classification on small biopsy samples [22].

Fine needle aspiration biopsy – considered an inexpensive and cost-efficient method for screening and diagnosis, and used widely in some countries – may not be able to achieve the same degree of classification accuracy as the core biopsy.

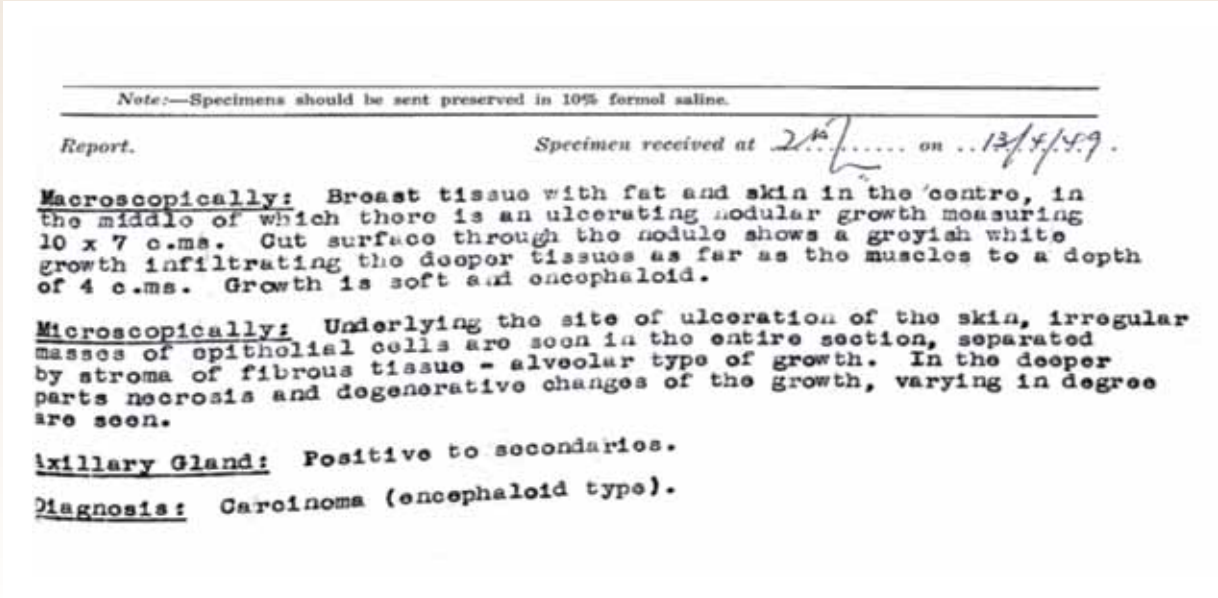
Liquid biopsy – currently still an emerging tool for cancer surveillance – may impact future classification of cancers, especially in treatment of resistant cancers through identification of predictive biomarkers in circulating tumour cells and cell-free DNA [23].

9. Digital pathology and artificial intelligence

The use of digital pathology to improve cancer classification is already a reality through the sharing of whole slide images to promote inter-observer reproducibility and expert diagnosis. Digital pathology also has the potential to harness artificial intelligence tools to facilitate cancer diagnosis, classification and grading, as well as quantify predictive and prognostic markers, for instance allowing the assessment of proliferation that is important for many tumour types [24].

10. Reporting of cancer

Many decades ago, the diagnosis of cancer could be based on a clinical conclusion, macroscopic assessment of the tumour, or a brief histological evaluation (Figure 2.6). Pathologic diagnosis of cancer today however, has become a comprehensive rendering of not just the specific cancer subtype, but includes many histological parameters of prognostic and predictive importance, especially those that may guide targeted therapy.



Note:—Specimens should be sent preserved in 10% formol saline.

Report. *Specimen received at* 24 on 13/4/49.

Macroscopically: Breast tissue with fat and skin in the centre, in the middle of which there is an ulcerating nodular growth measuring 10 x 7 c.ms. Cut surface through the nodule shows a greyish white growth infiltrating the deeper tissues as far as the muscles to a depth of 4 c.ms. Growth is soft and encephaloid.

Microscopically: Underlying the site of ulceration of the skin, irregular masses of epitholial cells are seen in the entire section, separated by stroma of fibrous tissue - alveolar type of growth. In the deeper parts necrosis and degenerative changes of the growth, varying in degree are seen.

Axillary Gland: Positive to secondaries.

Diagnosis: Carcinoma (encephaloid type).

Figure 2.6. A pathology report from 1949 shows brief macroscopic and microscopic description of a breast tumour, with carcinoma as the final diagnosis. Today, pathology reporting requires multiple reporting elements which include prognostic markers.

The reporting elements for any cancer are substantial, leading to the development of datasets and templates published by professional bodies in pathology, with a move towards harmonisation by the International Collaboration on Cancer Reporting [25].

Interactions with cancer classification

Several important factors interact closely with cancer classification. Staging systems [by Union for International Cancer Control (UICC) and American Joint Committee on Cancer (AJCC)] are integrally linked to cancer typing. Cancers and sarcomas have different staging approaches, with specific risk systems used for some tumour types, such as gastrointestinal stromal tumours, that also account for the organ or location of the tumour.

Increasing dependence on molecular information to classify tumours such as the soft tissue sarcomas and brain gliomas, while improving diagnostic precision, may result in parts of the world without access to these tools being left without diagnostic guidance. This is being addressed by clarifying the extent to which histological diagnosis is sufficient, and when further typing is valuable for patient care.

Pathologist and interprofessional education to keep abreast of changes in cancer classification and terminologies, as well as the impact of classification on prognosis and therapy, need to be continually addressed. As ever, close multidisciplinary communication is the way forward for optimal cancer care.

Conclusion

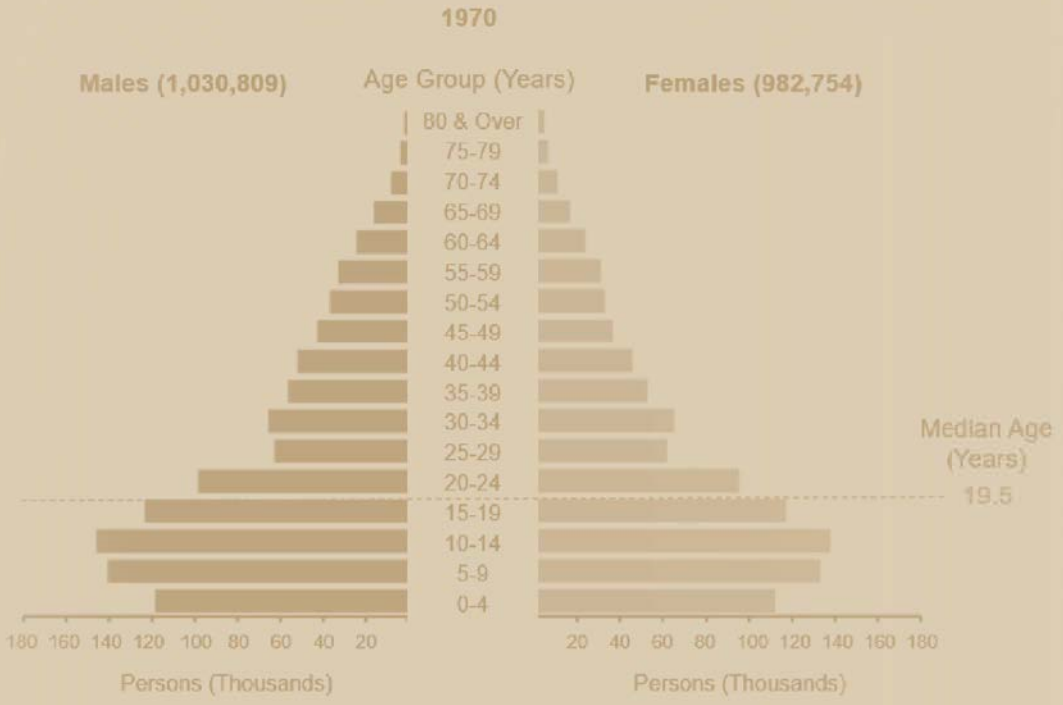
Cancer is a public health concern. Individuals diagnosed with cancer – at least during therapy – lose economic viability with many suffering impaired quality of life. Accurate classification and diagnosis allow a greater understanding of cancer trends and the role of risk factors particularly those that are preventable. Healthcare policies may in turn be shaped to reduce and remove these risks.

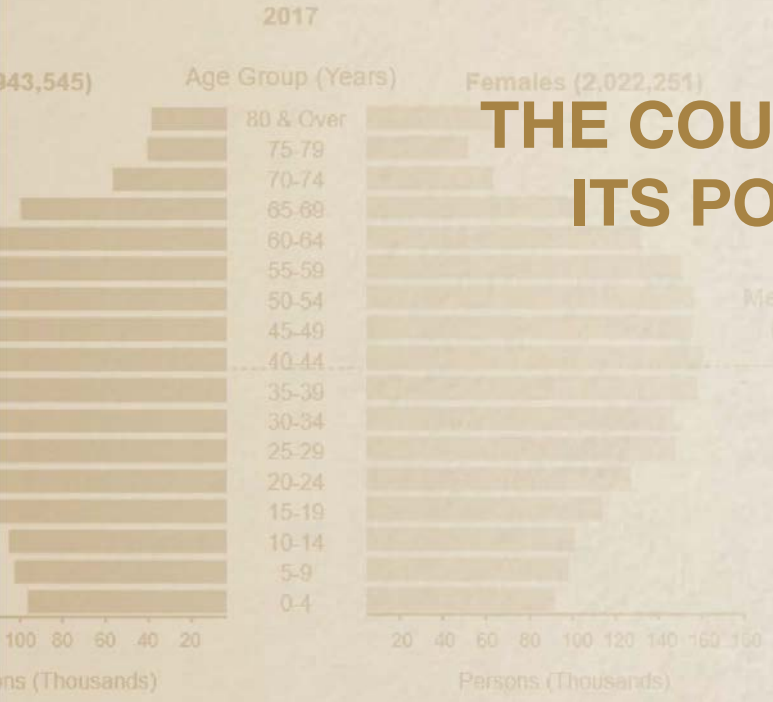
Cancer registries are critical for documenting and tracking the cancer burden of a country and its society. It is crucial therefore, that cancers are correctly classified and changes occurring at the diagnostic front are seamlessly and effectively communicated to all involved in cancer care and data collection.

Disclaimer

The authors alone are responsible for the views expressed in this article and they do not necessarily represent the views, decisions or policies of the institutions with which they are affiliated.

Figure 3.2: POPULATION PYRAMIDS FOR THE RESIDENT POPULATION, 19





CHAPTER 3

THE COUNTRY AND ITS POPULATION

3.1 GEOGRAPHY AND CLIMATE

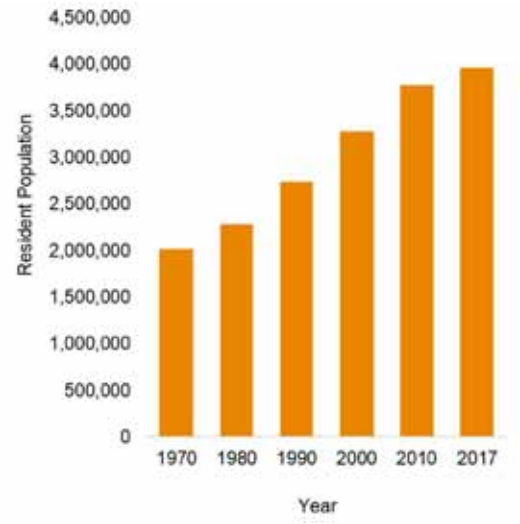
Singapore is situated in Southeast Asia and it lies at the southern tip of the Malaysian peninsula. As of 2017, its total land area was approximately 719.9 km^2, comprising the mainland and several smaller islands [26]. As Singapore is located close to the equator, it enjoys relatively stable temperatures throughout the year. In 2017, the average daily maximum and minimum temperatures were around 31^oC and 25^oC respectively [26].

3.2 POPULATION

In this monograph, 'Singapore residents' refers to Singapore citizens and permanent residents, and 'total population' comprises both Singapore residents and non-residents (foreigners who are working, studying or living in Singapore but not granted permanent residence). These terms and definitions are identical to those used by the Singapore Department of Statistics (DOS) in its publications such as the Census of Population [27].

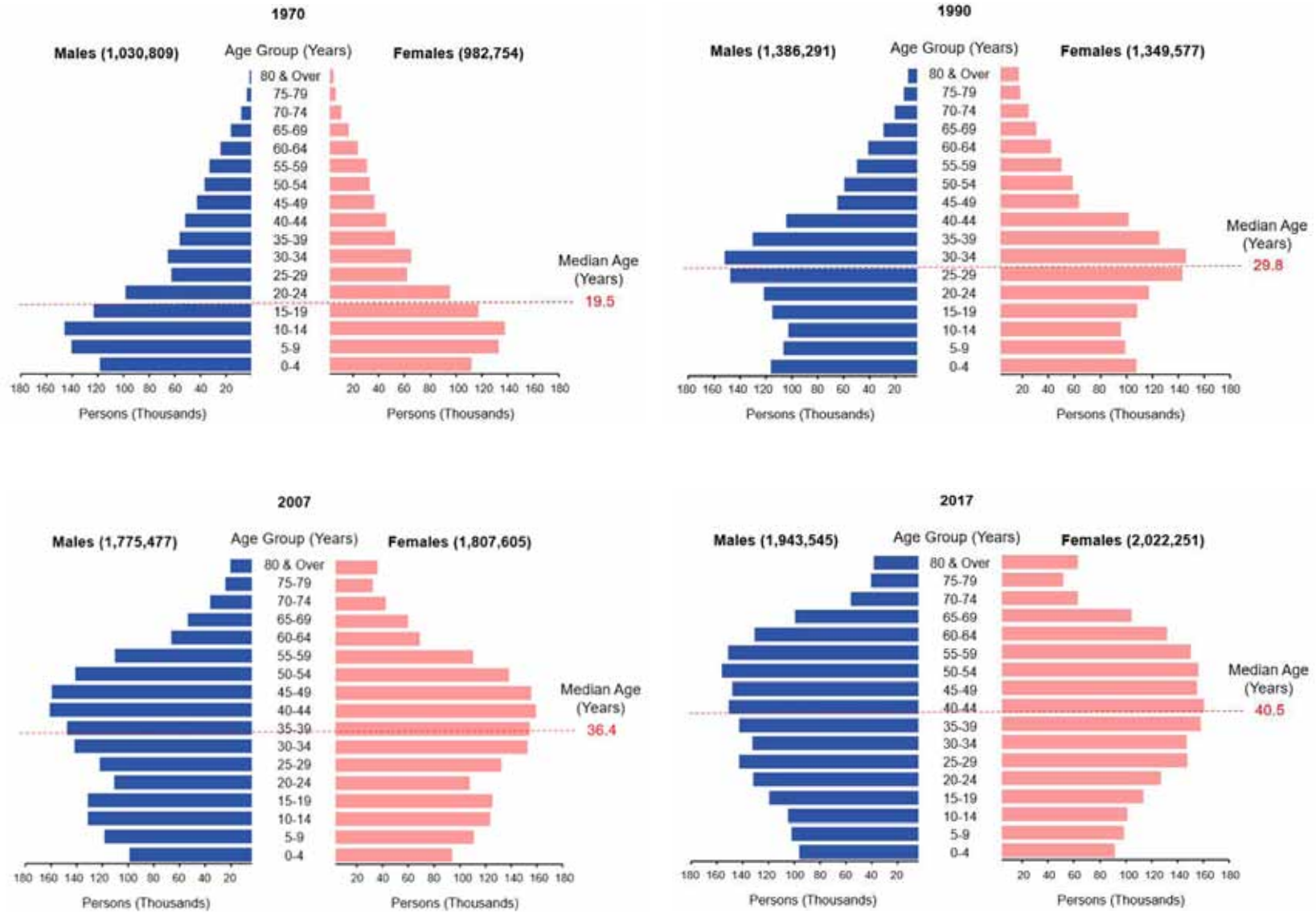
The Singapore resident population has grown over the years - between 1970 and 2017 the resident population almost doubled, from 2.01 million to 3.97 million [28] (Figure 3.1).

Figure 3.1: POPULATION SIZES FOR THE RESIDENT POPULATION, 1970-2017



Singapore faces the challenges of an ageing population, with the resident population living longer and the birth rate declining. The median age of the resident population rose from 19.5 years in 1970 to 40.5 years in 2017 [28] (Figure 3.2). This is mainly attributed to the increasing life expectancy [28] and declining total fertility rate [29] over the past decades. The life expectancy at birth increased from 64.1 years for males and 67.8 years for females in 1970, to 80.7 years for males and 85.2 years for females in 2017. The total fertility rate declined from 3.07 per female in 1970 to 1.16 per female in 2017.

Figure 3.2: POPULATION PYRAMIDS FOR THE RESIDENT POPULATION, 1970-2017



3.3 GENDER AND ETHNIC COMPOSITION

The male to female ratio amongst Singapore residents declined gradually over time (Table 3.1). In 1970, there were 1,049 male per 1,000 female residents. As of 2017, there were 961 male per 1,000 female residents [28].

Singapore is a multi-ethnic country and the three major ethnic groups in the resident population are the Chinese, the Malays and the Indians. The ethnic composition of the resident population remained fairly consistent over the years (Table 3.1). As of 2017, the Chinese made up 74.3% of the resident population, followed by the Malays at 13.4%, the Indians at 9.0% and other ethnic groups at 3.2% [28]. The ethnicity of Singapore residents is recorded based on the father's ethnic group and 22.1% of all registered marriages in 2017 were inter-ethnic marriages [28].

Table 3.1: GENDER AND ETHNIC COMPOSITION OF SINGAPORE RESIDENTS, 1970-2017

Gender Composition (%)	1970	1980	1990	2000	2010	2017
Male	51.2	50.8	50.7	49.9	49.3	49.0
Female	48.8	49.2	49.3	50.1	50.7	51.0
Ethnic Composition (%)	**1970**	**1980**	**1990**	**2000**	**2010**	**2017**
Chinese	77.0	78.3	77.8	76.8	74.1	74.3
Malays	14.8	14.4	14.0	13.9	13.4	13.4
Indians	7.0	6.3	7.1	7.9	9.2	9.0
Others	1.2	1.0	1.1	1.4	3.3	3.2

3.4 HEALTHCARE SERVICE DELIVERY AND HEALTH PROMOTION

Singapore has a comprehensive healthcare system, one of the best in the world according to the Bloomberg 2018 Healthcare Efficiency Index [30]. The healthcare system is designed to provide the population with good quality and affordable healthcare. Healthcare services include primary health medical treatments and preventive healthcare provided by outpatient polyclinics and private medical practitioner clinics [31]; hospital services, which include inpatient, outpatient and emergency services, provided by the restructured[2] and private hospitals [32]; and highly advanced specialised medical care provided by national centres of excellence such as National Cancer Centre Singapore (NCCS), National Heart Centre Singapore (NHCS), Singapore National Eye Centre (SNEC), National Skin Centre (NSC), National Neuroscience Institute (NNI) and National Centre for Infectious Diseases (NCID).

[2] Public general hospitals restructured to be run as private companies but wholly owned by the Singapore government.

Intermediate and Long Term Care (ILTC) facilities provide services for persons who need further care and treatment after being discharged from acute hospitals [33].

Approximately 80% of hospital care and 20% of primary healthcare are provided by the public healthcare system, whereas the private sector provides about 20% of hospital care and 80% of primary healthcare [31] [34].

The MOH works to shape the future of healthcare for Singapore and also actively promotes healthy living and preventive health programmes. Singaporeans are encouraged to take responsibility for their health and adopt healthy lifestyle practices.

In order to strengthen health promotion, health education and disease prevention in Singapore, the HPB was set up in 2001. Since then, a wide range of health promotion and disease prevention programmes have been introduced or supported by HPB. These include programmes aimed at reducing risk factors and improving early detection of cancer. For instance, school-based smoking prevention programmes (such as the “No To Tobacco” education programme) and smoking cessation programmes (such as “I Quit”, an annual national tobacco control campaign) have been rolled out by HPB. The Screen for Life (SFL) programme (a consolidated screening programme that includes BreastScreen Singapore, CervicalScreen Singapore, and National Colorectal Cancer Screening) subsidises regular screening for breast, cervical and colorectal cancers. A more recent initiative is the offer of fully-subsidised Human Papilloma Virus (HPV) vaccination, from 2019 onwards, for all female secondary one students to protect them against cervical cancer.

Figure 4.1: DIFFERENCES BETWEEN PERIOD AND COHOR

Period approach

Year of diagnosis	Period of follow-up						
	2008	2009	2010	2011	2012	2013	2014
2008	0-1	1-2	2-3	3-4	4-5	5	
2009		0-1	1-2	2-3	3-4	4-5	5
2010			0-1	1-2	2-3	3-4	4-5
2011				0-1	1-2	2-3	3-4
2012					0-1	1-2	2-3
2013						0-1	1-2
2014							0-1
2015							
2016							
2017							

Cohort approach

Year of diagnosis	Period of follow-up						
	2008	2009	2010	2011	2012	2013	2014
2008	0-1	1-2	2-3	3-4	4-5	5	
2009		0-1	1-2	2-3	3-4	4-5	5
2010			0-1	1-2	2-3	3-4	4-5
2011				0-1	1-2	2-3	3-4
2012					0-1	1-2	2-3
2013							
2014							
2015							
2016							
2017							

CHAPTER 4

METHODOLOGY

The SCR was first established in 1967 to collect information on all cancers diagnosed in Singapore from 1 January 1968 onwards. The key objective of setting up this registry was to obtain information on population-based cancer trends and patterns in Singapore.

4.1 LEGISLATION

The National Registry of Diseases (including SCR) is governed by the National Registry of Diseases Act which was enacted in 2007. The Act ensures comprehensive coverage of reportable diseases through the mandatory reporting and collection of information from healthcare providers and ensures appropriate use of the information while maintaining patient confidentiality. The National Registry of Diseases (Cancer Notification) Regulations 2009 had been operational since 1 August 2009 [35].

4.2 DATA SOURCES

Comprehensive cancer registration was achieved through data obtained from notifications received from (a) medical practitioners, (b) pathology laboratories, (c) haematology laboratories and departments, and (d) healthcare institutions.

This monograph is based on the anonymised data on all cases of malignant and certain borderline tumours [36] diagnosed among Singapore residents from 1 January 1968 through 31 December 2017 in Singapore, as they stood as of 31 December 2018. Mortality data were as they stood as of 31 December 2018.

4.3 DATA PROCESSING AND CODING

Identification key

The primary identification key for Singapore residents is the National Registration Identity Card (NRIC) number. For non-residents, their passport numbers or foreign identification numbers (FIN) are used. These unique numbers are used for updating existing records in the database and filtering duplicate records notified by multiple data sources. Cases of cancer diagnosed in Singapore among foreigners were registered in the database but not included in the analysis of this monograph.

Verification of information

All notifications were corroborated with clinical medical records. Registry coordinators (RCs) would review medical records to verify discrepancies in information and collect data to complete the registration of case records. The visiting consultant pathologist would be consulted for complex cases. Regular internal audits to assess the quality of the data were conducted and results from the audits showed that the registry achieved high inter-rater reliability (above 95%) for all data items.

Coding of primary site and histology

The International Classification of Diseases, 9th Edition (ICD-9) [37] was used for the coding of primary sites and the Manual of Tumour Nomenclature and Coding (MOTNAC) [38] was used for histology coding up till 1992. Between 1993 and 2002, the SCR employed the International Classification of Diseases for Oncology, 2nd Edition (ICD-O-2) [39]. From 2003 onwards, the International Classification of Diseases for Oncology, 3rd Edition (ICD-O-3) [40] was adopted. In addition to the ICD-O-3, the WHO Classification of Tumours, 4th Edition series (also known as the Blue Books) [41] were also used from 2010 onwards. Guidelines applied for the registration of multiple primary cancers are listed in Chapter Eight. In this monograph, the coding of primary sites is presented using the International Statistical Classification of Diseases and Related Health Problems, 10th Edition, Australian Modification (ICD-10-AM) [42].

Computation of cancer incidence includes only invasive tumours (behaviour code '3') and certain tumours of borderline malignancy (behaviour code '1') [36]. For breast and cervical cancers, the incidence rates for the carcinoma-in-situ (behaviour code '2') were included in the respective commentary sections in Chapter Nine.

Cancer staging

The registry adopted stage grouping guidelines from the American Joint Committee on Cancer (AJCC) Cancer Staging Manual, 6th Edition [43] for cases diagnosed between 2003 to 2009, and the 7th Edition for cases diagnosed from 2010 to 2017 [44].

Follow-up

All treatments administered within six months from the date of diagnosis were recorded and case records were updated upon patients' demise.

4.4 PATIENT SELECTION FOR SURVIVAL ANALYSIS

Single and multiple primary malignant tumours [45] in individuals aged 15 years and above at diagnosis were included for survival analysis in the monograph. Individuals diagnosed at 14 years of age and under were not included in survival analysis because of their differences in biological characteristics, treatment protocols and survival outcomes. Multiple primary cases were included in accordance with the European Cancer Registry Eurocare-6 [46] and CONCORD-3 [45] study protocols.

In order to determine the mortality status of the cancer patients, patients were followed up until 31 December 2018.

For patients diagnosed within the period from 1 January 1968 to 31 March 1996, the 1997 Electoral Register was used to confirm the mortality status (since the earlier death records were not complete and some of the patients' eventual deaths were not recorded). Patients who were not in the mortality listing nor in the 1997 Electoral Register were excluded in the survival analysis.

Cases based on Death Certificate Only (DCO; i.e. cases which were registered based on mortality data) were excluded from the survival analysis since their survival time was unknown.

4.5 POPULATION DENOMINATORS

Population estimates were used as the denominators to calculate incidence and mortality rates. Population denominators from 1980 to 2017 were obtained from the DOS, which has been releasing the mid-year resident population estimates annually since 1980; these population denominators are widely used in official publications in Singapore. The population denominators from 1968 to 1979 were obtained through inter- and extrapolation of population figures from the census years of 1980, 1990 and 2000 [47] [48] [49].

4.6 STATISTICAL METHODS

Cancer incidence and mortality rate

Cancer incidence and mortality rates were calculated for all cancer sites combined, and for the most common cancer sites by gender, ethnicity, and age group. The crude incidence or mortality rates (CIR or CMR) are defined as the number of new cancer cases or deaths, divided by the population at risk in the specified time period and expressed as an annual rate per 100,000 population. The age-specific incidence or mortality rates are defined as the number of new cancer cases or deaths, in each specified time period by the population at risk for that age stratum. Incidence and mortality rates were age-standardised to adjust for differences in age structure in the Singapore resident population over time and to facilitate international comparison. Age-standardised incidence or mortality rates (ASIR or ASMR) were calculated as the sum of the weighted age-specific incidence or mortality rates using the direct method based on the Segi-Doll World Standards [50].

Trends of cancer incidence and mortality rate

Temporal trends in incidence and mortality rates over the last decade were described by the annual percent change (APC). APC was estimated by fitting a regression line through the logarithms of the rates for the given time period.

Lifetime risk of developing cancer

Lifetime risk of developing cancer is calculated using the DevCan software package, developed by Surveillance, Epidemiology, and End Results (SEER), based on age-specific cancer rates [51]. The cut-off point for lifetime risk was taken to be 75 years of age.

Relative risk

Adjusted relative risks (adjustment for age), together with their corresponding 95% Confidence Interval (CI) for the most common cancers among the major ethnic groups (Chinese as reference group) were estimated by fitting the Poisson regression model with age and ethnicity as covariates, and the population at risk as offset.

Survival estimation

One-, three-, five-, and ten-year observed or relative survivals were estimated for cases diagnosed from 1968 through 2002. One-, three-, and five-year observed or relative survivals were estimated for patients diagnosed from 2003 onwards.

Relative survival is commonly used to describe the survival experience of the patients in a population-based study [52]. When large numbers 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 are analysed [53]. It has been widely used by many registries, such as Eurocare [54], SEER [55] and various countries [56] 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 according to factors believed to be associated with survival at baseline (gender, age and calendar year of diagnosis). In other words, it reflects the chances of survival assuming that cancer is the only possible cause of death.

The expected survival was estimated from the Singapore general population which included deaths from all causes. Population life tables for the period of 1968-2002 was constructed using the Mortpak software with deaths and population counts obtained from the DOS [57]. Complete life tables used to estimate expected survival for the period of 2003-2017 were obtained from the DOS [58].

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. Cumulative survival ratios were computed by taking the product of interval-specific ratios where the follow-up time was set to be one year. The Greenwood's formula was used to obtain the standard errors for the corresponding survival estimates [52].

The Period approach was used to estimate survival so as to highlight the temporal change in patient survival in a timelier fashion [59] [60]. In contrast to the conventional Cohort approach, which describes the survival experience for a certain cohort of patients diagnosed within a time period, the Period approach 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 4.1 illustrates how both Period and Cohort methods capture five-year survival information.

Figure 4.1: DIFFERENCES BETWEEN PERIOD AND COHORT APPROACHES

Period approach

Year of diagnosis	Period of follow-up									
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
2008	0-1	1-2	2-3	3-4	4-5	5				
2009		0-1	1-2	2-3	3-4	4-5	5			
2010			0-1	1-2	2-3	3-4	4-5	5		
2011				0-1	1-2	2-3	3-4	4-5	5	
2012					0-1	1-2	2-3	3-4	4-5	5
2013						0-1	1-2	2-3	3-4	4-5
2014							0-1	1-2	2-3	3-4
2015								0-1	1-2	2-3
2016									0-1	1-2
2017										0-1

Cohort approach

Year of diagnosis	Period of follow-up									
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
2008	0-1	1-2	2-3	3-4	4-5	5				
2009		0-1	1-2	2-3	3-4	4-5	5			
2010			0-1	1-2	2-3	3-4	4-5	5		
2011				0-1	1-2	2-3	3-4	4-5	5	
2012					0-1	1-2	2-3	3-4	4-5	5
2013										
2014										
2015										
2016										
2017										

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

The Brenner II method was used to adjust for the different age structures in survival analysis [61]. Age-specific weights were first individually assigned to each patient and then the conventional survival analysis was carried out using the 'weighted individual data'. This method was used so that age-standardised survival could still be obtained even if none of the patients within one or more age strata was followed up over the entire period of interest.

The International Cancer Survival Standard (ICSS) weights developed in 2004 were used for age-standardisation [62], in which age at cancer diagnosis was categorised into the following groups: 15-44, 45-54, 55-64, 65-74, 75+ years for most cancers; and 15-54, 55-64, 65-74, 75-84, 85+ years for prostate cancer. ICSS1 was used for most cancer sites for which incidence increased steeply with age. For cancer sites with broadly constant incidence by age (including melanoma of the skin, nasopharynx, connective tissue, cervix uteri, brain, thyroid gland, and bone), ICSS2 was used. For cancers which mainly affect young adults (including testicular tumours, Hodgkin's disease, and acute lymphatic leukaemia), ICSS3 was used.

The STATA Package strs, developed by Paul Dickman, was used to obtain the relative and observed survival estimates [63]. Survival estimation based on fewer than ten cases was deemed to be statistically unstable and hence was not included in this monograph.

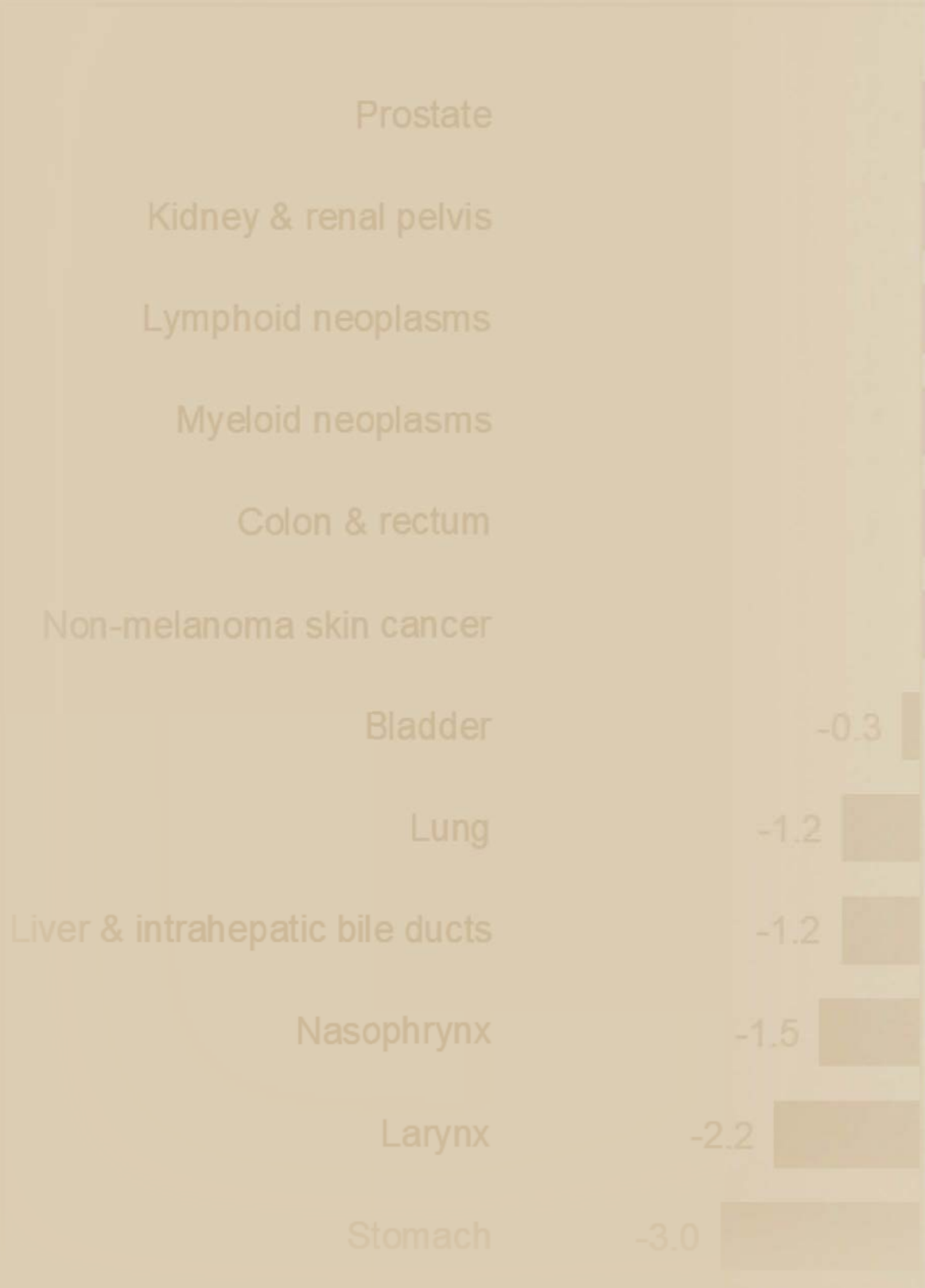
International comparisons

Data for international comparisons of cancer incidence during 2008-2012 was taken from 'Cancer Incidence in Five Continents (Volume XI)' [64].

Data for international comparisons of cancer survival was taken from 'Global Surveillance of Trends in Cancer Survival 2000-14 (CONCORD-3)' [45]. The CONCORD-3 study used the Cohort approach to examine survival trends among patients diagnosed during 2000-2004 and 2005-2009 and the Period approach for patients diagnosed during 2010-2014. The Pohar-Perme net survival was estimated with the STATA package, stns [65].

When benchmarking Singapore's cancer incidence statistics on an international basis, it should be noted that a high incidence rate does not necessarily suggest failure in primary prevention strategies since early detection of subclinical cancer and over-diagnosis can both contribute to higher incidence rates. When benchmarking Singapore's survival statistics on an international basis, one should bear in mind the complexity of factors affecting survival, including incidence-related factors such as 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 [66].

Figure 5.1.2(a): ANNUAL PERCENTAGE CHANGE (%)
FOR TEN MOST FREQUENT CANCERS, 1968-2017 (M



CHAPTER 5

TRENDS IN CANCER INCIDENCE, 1968-2017

The findings presented in Chapter Five highlight the key trends in cancer incidence observed in the data collected by the registry in the past fifty years, from 1968-2017. Variations in the incidence of the most common cancers that occurred during this period are also discussed.

5.1 INCIDENCE OF CANCER BY GENDER, 1968-2017

The total number of cases, crude incidence rate (CIR) and age-standardised incidence rate (ASIR) of cancer in every five-year period from 1968-2017, with breakdown by gender, can be seen in Table 5.1.1. Across fifty years, the total number of malignancies diagnosed every five years increased nearly six times from 12,072 in 1968-1972 to 71,265 in 2013-2017. The CIR rose from 120.3 to 365.1 per 100,000 population from 1968-1972 to 2013-2017. Similarly, the ASIR, which took into account Singapore's ageing population, showed an increase – from 188.7 to 229.6 per 100,000 population in the same period.

While a larger proportion of cancer diagnoses was found among males in the earlier years, the proportion of females diagnosed with cancer surpassed that of males from 1998-2002 onwards. It was also during that same period that the CIR of cancer in females surpassed that of males for the first time, likely due to the rapid climb in incidence of female breast cancer. However, the ASIR of cancer in males remained higher than for females throughout the past fifty years (Figure 5.1.1).

Even though there was an overall increase in cancer incidence, it did not mean that the incidence of all cancers had been on the rise – the incidence of some cancers rose along with the general trend, while others had actually declined. The numbers of cases and ASIRs for the top ten most frequent cancers for males and females for each five-year period are shown in Table 5.1.2(a) and Table 5.1.2(b).

Among males, lung cancer was the top cancer diagnosed for most of the period under study before falling to second place from 2008-2012 onwards (Table 5.1.2(a)). Possible factors that contributed to this trend were the lower rates of smoking and improvements in indoor air quality [67]. In 1968-1972, colorectal cancer was the fifth most common cancer, but in 2008-2012, it overtook lung cancer as the leading cancer diagnosed among males. The gradually declining ASIR of stomach cancer led it to fall from the second most common cancer in 1968-1982 to seventh in 2008-2017. Population ageing, as well as increased awareness and screening saw prostate cancer emerge among the top ten cancers for the first time in 1983-1987. By 2003-2007, it became the third most common cancer among males.

Among females, breast cancer remained the most common cancer in the past fifty years (Table 5.1.2(b)). Of the gynaecological cancers, cervical cancer, the second most common cancer in 1968-1972, fell to tenth place in 2008-2012, likely due to an increase in screening and earlier detection of pre-cancerous lesions. On the other hand, an upward trend was observed for ovarian and uterine cancers. Stomach cancer, the third most common cancer in 1968-1972, fell to ninth place in 2013-2017. Similar to the trends seen among males, lung and colorectal cancers were consistently among the top ranked cancers for females.

While some changes in ASIR occurred gradually and incrementally, others happened more rapidly. Figures 5.1.2(a) and 5.1.2(b) show the annual percentage change (APC) in the incidence of all cancer sites that had ever emerged as one of the ten most frequent cancers in any five-year period, for males and females respectively.

Among males, the highest positive APC was observed for prostate cancer, at 4.9%, and the highest negative APC was observed for oesophageal cancer, at -4.0%. Negative APCs were observed for cancers that were on the decline for most of the fifty-year period, such as lung, liver, nasopharyngeal, and stomach cancers. As the population aged, cancers strongly associated with old age, such as prostate and colorectal cancers, displayed positive APCs.

Among females, the highest positive APCs were observed for uterine and breast cancers, at 3.1% and 3.0% respectively. Similar to the trends seen among males, oesophageal cancer in females displayed the highest negative APC, at -5.8%. The cancers that were on the decline among females in the fifty-year period - lung, liver, nasopharyngeal, cervical, and stomach cancers – also displayed negative APCs.

The fifty-year trends for the ten most frequent cancers diagnosed in the latest five-year period for males and females are discussed in greater depth in Chapter Nine.

Table 5.1.1: INCIDENCE NUMBER AND RATE (PER 100,000 POPULATION) FOR CANCER BY GENDER AND FIVE-YEAR PERIOD, 1968-2017

Period	Gender	Number	%	CIR	ASIR
1968-1972	Male	6985	57.9	136.0	228.2
	Female	5087	42.1	103.9	155.0
	Total	12072	100	120.3	188.7
1973-1977	Male	8553	58.0	158.4	246.3
	Female	6186	42.0	119.0	161.2
	Total	14739	100	139.1	200.6
1978-1982	Male	10124	55.9	174.5	250.8
	Female	7992	44.1	142.1	175.8
	Total	18116	100	158.6	210.2
1983-1987	Male	11678	53.7	185.7	244.0
	Female	10067	46.3	164.6	183.7
	Total	21745	100	175.3	210.5
1988-1992	Male	13633	51.7	197.7	237.1
	Female	12761	48.3	189.6	191.7
	Total	26394	100	193.7	211.6
1993-1997	Male	16232	50.8	214.3	236.4
	Female	15746	49.2	210.0	196.0
	Total	31978	100	212.2	213.2
1998-2002	Male	19048	49.0	232.7	234.8
	Female	19860	51.0	241.9	204.3
	Total	38908	100	237.3	216.5
2003-2007	Male	22404	48.7	260.1	235.2
	Female	23615	51.3	270.1	207.1
	Total	46019	100	265.2	217.6
2008-2012	Male	27937	48.8	301.8	234.8
	Female	29306	51.2	308.5	213.8
	Total	57243	100	305.2	221.3
2013-2017	Male	34461	48.4	359.6	234.0
	Female	36804	51.6	370.5	229.6
	Total	71265	100	365.1	229.6

Figure 5.1.1: AGE-STANDARDISED INCIDENCE RATE (PER 100,000 POPULATION) FOR CANCER BY GENDER AND FIVE-YEAR PERIOD, 1968-2017

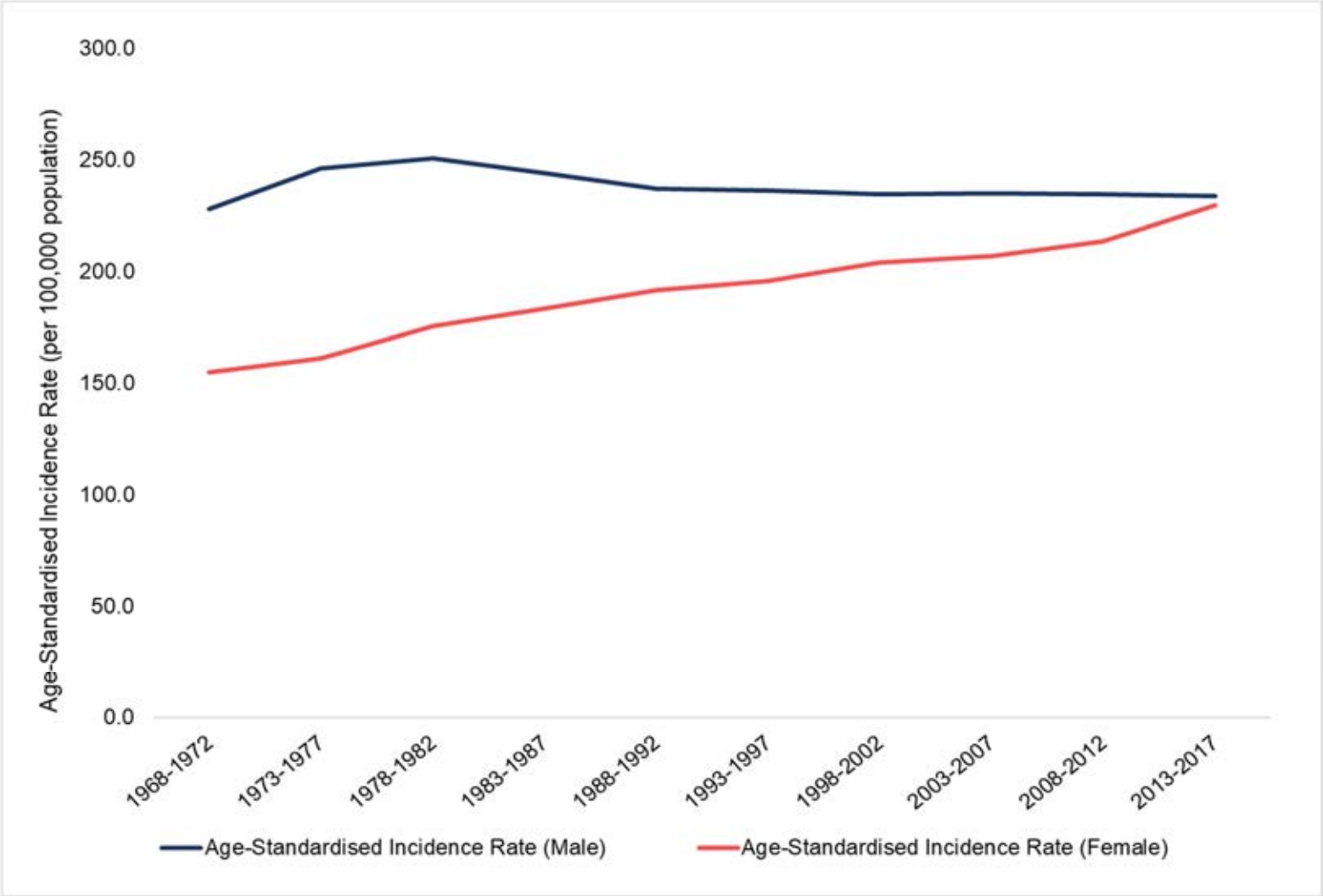


Table 5.1.2(a): TEN MOST FREQUENT CANCERS AMONG MALES BY FIVE-YEAR PERIOD, 1968-2017

1968-1972			1973-1977			1978-1982			1983-1987			1988-1992		
SITE	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**
Lung	1361	47.3	Lung	1920	57.9	Lung	2440	63.0	Lung	2770	60.1	Lung	2971	54.1
Stomach	1094	37.7	Stomach	1216	36.5	Stomach	1233	31.8	Colon & rectum	1435	30.2	Colon & rectum	2052	36.0
Liver & intrahepatic bile ducts	898	28.7	Liver & intrahepatic bile ducts	965	27.4	Liver & intrahepatic bile ducts	1126	27.8	Stomach	1334	29.3	Stomach	1374	24.8
Nasopharynx	569	15.0	Colon & rectum	824	24.6	Colon & rectum	1057	26.7	Liver & intrahepatic bile ducts	1095	23.2	Liver & intrahepatic bile ducts	1089	19.0
Colon & rectum	563	19.4	Nasopharynx	672	15.5	Nasopharynx	705	14.5	Nasopharynx	868	15.1	Nasopharynx	1069	15.7
Oesophagus	450	16.6	Oesophagus	465	15.0	Oesophagus	440	11.8	Lymphoid neoplasms	511	10.0	Lymphoid neoplasms	613	10.2
Lymphoid neoplasms	253	6.2	Lymphoid neoplasms	267	6.3	Lymphoid neoplasms	352	7.8	Oesophagus	398	8.8	Prostate	529	9.7
Larynx	193	6.9	Non-melanoma skin	247	7.6	Non-melanoma skin	319	8.1	Non-melanoma skin	371	8.0	Non-melanoma skin	501	8.6
Non-melanoma skin	167	6.3	Larynx	221	6.7	Larynx	290	7.4	Prostate	356	8.2	Urinary bladder	414	7.4
Urinary bladder	150	5.4	Urinary bladder	197	6.3	Urinary bladder	271	7.1	Urinary bladder	316	7.0	Oesophagus	408	7.5
All sites	**6985**	**228.2**	**All sites**	**8553**	**246.3**	**All sites**	**10124**	**250.8**	**All sites**	**11678**	**244.0**	**All sites**	**13633**	**237.1**
1993-1997			**1998-2002**			**2003-2007**			**2008-2012**			**2013-2017**		
SITE	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**
Lung	3168	48.1	Lung	3598	45.8	Lung	3862	41.3	Colon & rectum	4787	39.3	Colon & rectum	5799	38.2
Colon & rectum	2550	37.6	Colon & rectum	3252	40.1	Colon & rectum	3849	40.0	Lung	4291	35.7	Lung	4992	32.6
Stomach	1442	21.7	Liver & intrahepatic bile ducts	1554	19.1	Prostate	2209	24.2	Prostate	3336	28.6	Prostate	4853	31.8
Liver & intrahepatic bile ducts	1302	18.9	Stomach	1452	18.5	Liver & intrahepatic bile ducts	1787	18.7	Liver & intrahepatic bile ducts	2134	17.6	Liver & intrahepatic bile ducts	2705	17.7
Nasopharynx	1131	13.6	Prostate	1359	17.6	Stomach	1380	14.6	Lymphoid neoplasms	1842	16.9	Lymphoid neoplasms	2259	17.8
Prostate	901	13.8	Nasopharynx	1104	11.1	Lymphoid neoplasms	1349	14.9	Non-melanoma skin	1469	12.0	Non-melanoma skin	1866	12.3
Lymphoid neoplasms	824	11.6	Lymphoid neoplasms	1047	13.0	Nasopharynx	1212	10.9	Stomach	1450	12.0	Stomach	1551	10.2
Non-melanoma skin	667	9.5	Non-melanoma skin	789	9.6	Non-melanoma skin	954	10.0	Nasopharynx	1147	8.9	Kidney & other urinary organs	1381	9.4
Urinary bladder	486	7.2	Urinary bladder	614	7.7	Urinary bladder	683	7.2	Kidney & other urinary organs	1006	8.2	Myeloid neoplasms	1134	8.1
Oesophagus	389	6.0	Kidney & other urinary organs	468	5.6	Kidney & other urinary organs	647	6.4	Myeloid neoplasms	883	7.6	Nasopharynx	1079	7.5
All sites	**16232**	**236.4**	**All sites**	**19048**	**234.8**	**All sites**	**22404**	**235.2**	**All sites**	**27937**	**234.8**	**All sites**	**34461**	**234.0**

Table 5.1.2(b): TEN MOST FREQUENT CANCERS AMONG FEMALES BY FIVE-YEAR PERIOD, 1968-2017

1968-1972			1973-1977			1978-1982			1983-1987			1988-1992		
SITE	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**
Female breast	672	20.1	Female breast	861	22.1	Female breast	1237	26.9	Female breast	1737	31.1	Female breast	2631	38.6
Cervix uteri	603	18.0	Colon & rectum	715	19.6	Colon & rectum	1084	24.6	Colon & rectum	1393	26.1	Colon & rectum	1848	28.3
Stomach	542	17.4	Cervix uteri	675	17.6	Lung	893	20.8	Lung	1072	20.4	Lung	1174	18.0
Lung	489	16.2	Lung	663	18.5	Cervix uteri	751	16.6	Cervix uteri	897	16.2	Cervix uteri	1002	15.3
Colon & rectum	478	15.4	Stomach	610	16.6	Stomach	643	14.6	Stomach	772	14.3	Stomach	826	12.5
Liver & intrahepatic bile ducts	243	7.9	Nasopharynx	274	6.4	Ovary & fallopian tube	414	8.7	Ovary & fallopian tube	504	8.8	Ovary & fallopian tube	703	10.4
Nasopharynx	222	6.1	Ovary & fallopian tube	262	6.2	Non-melanoma skin	328	7.3	Nasopharynx	374	6.3	Non-melanoma skin	526	7.6
Ovary & fallopian tube	222	6.0	Liver & intrahepatic bile ducts	255	6.9	Nasopharynx	326	6.6	Non-melanoma skin	374	6.9	Lymphoid neoplasms	457	7.3
Oesophagus	188	6.4	Non-melanoma skin	198	5.4	Liver & intrahepatic bile ducts	305	7.0	Thyroid	370	5.8	Nasopharynx	444	6.2
Thyroid	163	4.4	Lymphoid neoplasms	180	4.2	Thyroid	226	4.2	Liver & intrahepatic bile ducts	354	6.7	Thyroid	436	6.0
All sites	**5087**	**155.0**	**All sites**	**6186**	**161.2**	**All sites**	**7992**	**175.8**	**All sites**	**10067**	**183.7**	**All sites**	**12761**	**191.7**
1993-1997			**1998-2002**			**2003-2007**			**2008-2012**			**2013-2017**		
SITE	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**
Female breast	3598	43.5	Female breast	5577	55.6	Female breast	6856	58.9	Female breast	8560	63.0	Female breast	10824	69.8
Colon & rectum	2300	29.5	Colon & rectum	2795	29.1	Colon & rectum	3350	28.8	Colon & rectum	3920	27.0	Colon & rectum	4835	27.2
Lung	1444	18.3	Lung	1603	16.4	Lung	1905	16.3	Lung	2262	15.4	Lung	2788	15.4
Cervix uteri	1128	13.9	Ovary & fallopian tube	1061	11.1	Corpus uteri	1356	11.9	Corpus uteri	1787	13.1	Corpus uteri	2610	16.9
Stomach	917	11.4	Cervix uteri	1038	10.7	Ovary & fallopian tube	1347	12.2	Ovary & fallopian tube	1625	12.7	Ovary & fallopian tube	1874	13.1
Ovary & fallopian tube	886	11.0	Stomach	969	10.0	Cervix uteri	1015	8.9	Lymphoid neoplasms	1246	10.5	Lymphoid neoplasms	1725	12.3
Non-melanoma skin	666	8.1	Corpus uteri	908	9.5	Lymphoid neoplasms	1009	10.3	Non-melanoma skin	1217	8.0	Non-melanoma skin	1507	8.0
Corpus uteri	609	7.8	Non-melanoma skin	790	7.9	Stomach	891	7.4	Stomach	1075	7.1	Thyroid	1426	10.3
Lymphoid neoplasms	552	7.2	Lymphoid neoplasms	714	8.1	Non-melanoma skin	800	6.7	Thyroid	991	7.9	Stomach	1147	6.2
Thyroid	492	5.7	Thyroid	654	6.7	Thyroid	661	6.0	Cervix uteri	926	6.8	Cervix uteri	1077	7.1
All sites	**15746**	**196.0**	**All sites**	**19860**	**204.3**	**All sites**	**23615**	**207.1**	**All sites**	**29306**	**213.8**	**All sites**	**36804**	**229.6**

Figure 5.1.2(a): ANNUAL PERCENTAGE CHANGE (%) IN CANCER INCIDENCE FOR TEN MOST FREQUENT CANCERS, 1968-2017 (MALES)

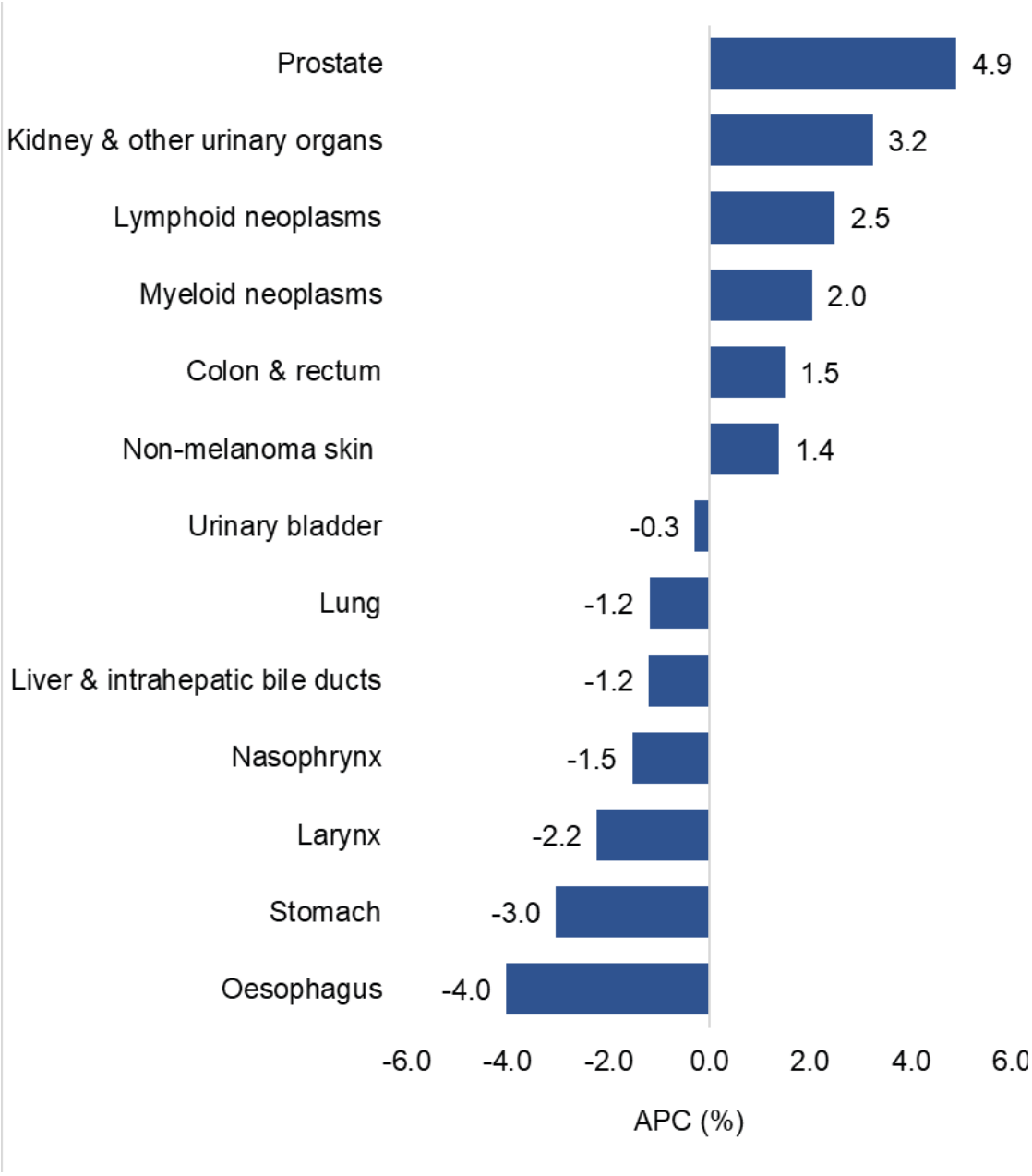
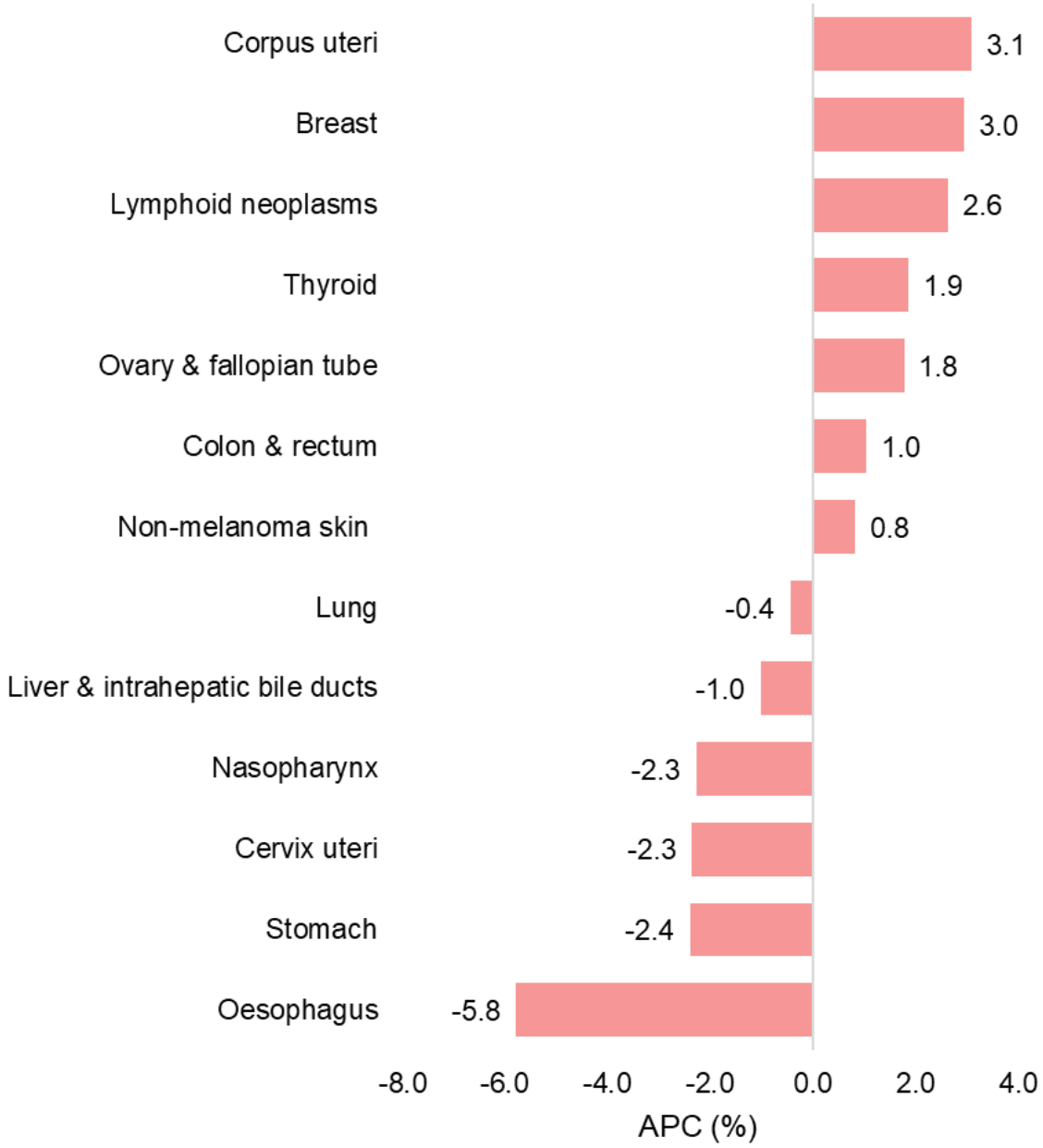


Figure 5.1.2(b): ANNUAL PERCENTAGE CHANGE (%) IN CANCER INCIDENCE FOR TEN MOST FREQUENT CANCERS, 1968-2017 (FEMALES)



5.2 INCIDENCE OF CANCER BY ETHNICITY, 1968-2017

The data for cancer incidence by ethnicity revealed differences in trends between the three main ethnic groups. These differences are examined in this section.

The Chinese accounted for between 82.0% to 88.0% of cancer cases diagnosed in every five-year period. This was disproportionately higher compared to the Malays and the Indians as the Chinese only made up about 75.0% of the resident population (Table 5.2.1). From 1968-2017, the Chinese consistently had the highest cancer incidence rates among the three major ethnic groups. While the proportion of Malays among all cases of cancer in the resident population increased gradually from 6.0% in 1968-1972 to 9.8% in 2013-2017, the proportion of Indians remained fairly constant at 4.0-5.0%.

The ASIR of cancer among the Chinese saw a steady increase from 202.8 to 234.6 per 100,000 population from 1968-1972 to 2013-2017. The ASIR of cancer among the Malays jumped more than twofold, from 96.2 to 214.8 per 100,000 population over the same period. Prior to 1988-1992, the ASIR of cancer among the Malays was the lowest for the three major ethnic groups but thereafter, it consistently ranked second behind the Chinese. The Indians saw an overall increase in the incidence of cancer, from 139.0 per 100,000 population in 1968-1972 to 167.0 per 100,000 population in 2013-2017.

Throughout the period under study, the ASIR of cancer was consistently higher among Chinese males compared to their female counterparts (Figures 5.2.1(a) – 5.2.1(c)). However, the ASIR of cancer in Chinese males began declining from 1978-1982 while the ASIR for Chinese females rose throughout the fifty-year period. This was likely due to the rapid rise in incidence of breast cancer (the leading cancer in females) among female Singapore residents, and the falling incidence of lung cancer (the leading cancer in males) among male Singapore residents. The ASIR of cancer in the Malays was generally higher in males prior to 2003-2007, after which it was exceeded by the ASIR for females. As for the Indians, with the exception of 1973-1977, the ASIR of cancer among females was higher than that of males for the period 1968-2017.

Differences among the ethnic groups existed in terms of the ten most common cancers. Tables 5.2.2(a)-5.2.2(f) show the changes in the ASIR and relative ranking of the ten most frequent cancers for each five-year period among gender and ethnic-specific groups.

Lung cancer was consistently among the top four leading cancers among the males for all three ethnic groups. In fact, it was the leading cancer among Chinese and Malay

males from 1968-2002 and 1973-2017 respectively (Tables 5.2.2(a)-5.2.2(c)). The rankings for colorectal and prostate cancers rose in tandem with the rise of their respective ASIR. On the other hand, as the ASIR of nasopharyngeal cancer decreased over the years, its ranking among the ten most frequent cancers fell for the Chinese and Malays. This drop in ranking was particularly pronounced for the Chinese. Notably, nasopharyngeal cancer was never among the ten most frequent cancers found in Indian males for the period under study. A drop in the ASIR of stomach cancer among males of all three ethnic groups caused a corresponding drop in its ranking.

Among females, the ASIR of breast cancer continued to rise; it was the leading cancer for the Chinese and Malays throughout the fifty years, and from 1983-1987 onwards, it became the leading cancer for the Indians as well (Tables 5.2.2(d)-5.2.2(f)). While the ranking of colorectal cancer rose for the Chinese and Malays like it did for their male counterparts, that for Indian females remained between second to fourth place throughout. The gynaecological cancers that saw overall increases in ASIR as well as in ranking for all three ethnic groups were uterine and ovarian cancers. Cervical cancer fell in terms of both ASIR and ranking among the ten most common cancers. Similar to males, both the ASIR and overall ranking of stomach cancer fell among females.

Table 5.2.1: INCIDENCE NUMBER AND RATE (PER 100,000 POPULATION) FOR CANCER BY ETHNICITY AND FIVE-YEAR PERIOD, 1968-2017

Period	Ethnic group	Number	%	CIR	ASIR
1968-1972	Chinese	10625	88.0	136.8	202.8
	Malay	725	6.0	48.6	96.2
	Indian	566	4.7	80.2	139.0
	Total	12072	100	120.3	188.7
1973-1977	Chinese	12930	87.7	156.7	215.6
	Malay	917	6.2	59.7	107.2
	Indian	720	4.9	103.5	156.9
	Total	14739	100	139.1	200.6
1978-1982	Chinese	15909	87.8	177.9	227.0
	Malay	1180	6.5	71.9	117.6
	Indian	835	4.6	114.7	162.6
	Total	18116	100	158.6	210.2
1983-1987	Chinese	19033	87.5	196.7	228.1
	Malay	1520	7.0	86.2	125.6
	Indian	967	4.4	115.8	144.9
	Total	21745	100	175.3	210.5
1988-1992	Chinese	23007	87.2	217.2	229.4
	Malay	2022	7.7	105.2	141.4
	Indian	1052	4.0	109.3	121.5
	Total	26394	100	193.7	211.6
1993-1997	Chinese	27687	86.6	237.4	230.1
	Malay	2579	8.1	122.0	152.6
	Indian	1298	4.1	117.2	120.7
	Total	31978	100	212.2	213.2
1998-2002	Chinese	33351	85.7	265.0	231.2
	Malay	3334	8.6	146.3	168.5
	Indian	1673	4.3	129.5	129.9
	Total	38908	100	237.3	216.5
2003-2007	Chinese	39235	85.3	298.5	229.2
	Malay	3988	8.7	166.0	173.0
	Indian	2007	4.4	137.9	140.3
	Total	46019	100	265.2	217.6
2008-2012	Chinese	47822	83.5	343.4	229.3
	Malay	5241	9.2	208.4	190.5
	Indian	2746	4.8	160.2	154.7
	Total	57243	100	305.2	221.3
2013-2017	Chinese	58804	82.5	405.6	234.6
	Malay	6955	9.8	266.8	214.8
	Indian	3583	5.0	201.8	167.0
	Total	71265	100	365.1	229.6

Figure 5.2.1(a): AGE-STANDARDISED INCIDENCE RATE (PER 100,000 POPULATION) FOR CANCER BY ETHNICITY AND FIVE-YEAR PERIOD, 1968-2017 (ALL)

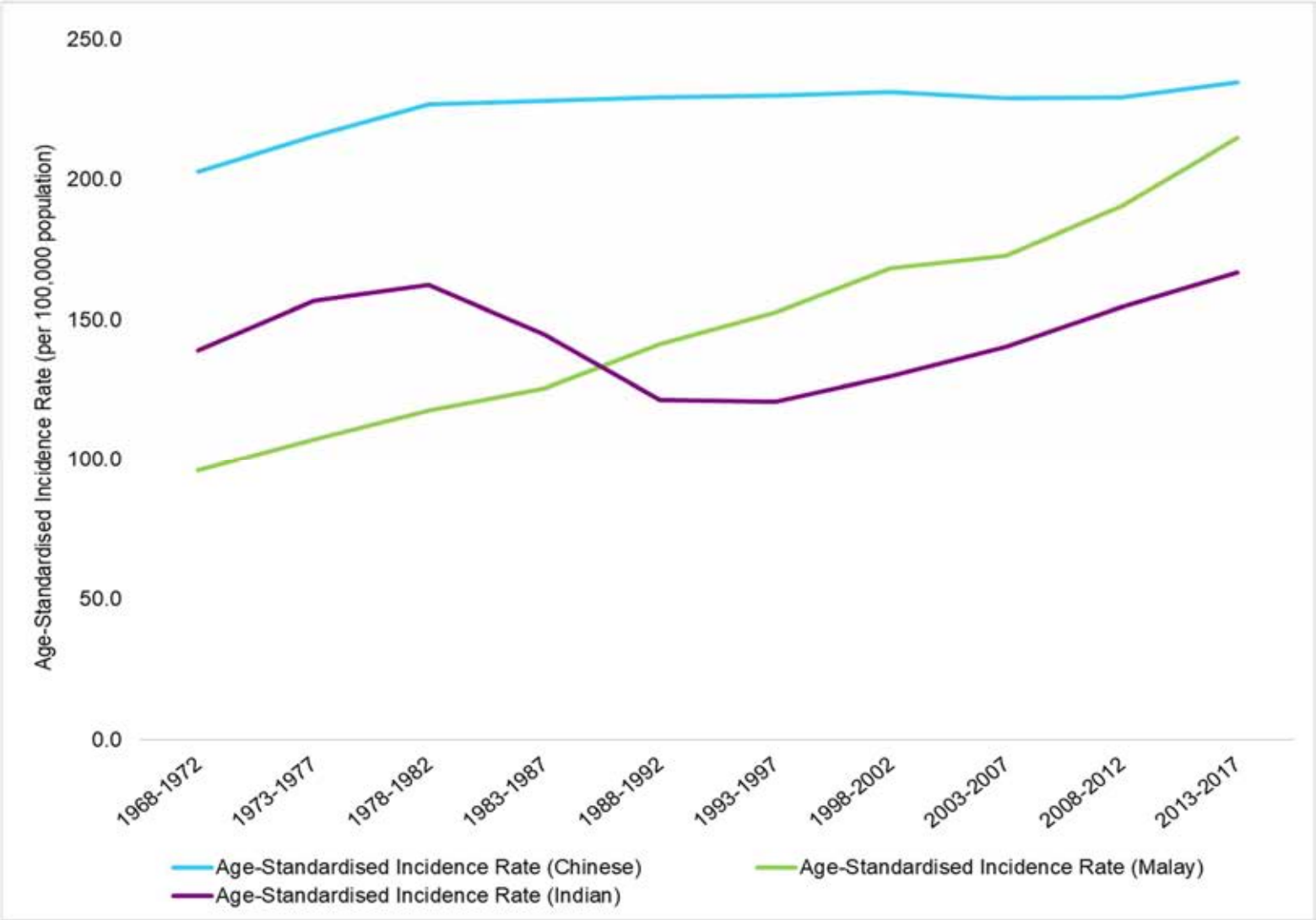


Figure 5.2.1(b): AGE-STANDARDISED INCIDENCE RATE (PER 100,000 POPULATION) FOR CANCER BY ETHNICITY AND FIVE-YEAR PERIOD, 1968-2017 (MALES)

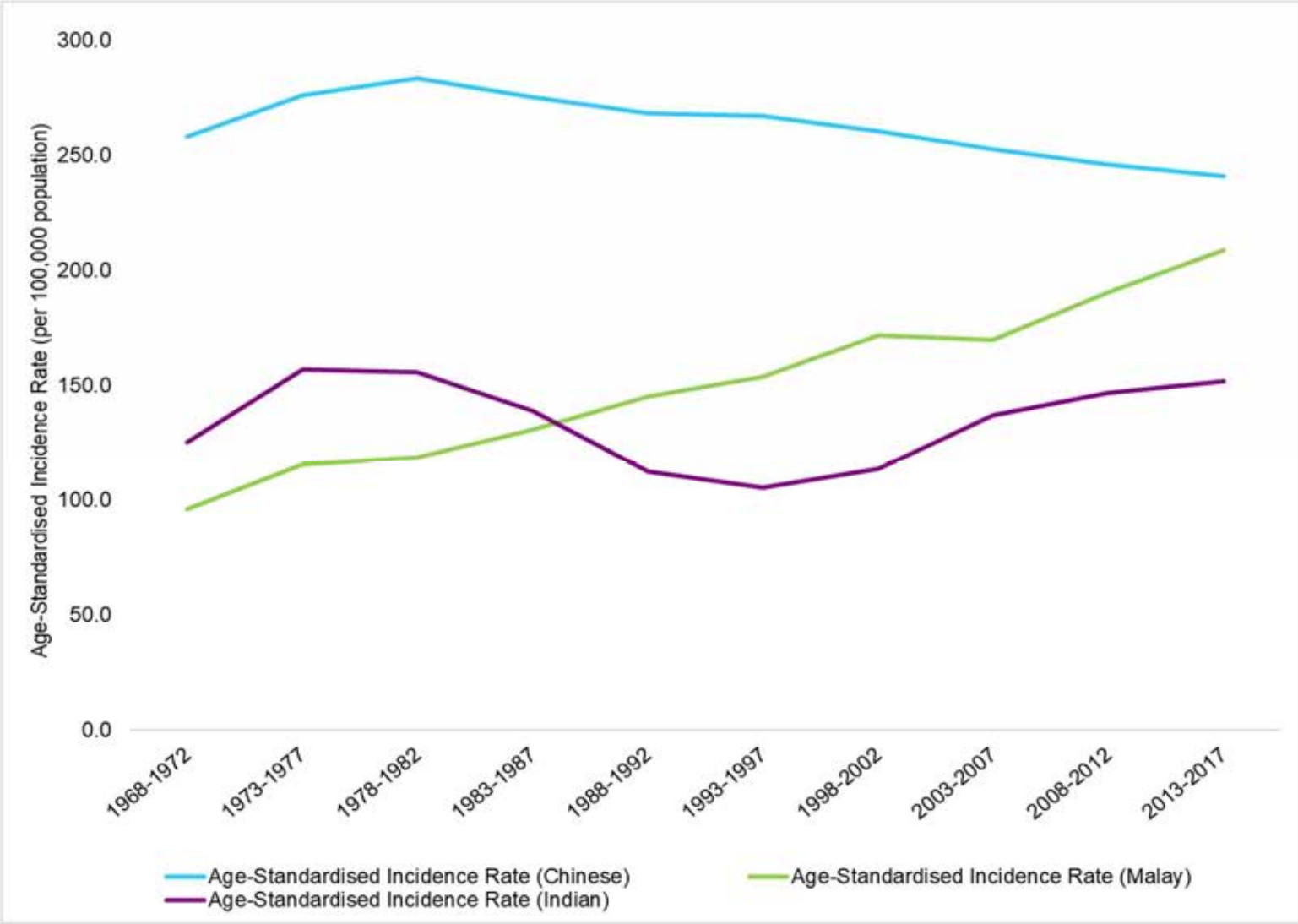


Figure 5.2.1(c): AGE-STANDARDISED INCIDENCE RATE (PER 100,000 POPULATION) FOR CANCER BY ETHNICITY AND FIVE-YEAR PERIOD, 1968-2017 (FEMALES)

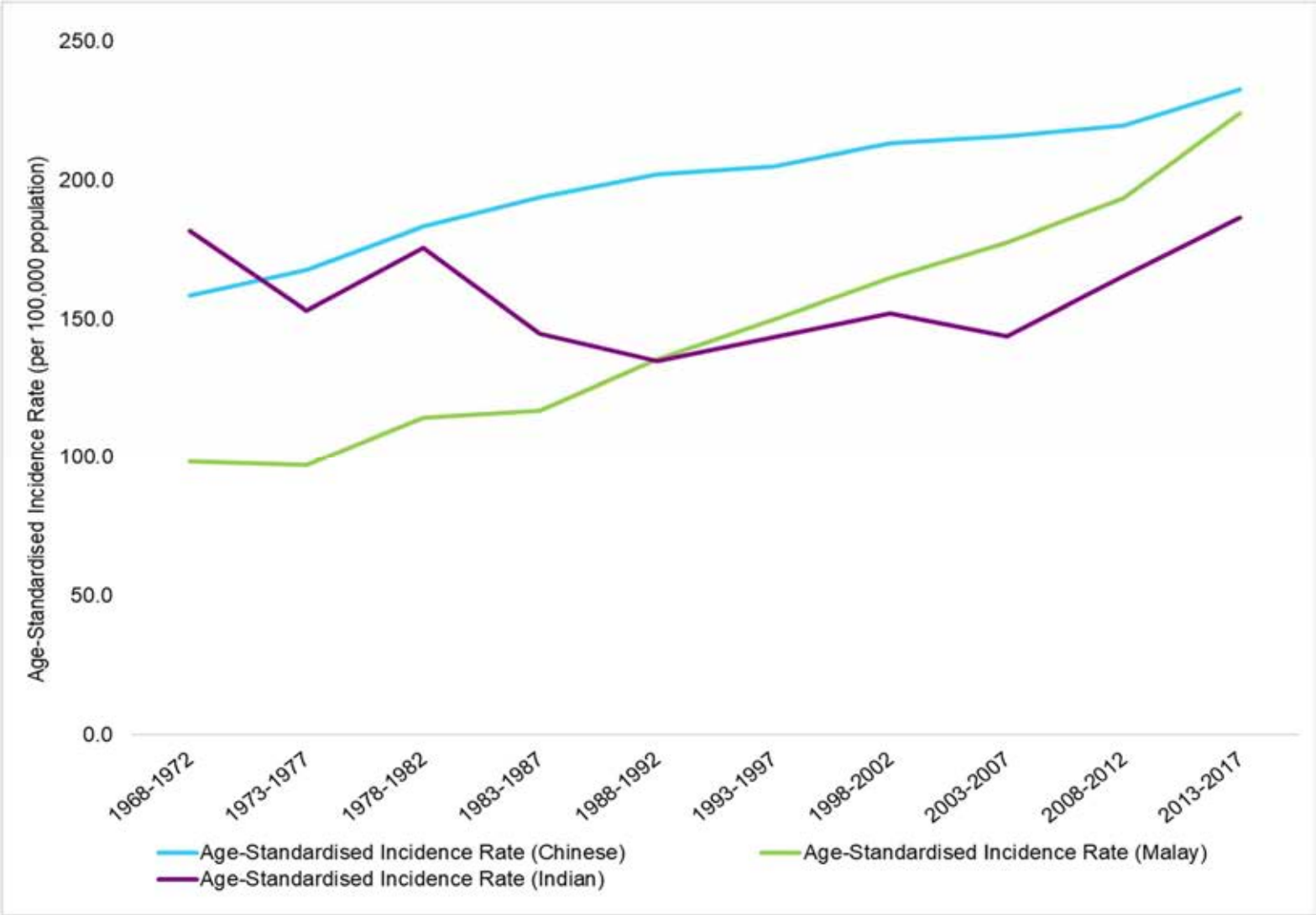


Table 5.2.2(a): TEN MOST FREQUENT CANCERS AMONG CHINESE MALES BY FIVE-YEAR PERIOD, 1968-2017

1968-1972			1973-1977			1978-1982			1983-1987			1988-1992		
SITE	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**
Lung	1273	55.7	Lung	1728	66.6	Lung	2226	73.9	Lung	2475	70.1	Lung	2617	62.8
Stomach	1002	43.7	Stomach	1105	42.3	Stomach	1129	37.5	Colon & rectum	1280	35.1	Colon & rectum	1832	41.9
Liver & intrahepatic bile ducts	792	32.8	Liver & intrahepatic bile ducts	840	31.1	Liver & intrahepatic bile ducts	988	31.6	Stomach	1220	34.7	Stomach	1251	29.7
Nasopharynx	538	19.3	Colon & rectum	722	27.5	Colon & rectum	946	30.9	Liver & intrahepatic bile ducts	974	27.0	Nasopharynx	1012	18.8
Colon & rectum	492	21.7	Nasopharynx	641	19.6	Nasopharynx	679	18.1	Nasopharynx	827	18.4	Liver & intrahepatic bile ducts	960	22.0
Oesophagus	425	19.6	Oesophagus	436	17.8	Oesophagus	404	13.8	Lymphoid neoplasms	385	9.9	Lymphoid neoplasms	458	10.0
Lymphoid neoplasms	182	5.9	Lymphoid neoplasms	213	6.6	Non-melanoma skin	276	8.9	Oesophagus	377	10.7	Non-melanoma skin	424	9.5
Larynx	174	7.8	Non-melanoma skin	205	8.1	Lymphoid neoplasms	263	7.5	Non-melanoma skin	317	8.7	Prostate	413	9.7
Non-melanoma skin	135	6.5	Larynx	188	7.2	Larynx	255	8.3	Urinary bladder	262	7.4	Oesophagus	366	8.8
Urinary bladder	130	5.8	Urinary bladder	172	7.0	Urinary bladder	229	7.7	Prostate	257	7.5	Urinary bladder	339	8.0
All sites	**6165**	**258.1**	**All sites**	**7463**	**276.1**	**All sites**	**8879**	**283.6**	**All sites**	**10151**	**275.5**	**All sites**	**11807**	**268.4**
1993-1997			**1998-2002**			**2003-2007**			**2008-2012**			**2013-2017**		
SITE	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**
Lung	2818	56.5	Lung	3150	52.3	Colon & rectum	3413	44.3	Colon & rectum	4188	42.6	Colon & rectum	4979	40.7
Colon & rectum	2291	44.1	Colon & rectum	2897	46.0	Lung	3346	44.9	Lung	3648	37.5	Prostate	4183	33.3
Stomach	1325	26.1	Liver & intrahepatic bile ducts	1372	21.7	Prostate	1869	25.5	Prostate	2867	30.0	Lung	4157	33.2
Liver & intrahepatic bile ducts	1121	21.2	Stomach	1319	21.9	Liver & intrahepatic bile ducts	1559	20.5	Liver & intrahepatic bile ducts	1834	18.7	Liver & intrahepatic bile ducts	2286	18.6
Nasopharynx	1054	16.0	Prostate	1097	18.5	Stomach	1241	16.5	Lymphoid neoplasms	1344	15.8	Lymphoid neoplasms	1651	16.4
Prostate	716	14.4	Nasopharynx	1018	12.9	Nasopharynx	1113	12.6	Stomach	1299	13.4	Non-melanoma skin	1508	12.1
Lymphoid neoplasms	625	11.4	Lymphoid neoplasms	796	12.8	Lymphoid neoplasms	1054	14.9	Non-melanoma skin	1151	11.9	Stomach	1367	11.0
Non-melanoma skin	569	10.6	Non-melanoma skin	671	10.5	Non-melanoma skin	774	10.3	Nasopharynx	1037	10.3	Kidney & other urinary organs	1183	10.1
Urinary bladder	400	7.7	Urinary bladder	493	8.0	Urinary bladder	558	7.4	Kidney & other urinary organs	868	8.8	Nasopharynx	965	8.7
Oesophagus	356	7.1	Kidney & other urinary organs	413	6.4	Kidney & other urinary organs	537	6.7	Myeloid neoplasms	702	7.6	Pancreas	906	7.3
All sites	**14070**	**267.3**	**All sites**	**16339**	**260.5**	**All sites**	**19174**	**252.7**	**All sites**	**23522**	**246.2**	**All sites**	**28700**	**241.0**

Table 5.2.2(b): TEN MOST FREQUENT CANCERS AMONG MALAY MALES BY FIVE-YEAR PERIOD, 1968-2017

1968-1972			1973-1977			1978-1982			1983-1987			1988-1992		
SITE	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**
Liver & intrahepatic bile ducts	58	15.0	Lung	111	26.0	Lung	122	25.9	Lung	191	32.4	Lung	241	37.0
Lung	47	14.9	Liver & intrahepatic bile ducts	75	16.6	Liver & intrahepatic bile ducts	78	15.7	Liver & intrahepatic bile ducts	78	12.6	Colon & rectum	121	18.1
Lymphoid neoplasms	36	6.0	Colon & rectum	44	11.0	Colon & rectum	52	10.0	Lymphoid neoplasms	75	10.7	Lymphoid neoplasms	97	12.7
Stomach	33	10.2	Stomach	36	9.7	Lymphoid neoplasms	47	7.3	Colon & rectum	73	13.1	Liver & intrahepatic bile ducts	82	11.4
Colon & rectum	26	7.5	Lymphoid neoplasms	30	4.8	Stomach	41	9.7	Prostate	45	9.4	Stomach	56	8.3
Nasopharynx	25	4.6	Nasopharynx	26	5.4	Prostate	25	7.0	Stomach	33	6.0	Prostate	54	9.0
Myeloid neoplasms	16	3.3	Myeloid neoplasms	21	3.0	Nasopharynx	23	3.8	Nasopharynx	30	4.3	Nasopharynx	51	6.6
Non-melanoma skin	15	4.6	Prostate	20	7.0	Myeloid neoplasms	22	3.8	Urinary bladder	28	5.2	Urinary bladder	45	6.8
Urinary bladder	9	3.7	Non-melanoma skin	12	2.7	Non-melanoma skin	19	3.4	Non-melanoma skin	25	4.5	Myeloid neoplasms	34	4.2
Prostate	9	4.2	Urinary bladder	12	3.2	Urinary bladder	17	3.3	Pancreas	23	4.3	Non-melanoma skin	29	4.1
All sites	**357**	**96.2**	**All sites**	**507**	**115.5**	**All sites**	**606**	**118.7**	**All sites**	**786**	**131.0**	**All sites**	**1012**	**145.1**
1993-1997			**1998-2002**			**2003-2007**			**2008-2012**			**2013-2017**		
SITE	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**
Lung	241	30.6	Lung	318	36.1	Lung	357	34.2	Lung	439	35.5	Lung	555	37.2
Colon & rectum	162	20.8	Colon & rectum	208	23.0	Colon & rectum	259	25.4	Colon & rectum	348	28.2	Colon & rectum	497	31.5
Lymphoid neoplasms	125	14.1	Lymphoid neoplasms	178	18.3	Lymphoid neoplasms	184	17.3	Lymphoid neoplasms	294	23.5	Lymphoid neoplasms	380	26.5
Liver & intrahepatic bile ducts	122	15.6	Prostate	140	16.6	Prostate	173	18.1	Prostate	218	19.5	Prostate	322	22.5
Prostate	89	12.6	Liver & intrahepatic bile ducts	114	12.5	Liver & intrahepatic bile ducts	142	13.5	Liver & intrahepatic bile ducts	187	15.0	Liver & intrahepatic bile ducts	248	15.4
Nasopharynx	60	6.6	Urinary bladder	72	7.8	Nasopharynx	84	6.9	Myeloid neoplasms	112	9.1	Myeloid neoplasms	165	11.2
Myeloid neoplasms	56	6.4	Myeloid neoplasms	64	6.7	Myeloid neoplasms	68	6.2	Nasopharynx	86	6.1	Kidney & other urinary organs	103	6.7
Stomach	52	6.6	Stomach	63	6.5	Urinary bladder	62	5.8	Urinary bladder	80	6.7	Nasopharynx	90	5.4
Urinary bladder	45	5.8	Nasopharynx	63	5.6	Kidney & other urinary organs	55	5.1	Kidney & other urinary organs	68	5.4	Stomach	89	5.7
Kidney & other urinary organs	35	4.2	Non-melanoma skin	40	4.6	Stomach	53	5.0	Non-melanoma skin	59	4.4	Urinary bladder	81	5.4
All sites	**1241**	**154.0**	**All sites**	**1589**	**171.9**	**All sites**	**1783**	**169.8**	**All sites**	**2369**	**190.7**	**All sites**	**3139**	**208.8**

Table 5.2.2(c): TEN MOST FREQUENT CANCERS AMONG INDIAN MALES BY FIVE-YEAR PERIOD, 1968-2017

1968-1972			1973-1977			1978-1982			1983-1987			1988-1992		
SITE	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**
Stomach	54	20.5	Stomach	73	22.6	Lung	74	21.7	Lung	92	21.4	Lung	83	14.4
Liver & intrahepatic bile ducts	42	10.3	Lung	65	19.7	Stomach	56	16.0	Colon & rectum	72	15.7	Colon & rectum	72	13.7
Colon & rectum	37	9.8	Liver & intrahepatic bile ducts	44	13.8	Liver & intrahepatic bile ducts	54	14.1	Stomach	70	15.8	Stomach	57	10.1
Lung	34	10.2	Colon & rectum	43	15.5	Colon & rectum	42	12.9	Lymphoid neoplasms	45	10.7	Lymphoid neoplasms	49	9.0
Lymphoid neoplasms	32	8.1	Mouth	26	10.4	Lymphoid neoplasms	35	9.9	Prostate	41	9.9	Prostate	43	8.1
Mouth	22	8.1	Oesophagus	23	6.8	Oesophagus	30	8.1	Liver & intrahepatic bile ducts	40	9.4	Liver & intrahepatic bile ducts	39	6.2
Pharynx	20	7.6	Larynx	21	7.1	Larynx	28	7.9	Larynx	39	9.1	Oesophagus	31	5.6
Oesophagus	18	5.4	Tongue	20	5.4	Prostate	26	9.4	Mouth	26	5.3	Larynx	29	4.9
Myeloid neoplasms	14	3.7	Lymphoid neoplasms	20	6.2	Pharynx	24	8.9	Tongue	23	4.5	Urinary bladder	23	4.5
Larynx	12	4.4	Pharynx	18	5.9	Myeloid neoplasms	22	6.1	Urinary bladder	21	5.0	Mouth	22	3.7
All sites	**398**	**125.4**	**All sites**	**498**	**157.0**	**All sites**	**537**	**155.9**	**All sites**	**622**	**139.0**	**All sites**	**625**	**112.3**
1993-1997			**1998-2002**			**2003-2007**			**2008-2012**			**2013-2017**		
SITE	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**
Lung	74	10.8	Colon & rectum	117	16.2	Colon & rectum	129	17.6	Colon & rectum	177	19.7	Colon & rectum	222	20.5
Prostate	69	9.8	Lung	94	12.6	Lung	125	17.6	Prostate	158	20.4	Prostate	201	20.2
Colon & rectum	68	9.7	Prostate	86	11.8	Prostate	117	15.9	Lymphoid neoplasms	151	17.4	Lung	194	19.0
Stomach	57	8.5	Stomach	62	7.9	Lymphoid neoplasms	86	12.2	Lung	151	17.8	Lymphoid neoplasms	158	16.1
Lymphoid neoplasms	56	9.1	Liver & intrahepatic bile ducts	60	8.1	Stomach	70	9.4	Liver & intrahepatic bile ducts	82	9.3	Liver & intrahepatic bile ducts	124	11.6
Liver & intrahepatic bile ducts	49	7.6	Lymphoid neoplasms	59	8.9	Liver & intrahepatic bile ducts	69	9.2	Stomach	78	8.5	Stomach	77	6.7
Larynx	37	5.7	Urinary bladder	35	4.6	Urinary bladder	41	5.5	Kidney & other urinary organs	47	5.4	Kidney & other urinary organs	73	6.3
Urinary bladder	33	5.2	Oesophagus	25	3.3	Kidney & other urinary organs	37	5.1	Myeloid neoplasms	47	5.2	Myeloid neoplasms	60	5.2
Mouth	24	3.8	Myeloid neoplasms	23	3.2	Myeloid neoplasms	35	4.5	Urinary bladder	42	5.3	Pancreas	47	4.3
Non-melanoma skin	23	3.3	Pancreas	21	3.1	Pancreas	31	4.2	Pancreas	33	3.5	Urinary bladder	39	3.6
All sites	**694**	**105.4**	**All sites**	**826**	**113.7**	**All sites**	**994**	**137.1**	**All sites**	**1284**	**147.0**	**All sites**	**1603**	**152.0**

Table 5.2.2(d): TEN MOST FREQUENT CANCERS AMONG CHINESE FEMALES BY FIVE-YEAR PERIOD, 1968-2017

1968-1972			1973-1977			1978-1982			1983-1987			1988-1992		
SITE	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**
Female breast	554	19.5	Female breast	738	22.6	Female breast	1048	27.4	Female breast	1461	31.8	Female breast	2208	39.4
Cervix uteri	527	18.6	Colon & rectum	661	20.9	Colon & rectum	987	26.2	Colon & rectum	1296	28.7	Colon & rectum	1701	30.9
Stomach	492	18.1	Lung	622	19.9	Lung	849	22.8	Lung	992	22.0	Lung	1096	19.8
Lung	461	17.3	Cervix uteri	587	18.3	Cervix uteri	639	17.0	Cervix uteri	802	17.6	Cervix uteri	882	16.3
Colon & rectum	437	16.2	Stomach	568	17.8	Stomach	583	15.3	Stomach	719	15.6	Stomach	766	13.6
Nasopharynx	218	7.3	Nasopharynx	267	7.5	Ovary & fallopian tube	342	8.8	Ovary & fallopian tube	404	8.6	Ovary & fallopian tube	588	10.7
Liver & intrahepatic bile ducts	214	8.0	Liver & intrahepatic bile ducts	231	7.2	Nasopharynx	314	7.8	Nasopharynx	360	7.4	Non-melanoma skin	479	8.1
Ovary & fallopian tube	184	6.0	Ovary & fallopian tube	201	5.8	Non-melanoma skin	301	7.7	Non-melanoma skin	351	7.5	Nasopharynx	423	7.3
Oesophagus	170	6.5	Non-melanoma skin	181	5.7	Liver & intrahepatic bile ducts	273	7.2	Liver & intrahepatic bile ducts	314	7.0	Corpus uteri	370	7.1
Corpus uteri	136	4.9	Lymphoid neoplasms	146	4.2	Corpus uteri	190	5.1	Thyroid	305	5.9	Lymphoid neoplasms	367	7.3
All sites	**4460**	**158.5**	**All sites**	**5467**	**167.6**	**All sites**	**7030**	**183.2**	**All sites**	**8882**	**193.9**	**All sites**	**11200**	**202.3**

1993-1997			1998-2002			2003-2007			2008-2012			2013-2017		
SITE	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**
Female breast	2994	44.4	Female breast	4675	57.8	Female breast	5633	60.3	Female breast	6893	64.2	Female breast	8668	70.8
Colon & rectum	2090	32.0	Colon & rectum	2528	31.7	Colon & rectum	3039	31.3	Colon & rectum	3434	28.7	Colon & rectum	4118	28.2
Lung	1336	20.2	Lung	1442	17.6	Lung	1719	17.7	Lung	2005	16.5	Lung	2444	16.5
Cervix uteri	992	14.9	Cervix uteri	913	11.6	Corpus uteri	1120	12.2	Corpus uteri	1417	13.1	Corpus uteri	2077	17.1
Stomach	850	12.6	Stomach	886	10.9	Ovary & fallopian tube	1085	12.3	Ovary & fallopian tube	1283	12.7	Ovary & fallopian tube	1414	12.6
Ovary & fallopian tube	711	10.8	Ovary & fallopian tube	842	10.9	Cervix uteri	867	9.4	Non-melanoma skin	1066	8.3	Non-melanoma skin	1333	8.4
Non-melanoma skin	592	8.4	Corpus uteri	758	9.7	Stomach	817	8.2	Stomach	971	7.7	Lymphoid neoplasms	1276	11.2
Corpus uteri	497	7.8	Non-melanoma skin	716	8.5	Lymphoid neoplasms	773	9.9	Lymphoid neoplasms	924	9.8	Thyroid	1118	10.3
Lymphoid neoplasms	450	7.1	Lymphoid neoplasms	548	7.7	Non-melanoma skin	711	7.1	Thyroid	779	8.0	Stomach	1026	6.7
Thyroid	406	5.9	Thyroid	520	6.7	Liver & intrahepatic bile ducts	515	5.2	Cervix uteri	775	7.2	Liver & intrahepatic bile ducts	846	5.4
All sites	**13617**	**205.1**	**All sites**	**17012**	**213.3**	**All sites**	**20061**	**215.8**	**All sites**	**24300**	**219.6**	**All sites**	**30104**	**232.8**

Table 5.2.2(e): TEN MOST FREQUENT CANCERS AMONG MALAY FEMALES BY FIVE-YEAR PERIOD, 1968-2017

1968-1972			1973-1977			1978-1982			1983-1987			1988-1992		
SITE	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**
Female breast	64	16.9	Female breast	69	14.9	Female breast	111	20.9	Female breast	154	22.6	Female breast	260	33.4
Cervix uteri	45	11.4	Ovary & fallopian tube	49	10.6	Ovary & fallopian tube	57	9.7	Ovary & fallopian tube	65	9.1	Colon & rectum	93	13.5
Stomach	31	9.4	Cervix uteri	43	8.8	Colon & rectum	54	12.8	Lung	61	12.0	Cervix uteri	81	11.2
Ovary & fallopian tube	29	6.2	Colon & rectum	28	8.3	Cervix uteri	49	9.4	Colon & rectum	59	10.6	Ovary & fallopian tube	81	10.0
Lymphoid neoplasms	25	4.9	Stomach	24	7.3	Thyroid	33	4.8	Cervix uteri	56	8.9	Lymphoid neoplasms	68	8.9
Lung	20	7.6	Lung	22	6.7	Lung	29	7.8	Thyroid	43	4.9	Lung	60	9.5
Liver & intrahepatic bile ducts	19	6.7	Lymphoid neoplasms	21	3.6	Stomach	28	6.6	Lymphoid neoplasms	43	7.1	Thyroid	59	6.2
Colon & rectum	18	6.0	Thyroid	17	3.7	Lymphoid neoplasms	25	5.1	Liver & intrahepatic bile ducts	33	6.2	Corpus uteri	38	5.0
Thyroid	15	4.2	Corpus uteri	17	4.5	Liver & intrahepatic bile ducts	23	5.5	Stomach	29	5.3	Stomach	35	5.4
Corpus uteri	13	4.0	Myeloid neoplasms	16	3.1	Myeloid neoplasms	20	2.9	Corpus uteri	25	4.0	Myeloid neoplasms	28	3.5
All sites	**368**	**98.5**	**All sites**	**410**	**97.2**	**All sites**	**574**	**114.5**	**All sites**	**734**	**117.0**	**All sites**	**1010**	**135.6**
1993-1997			**1998-2002**			**2003-2007**			**2008-2012**			**2013-2017**		
SITE	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**
Female breast	356	37.2	Female breast	524	44.5	Female breast	729	54.5	Female breast	910	58.0	Female breast	1137	65.6
Colon & rectum	131	16.1	Colon & rectum	173	18.5	Colon & rectum	216	19.7	Colon & rectum	304	21.2	Colon & rectum	449	25.2
Ovary & fallopian tube	112	11.7	Ovary & fallopian tube	146	13.4	Ovary & fallopian tube	165	12.8	Lymphoid neoplasms	214	15.3	Ovary & fallopian tube	303	17.8
Cervix uteri	90	10.1	Lung	115	12.0	Lymphoid neoplasms	160	13.9	Ovary & fallopian tube	212	13.9	Corpus uteri	302	17.6
Lung	86	10.3	Lymphoid neoplasms	108	10.7	Lung	143	12.2	Corpus uteri	202	12.9	Lymphoid neoplasms	300	19.2
Lymphoid neoplasms	74	8.6	Corpus uteri	91	8.8	Corpus uteri	140	11.2	Lung	179	12.3	Lung	231	12.4
Corpus uteri	69	7.7	Cervix uteri	79	7.3	Cervix uteri	104	8.5	Thyroid	116	8.0	Thyroid	152	9.4
Thyroid	54	5.4	Thyroid	79	6.9	Thyroid	96	7.5	Cervix uteri	100	6.8	Cervix uteri	142	8.6
Myeloid neoplasms	42	4.7	Myeloid neoplasms	51	5.0	Myeloid neoplasms	58	4.6	Myeloid neoplasms	89	6.2	Myeloid neoplasms	106	6.5
Non-melanoma skin	35	4.4	Stomach	42	3.8	Liver & intrahepatic bile ducts	48	4.3	Liver & intrahepatic bile ducts	62	4.4	Liver & intrahepatic bile ducts	95	5.6
All sites	**1338**	**149.8**	**All sites**	**1745**	**164.9**	**All sites**	**2205**	**177.7**	**All sites**	**2872**	**193.5**	**All sites**	**3816**	**224.1**

Table 5.2.2(f): TEN MOST FREQUENT CANCERS AMONG INDIAN FEMALES BY FIVE-YEAR PERIOD, 1968-2017

1968-1972			1973-1977			1978-1982			1983-1987			1988-1992		
SITE	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**
Cervix uteri	26	26.8	Female breast	41	26.5	Cervix uteri	54	28.6	Female breast	88	32.4	Female breast	118	34.5
Female breast	25	25.6	Cervix uteri	37	26.8	Female breast	53	29.8	Cervix uteri	36	12.2	Colon & rectum	33	11.6
Colon & rectum	17	19.9	Stomach	12	9.4	Colon & rectum	36	27.9	Ovary & fallopian tube	29	9.4	Cervix uteri	32	8.7
Stomach	16	19.5	Colon & rectum	12	9.1	Stomach	21	15.9	Colon & rectum	27	15.6	Ovary & fallopian tube	28	7.6
Mouth	12	16.0	Ovary & fallopian tube	12	7.9	Mouth	13	9.5	Lymphoid neoplasms	20	7.5	Stomach	23	7.7
Thyroid	9	11.0	Corpus uteri	11	6.7	Ovary & fallopian tube	12	4.5	Thyroid	17	6.3	Lymphoid neoplasms	20	7.5
Oesophagus	6	5.7	Thyroid	10	4.8	Non-melanoma skin	8	4.8	Stomach	17	9.1	Corpus uteri	20	7.1
Liver & intrahepatic bile ducts	6	6.3	Oesophagus	9	7.1	Lymphoid neoplasms	8	3.0	Lung	10	5.7	Thyroid	17	3.6
Ovary & fallopian tube	6	5.3	Lung	9	7.5	Lung	8	6.1	Mouth	10	5.8	Mouth	13	4.4
Lymphoid neoplasms	6	4.1	Liver & intrahepatic bile ducts	9	5.1	Pharynx	7	4.3	Corpus uteri	9	3.1	Lung	12	4.3
All sites	**168**	**181.9**	**All sites**	**222**	**153.2**	**All sites**	**298**	**175.7**	**All sites**	**345**	**144.9**	**All sites**	**427**	**134.9**

1993-1997			1998-2002			2003-2007			2008-2012			2013-2017		
SITE	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**
Female breast	187	39.6	Female breast	290	48.7	Female breast	376	50.4	Female breast	542	58.4	Female breast	718	65.8
Colon & rectum	58	15.0	Colon & rectum	72	14.0	Corpus uteri	83	11.9	Corpus uteri	132	15.1	Corpus uteri	193	17.5
Ovary & fallopian tube	51	10.7	Ovary & fallopian tube	59	9.0	Ovary & fallopian tube	77	10.1	Colon & rectum	116	13.7	Colon & rectum	174	15.7
Cervix uteri	38	8.8	Corpus uteri	49	8.4	Colon & rectum	75	11.0	Ovary & fallopian tube	96	10.9	Ovary & fallopian tube	111	10.6
Corpus uteri	35	7.5	Thyroid	46	7.1	Lymphoid neoplasms	60	9.2	Lymphoid neoplasms	79	9.4	Thyroid	102	9.7
Stomach	25	7.3	Lymphoid neoplasms	45	8.5	Thyroid	39	4.8	Thyroid	60	6.2	Lymphoid neoplasms	102	11.5
Lymphoid neoplasms	24	5.3	Cervix uteri	38	6.8	Stomach	32	4.9	Lung	49	5.7	Lung	67	6.4
Thyroid	22	3.5	Stomach	34	6.1	Lung	29	4.4	Myeloid neoplasms	46	5.1	Pancreas	52	5.1
Mouth	19	5.6	Lung	34	7.1	Cervix uteri	24	3.5	Stomach	35	4.0	Cervix uteri	45	4.3
Lung	17	5.5	Myeloid neoplasms	21	3.5	Kidney & other urinary organs	22	3.4	Pancreas	29	3.6	Stomach	44	4.0
All sites	**604**	**143.5**	**All sites**	**847**	**152.1**	**All sites**	**1013**	**143.8**	**All sites**	**1462**	**165.5**	**All sites**	**1980**	**186.5**

5.3 INCIDENCE OF CANCER BY AGE GROUP, 1968-2017

Cancer incidence trends by three broad age groups – 15-34 years, 35-64 years and 65 years and above – are examined in this section. Among the three age groups, the proportion of those aged 15-34 years among all cancer diagnoses fell gradually from 7.0% in 1968-1972 to 3.2% in 2013-2017 (Table 5.3.1, Figure 5.3.1(a)). Similarly, the proportion of patients aged 35-64 years old also decreased from 60.3% in 1968-1972 to 46.4% in 2013-2017. Conversely, the proportion of those aged 65 years and above among cancer diagnoses increased from 29.8% in 1968-1972 to 49.8% in 2013-2017. The CIR and ASIR of cancer among those aged 65 years and above also reflected this trend, rising from 1058.4 to 1541.9 and 1055.0 to 1473.7 per 100,000 population respectively. While there had been a trend of an overall increase in the age-specific incidence of cancer in those aged 15-34 years and 65 years and above over the years for both males and females; the age-specific incidence of cancer in males aged 35-64 years had seen an overall decline while females of the same age group exhibited an overall increase in cancer incidence (Figures 5.3.1(b)-5.3.1(c)).

The three age groups differed in terms of the most common cancers diagnosed. The numbers of cases and ASIRs for the ten most frequent cancers for males and females in the three age groups for each five-year period from 1968-2017 are shown in Tables 5.3.2(a) – 5.3.2(f).

Among males aged 15-34 years, nasopharyngeal cancer was the most commonly found cancer from 1968-1972 to 1988-1992. Its decreasing ASIR led to a corresponding fall in its ranking to eighth in 2013-2017. Both the ASIR and relative ranking of lymphoid neoplasms increased for males aged 35-64 years and those aged 65 years and above; it was consistently among the top two leading cancers from 1978-1982 onwards for males aged 15-34 years. While colorectal cancer increased steadily in ranking for males aged 35-64 years, it ranked between second to fourth in every five-year period for males aged 65 years and above. Prostate cancer increased steadily in ASIR among those aged 65 years and above, and it rose from ninth place in 1968-1972 to first place in 2013-2017. Lung cancer was not common among the youngest age group but was consistently one of the two leading cancers in males aged 35-64 years. It was also the leading cancer diagnosed in males aged 65 years and above until 2008-2012.

Breast cancer was the leading cancer diagnosed in females aged 15-34 years from 1973-1977 onwards, and was consistently the most common cancer for the 35-64 years age band throughout 1968-2017. However, it only emerged as the leading cancer diagnosed in females aged 65 years and above in 2013-2017. The fall in the ASIR of cervical cancer led to a corresponding fall in its ranking for all three age bands.

Colorectal cancer was the leading cancer diagnosed in females aged 65 years and above for majority of the period under study, from 1978-2012. It gradually rose from fourth place to second place among the top ten cancers among females aged 35-64 years. Throughout the fifty years, lung cancer hovered between fourth to sixth place and first to third place among females aged 35-64 years, and 65 years and above, respectively. The rising ASIR of lymphoid neoplasms led to a corresponding increase in its ranking among the most common cancers for all three age groups.

Table 5.3.1: INCIDENCE NUMBER AND RATE (PER 100,000 POPULATION) FOR CANCER BY AGE GROUP AND FIVE-YEAR PERIOD, 1968-2017

Period	Age group	Number	%	CIR	ASIR
1968-1972	15-34 years	845	7.0	24.6	26.3
	35-64 years	7284	60.3	312.7	334.9
	65 years+	3592	29.8	1058.4	1055.0
	Total	12072	100	120.3	188.7
1973-1977	15-34 years	1027	7.0	25.2	26.2
	35-64 years	8093	54.9	315.0	338.5
	65 years+	5268	35.7	1206.3	1205.0
	Total	14739	100	139.1	200.6
1978-1982	15-34 years	1279	7.1	26.5	26.3
	35-64 years	9178	50.7	319.5	344.0
	65 years+	7390	40.8	1327.7	1324.4
	Total	18116	100	158.6	210.2
1983-1987	15-34 years	1481	6.8	28.8	26.8
	35-64 years	10726	49.3	305.0	339.8
	65 years+	9182	42.2	1353.1	1331.0
	Total	21745	100	175.3	210.5
1988-1992	15-34 years	1610	6.1	30.9	27.5
	35-64 years	12925	49.0	290.4	336.6
	65 years+	11467	43.4	1398.5	1354.7
	Total	26394	100	193.7	211.6
1993-1997	15-34 years	1614	5.0	31.8	27.2
	35-64 years	15461	48.3	277.1	327.2
	65 years+	14502	45.3	1475.9	1423.3
	Total	31978	100	212.2	213.2
1998-2002	15-34 years	1681	4.3	34.2	29.9
	35-64 years	19086	49.1	284.9	328.2
	65 years+	17689	45.5	1507.9	1449.2
	Total	38908	100	237.3	216.5
2003-2007	15-34 years	1786	3.9	35.9	32.3
	35-64 years	22598	49.1	301.1	326.7
	65 years+	21146	46.0	1518.0	1452.3
	Total	46019	100	265.2	217.6
2008-2012	15-34 years	2047	3.6	38.3	35.2
	35-64 years	28170	49.2	334.0	333.5
	65 years+	26492	46.3	1544.6	1451.0
	Total	57243	100	305.2	221.3
2013-2017	15-34 years	2295	3.2	43.0	39.3
	35-64 years	33042	46.4	372.9	352.1
	65 years+	35458	49.8	1541.9	1473.7
	Total	71265	100	365.1	229.6

Figure 5.3.1(a): AGE-SPECIFIC INCIDENCE RATE (PER 100,000 POPULATION) FOR CANCER BY AGE GROUP AND FIVE-YEAR PERIOD, 1968-2017 (ALL)

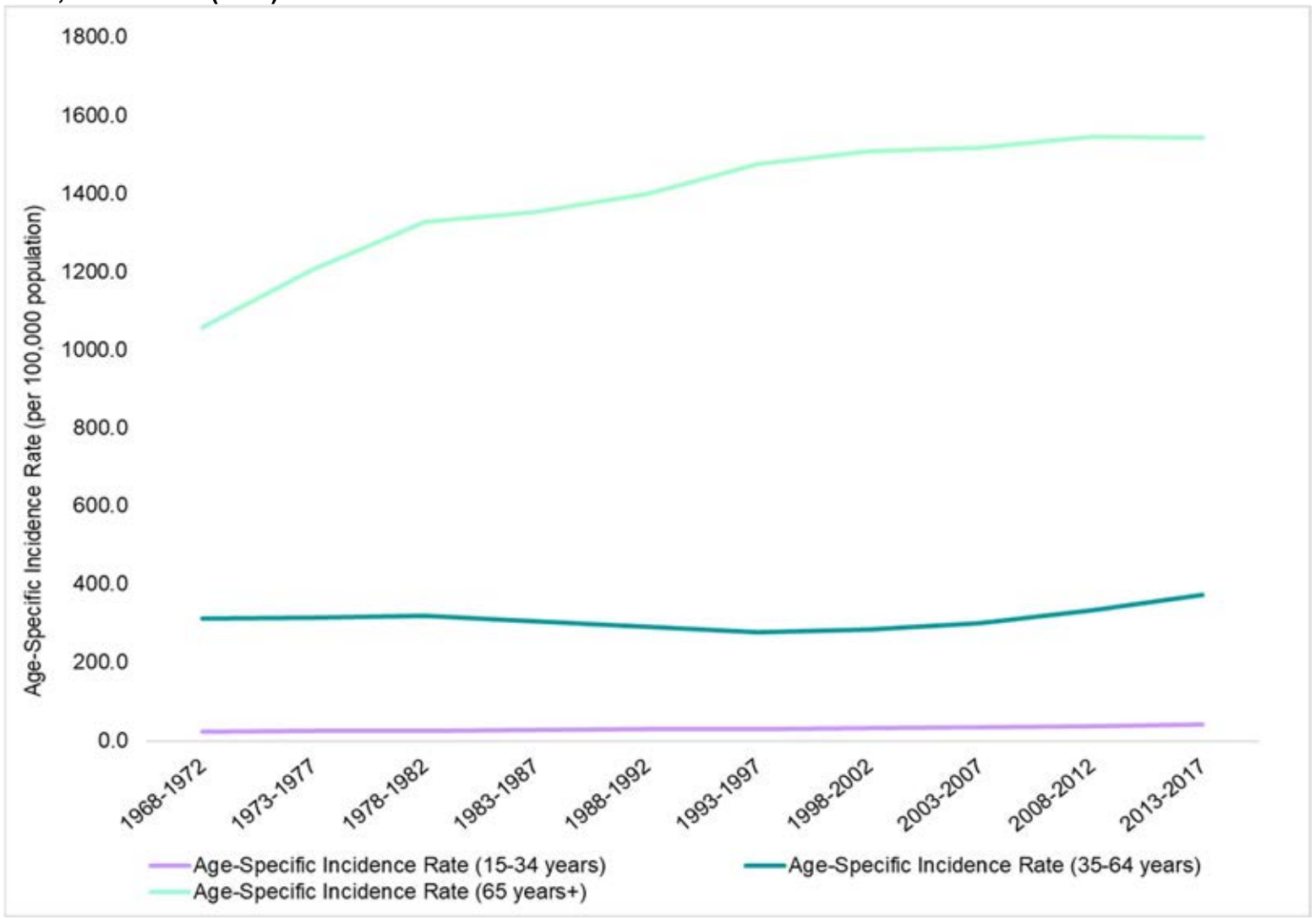


Figure 5.3.1(b): AGE-SPECIFIC INCIDENCE RATE (PER 100,000 POPULATION) FOR CANCER BY AGE GROUP AND FIVE-YEAR PERIOD, 1968-2017 (MALES)

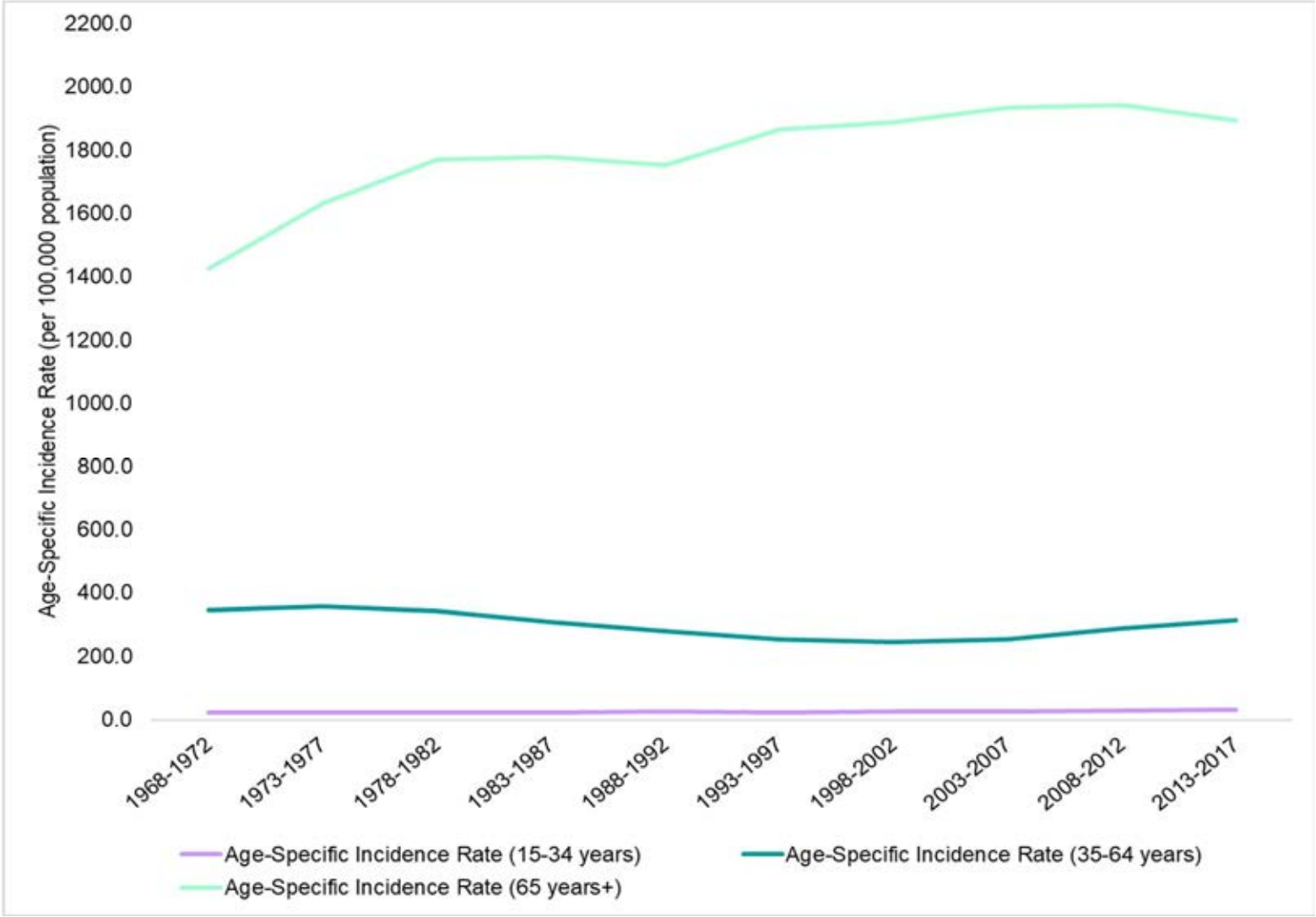


Figure 5.3.1(c): AGE-SPECIFIC INCIDENCE RATE (PER 100,000 POPULATION) FOR CANCER BY AGE GROUP AND FIVE-YEAR PERIOD, 1968-2017 (FEMALES)

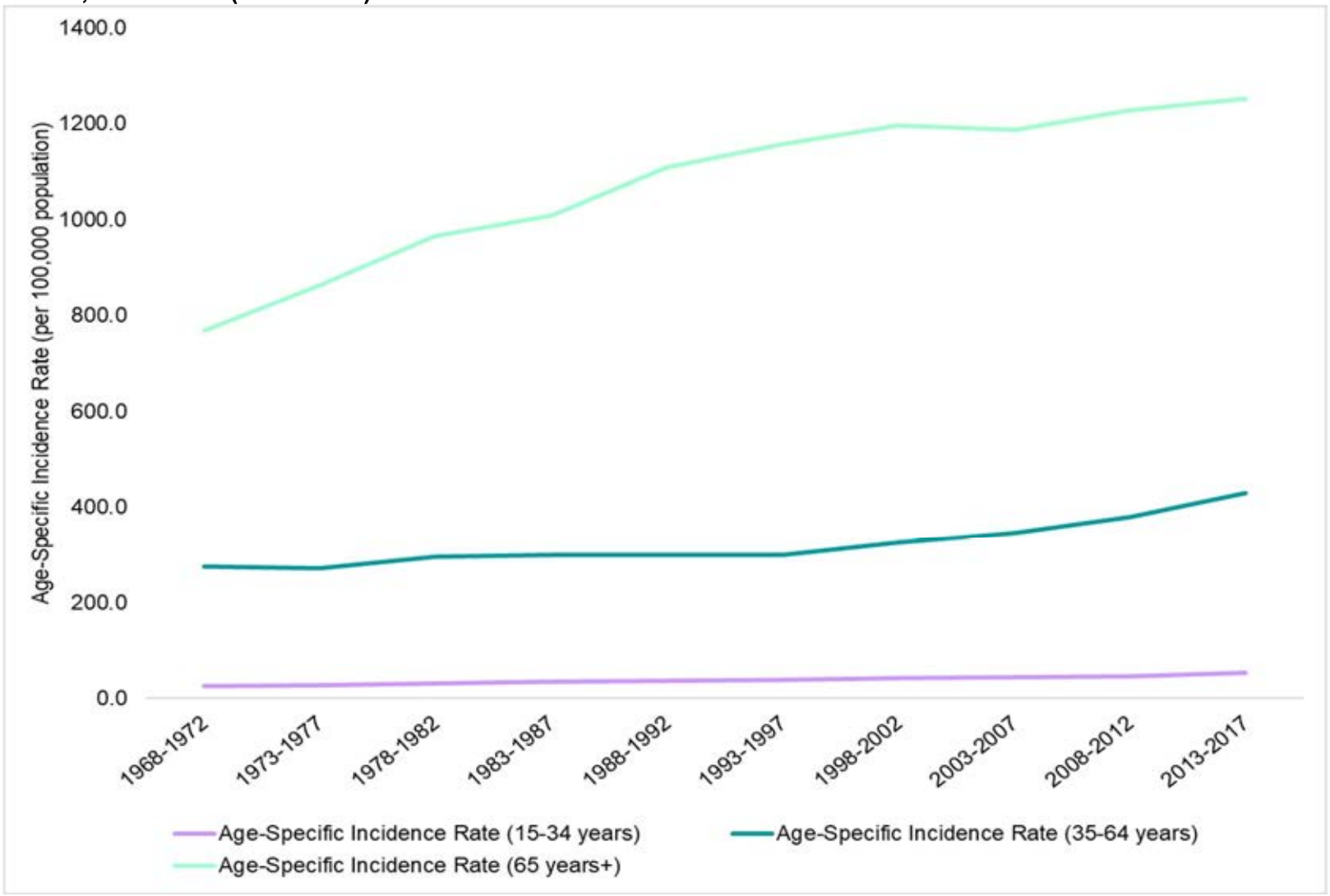


Table 5.3.2(a): TEN MOST FREQUENT CANCERS AMONG MALES (15-34 YEARS) BY FIVE-YEAR PERIOD, 1968-2017

1968-1972			1973-1977			1978-1982			1983-1987			1988-1992		
SITE	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**
Nasopharynx	99	6.1	Nasopharynx	116	5.9	Nasopharynx	118	4.8	Nasopharynx	132	4.5	Nasopharynx	141	4.3
Lymphoid neoplasms	43	2.4	Myeloid neoplasms	55	2.7	Lymphoid neoplasms	70	2.8	Lymphoid neoplasms	74	2.8	Lymphoid neoplasms	89	3.5
Myeloid neoplasms	36	2.0	Colon & rectum	47	2.3	Myeloid neoplasms	52	2.2	Colon & rectum	47	1.6	Colon & rectum	53	1.7
Colon & rectum	26	1.6	Liver & intrahepatic bile ducts	46	2.4	Colon & rectum	40	1.6	Myeloid neoplasms	44	1.7	Myeloid neoplasms	50	1.8
Stomach	21	1.4	Lymphoid neoplasms	45	2.2	Bone	34	1.4	Bone	37	1.5	Brain & CNS	41	1.4
Brain & CNS	19	1.0	Stomach	25	1.3	Testis	32	1.3	Brain & CNS	36	1.4	Liver & intrahepatic bile ducts	30	0.9
Bone	19	1.0	Testis	22	1.1	Brain & CNS	29	1.2	Thyroid	32	1.2	Bone	29	1.1
Liver & intrahepatic bile ducts	19	1.3	Bone	17	0.8	Liver & intrahepatic bile ducts	28	1.1	Testis	30	1.1	Testis	25	0.9
Lung	14	1.0	Thyroid	16	0.8	Stomach	23	0.9	Connective tissue	27	1.0	Thyroid	24	0.9
Testis	14	0.7	Brain & CNS	14	0.7	Non-melanoma skin	20	0.8	Liver & intrahepatic bile ducts	26	0.9	Non-melanoma skin	20	0.7
All sites	**397**	**24.1**	**All sites**	**480**	**24.0**	**All sites**	**556**	**22.5**	**All sites**	**602**	**21.7**	**All sites**	**657**	**22.7**
1993-1997			**1998-2002**			**2003-2007**			**2008-2012**			**2013-2017**		
SITE	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**
Lymphoid neoplasms	110	4.1	Lymphoid neoplasms	118	4.9	Lymphoid neoplasms	134	5.6	Lymphoid neoplasms	192	7.2	Lymphoid neoplasms	206	7.7
Nasopharynx	100	3.1	Nasopharynx	82	2.5	Nasopharynx	67	2.2	Testis	79	3.0	Testis	108	3.9
Myeloid neoplasms	61	2.3	Myeloid neoplasms	56	2.3	Testis	61	2.4	Brain & CNS	56	2.1	Myeloid neoplasms	70	2.5
Colon & rectum	47	1.4	Colon & rectum	55	1.9	Myeloid neoplasms	51	1.9	Myeloid neoplasms	56	2.1	Thyroid	63	2.2
Brain & CNS	37	1.4	Testis	42	1.6	Brain & CNS	46	1.9	Colon & rectum	47	1.6	Colon & rectum	53	1.8
Testis	34	1.2	Thyroid	33	1.1	Colon & rectum	44	1.5	Nasopharynx	41	1.4	Brain & CNS	51	1.9
Thyroid	28	1.0	Brain & CNS	27	1.1	Thyroid	40	1.4	Connective tissue	40	1.5	Connective tissue	41	1.5
Connective tissue	23	0.9	Connective tissue	25	1.1	Bone	27	1.2	Thyroid	39	1.3	Nasopharynx	40	1.3
Liver & intrahepatic bile ducts	23	0.8	Liver & intrahepatic bile ducts	20	0.7	Heart, thymus, & mediastinum	23	1.0	Bone	35	1.4	Bone	36	1.5
Bone	20	0.8	Non-melanoma skin	19	0.6	Lung	21	0.7	Heart, thymus, & mediastinum	31	1.2	Heart, thymus, & mediastinum	29	1.2
All sites	**613**	**21.3**	**All sites**	**625**	**23.3**	**All sites**	**647**	**24.7**	**All sites**	**790**	**28.6**	**All sites**	**863**	**31.0**

Table 5.3.2(b): TEN MOST FREQUENT CANCERS AMONG MALES (35-64 YEARS) BY FIVE-YEAR PERIOD, 1968-2017

1968-1972			1973-1977			1978-1982			1983-1987			1988-1992		
SITE	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**
Lung	836	76.1	Lung	1071	90.4	Lung	1126	86.2	Lung	1246	81.9	Lung	1262	71.5
Stomach	686	61.4	Stomach	641	53.0	Liver & intrahepatic bile ducts	651	48.3	Colon & rectum	687	44.4	Colon & rectum	956	51.8
Liver & intrahepatic bile ducts	638	56.0	Liver & intrahepatic bile ducts	598	49.0	Stomach	603	46.0	Nasopharynx	657	38.4	Nasopharynx	811	38.9
Nasopharynx	415	34.6	Nasopharynx	508	38.9	Colon & rectum	531	40.1	Liver & intrahepatic bile ducts	590	38.5	Stomach	574	32.1
Colon & rectum	338	29.7	Colon & rectum	434	36.0	Nasopharynx	510	35.2	Stomach	550	36.1	Liver & intrahepatic bile ducts	559	30.3
Oesophagus	265	24.1	Oesophagus	221	19.1	Oesophagus	176	13.8	Lymphoid neoplasms	207	12.9	Lymphoid neoplasms	275	14.2
Larynx	112	10.1	Larynx	132	11.2	Non-melanoma skin	149	11.1	Oesophagus	161	10.6	Non-melanoma skin	251	13.4
Non-melanoma skin	97	8.7	Non-melanoma skin	128	10.2	Lymphoid neoplasms	146	11.1	Non-melanoma skin	159	10.2	Oesophagus	160	9.1
Lymphoid neoplasms	94	8.3	Urinary bladder	112	9.4	Larynx	145	10.8	Larynx	132	8.8	Urinary bladder	144	8.1
Urinary bladder	78	7.2	Lymphoid neoplasms	99	8.0	Urinary bladder	113	8.7	Urinary bladder	113	7.3	Larynx	136	7.5
All sites	**4244**	**376.2**	**All sites**	**4708**	**387.2**	**All sites**	**4990**	**373.5**	**All sites**	**5489**	**351.7**	**All sites**	**6308**	**339.5**
1993-1997			**1998-2002**			**2003-2007**			**2008-2012**			**2013-2017**		
SITE	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**
Colon & rectum	1189	53.6	Colon & rectum	1457	54.6	Colon & rectum	1705	51.8	Colon & rectum	2220	52.9	Colon & rectum	2522	52.7
Lung	1167	55.2	Lung	1233	48.3	Lung	1283	41.1	Lung	1472	35.4	Lung	1607	33.3
Nasopharynx	905	34.4	Nasopharynx	898	27.9	Nasopharynx	963	26.3	Liver & intrahepatic bile ducts	1000	23.8	Prostate	1278	26.0
Liver & intrahepatic bile ducts	632	28.1	Liver & intrahepatic bile ducts	738	27.0	Liver & intrahepatic bile ducts	826	25.8	Prostate	999	25.0	Liver & intrahepatic bile ducts	1152	23.8
Stomach	551	25.9	Stomach	515	20.1	Prostate	639	22.1	Nasopharynx	926	21.7	Lymphoid neoplasms	943	20.3
Lymphoid neoplasms	365	15.3	Lymphoid neoplasms	476	16.3	Lymphoid neoplasms	611	17.6	Lymphoid neoplasms	862	20.5	Nasopharynx	806	17.8
Non-melanoma skin	291	12.6	Non-melanoma skin	357	12.7	Stomach	435	13.4	Non-melanoma skin	618	14.9	Kidney & other urinary organs	711	15.2
Kidney & other urinary organs	197	8.5	Prostate	319	13.6	Non-melanoma skin	398	12.2	Kidney & other urinary organs	549	13.0	Non-melanoma skin	657	14.1
Urinary bladder	192	8.7	Urinary bladder	226	8.6	Kidney & other urinary organs	372	10.7	Stomach	488	11.7	Stomach	553	11.6
Myeloid neoplasms	158	6.5	Myeloid neoplasms	222	7.7	Myeloid neoplasms	272	7.9	Myeloid neoplasms	389	9.2	Myeloid neoplasms	451	9.7
All sites	**7137**	**315.8**	**All sites**	**8193**	**299.3**	**All sites**	**9575**	**290.3**	**All sites**	**12098**	**289.3**	**All sites**	**13707**	**288.7**

Table 5.3.2(c): TEN MOST FREQUENT CANCERS AMONG MALES (65 YEARS+) BY FIVE-YEAR PERIOD, 1968-2017

1968-1972			1973-1977			1978-1982			1983-1987			1988-1992		
SITE	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**
Lung	510	333.5	Lung	843	425.9	Lung	1299	515.2	Lung	1504	493.4	Lung	1692	453.4
Stomach	387	260.9	Stomach	549	280.5	Stomach	607	245.8	Stomach	771	256.0	Colon & rectum	1042	277.4
Liver & intrahepatic bile ducts	239	154.9	Colon & rectum	340	181.3	Colon & rectum	485	196.7	Colon & rectum	698	227.4	Stomach	781	208.9
Colon & rectum	198	138.1	Liver & intrahepatic bile ducts	315	162.9	Liver & intrahepatic bile ducts	441	175.5	Liver & intrahepatic bile ducts	476	155.4	Liver & intrahepatic bile ducts	495	131.8
Oesophagus	185	130.1	Oesophagus	243	128.9	Oesophagus	262	107.0	Prostate	279	93.9	Prostate	433	114.3
Larynx	81	53.8	Non-melanoma skin	108	61.3	Prostate	177	74.8	Oesophagus	235	78.1	Urinary bladder	255	67.7
Urinary bladder	69	44.8	Prostate	101	57.3	Non-melanoma skin	148	62.3	Non-melanoma skin	199	66.4	Oesophagus	248	66.3
Non-melanoma skin	59	47.9	Larynx	89	45.4	Urinary bladder	147	60.6	Urinary bladder	199	66.5	Non-melanoma skin	229	60.8
Prostate	57	41.6	Urinary bladder	85	48.3	Larynx	144	57.0	Lymphoid neoplasms	156	51.1	Lymphoid neoplasms	164	43.8
Nasopharynx	50	32.8	Lymphoid neoplasms	56	28.3	Lymphoid neoplasms	88	35.7	Larynx	130	43.2	Larynx	146	39.0
All sites	**2137**	**1441.0**	**All sites**	**3175**	**1649.2**	**All sites**	**4429**	**1787.1**	**All sites**	**5400**	**1778.0**	**All sites**	**6457**	**1724.7**
1993-1997			**1998-2002**			**2003-2007**			**2008-2012**			**2013-2017**		
SITE	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**
Lung	1987	440.6	Lung	2347	437.6	Lung	2557	404.2	Lung	2801	350.8	Prostate	3574	338.9
Colon & rectum	1314	294.1	Colon & rectum	1738	322.8	Colon & rectum	2100	335.2	Colon & rectum	2519	319.6	Lung	3371	316.0
Stomach	871	191.7	Prostate	1035	189.9	Prostate	1569	247.8	Prostate	2336	297.8	Colon & rectum	3223	304.4
Prostate	760	164.6	Stomach	919	171.8	Liver & intrahepatic bile ducts	939	149.5	Liver & intrahepatic bile ducts	1114	141.4	Liver & intrahepatic bile ducts	1538	144.8
Liver & intrahepatic bile ducts	639	140.1	Liver & intrahepatic bile ducts	788	147.6	Stomach	936	147.2	Stomach	944	117.2	Non-melanoma skin	1187	109.6
Non-melanoma skin	356	77.3	Non-melanoma skin	413	77.8	Non-melanoma skin	535	85.4	Non-melanoma skin	822	102.0	Lymphoid neoplasms	996	95.4
Urinary bladder	290	63.3	Urinary bladder	383	70.4	Lymphoid neoplasms	480	76.9	Lymphoid neoplasms	669	84.6	Stomach	987	92.1
Lymphoid neoplasms	261	57.6	Lymphoid neoplasms	335	62.5	Urinary bladder	423	67.5	Kidney & other urinary organs	431	54.9	Kidney & other urinary organs	641	61.2
Oesophagus	242	54.4	Oesophagus	235	44.5	Pancreas	328	51.8	Pancreas	411	52.8	Pancreas	634	58.9
Larynx	206	45.3	Pancreas	234	43.7	Kidney & other urinary organs	260	41.4	Urinary bladder	409	50.9	Myeloid neoplasms	590	55.2
All sites	**8258**	**1826.7**	**All sites**	**9959**	**1856.7**	**All sites**	**11916**	**1895.2**	**All sites**	**14751**	**1862.6**	**All sites**	**19647**	**1852.2**

Table 5.3.2(d): TEN MOST FREQUENT CANCERS AMONG FEMALES (15-34 YEARS) BY FIVE-YEAR PERIOD, 1968-2017

1968-1972			1973-1977			1978-1982			1983-1987			1988-1992		
SITE	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**
Thyroid	58	3.6	Female breast	70	3.7	Female breast	106	4.4	Female breast	154	5.3	Female breast	180	5.2
Female breast	49	3.2	Nasopharynx	68	3.6	Thyroid	90	3.7	Thyroid	135	5.0	Ovary & fallopian tube	145	5.2
Ovary & fallopian tube	45	2.8	Thyroid	56	2.9	Nasopharynx	74	3.2	Ovary & fallopian tube	98	3.7	Thyroid	143	5.1
Cervix uteri	43	2.8	Ovary & fallopian tube	50	2.6	Ovary & fallopian tube	71	3.0	Nasopharynx	79	2.8	Nasopharynx	74	2.2
Nasopharynx	37	2.4	Cervix uteri	37	2.0	Cervix uteri	54	2.2	Cervix uteri	66	2.2	Lymphoid neoplasms	52	2.0
Lymphoid neoplasms	30	1.7	Myeloid neoplasms	34	1.7	Colon & rectum	43	1.8	Lymphoid neoplasms	50	2.0	Colon & rectum	50	1.7
Placenta	28	2.0	Lymphoid neoplasms	31	1.6	Myeloid neoplasms	42	1.8	Colon & rectum	48	1.7	Myeloid neoplasms	48	2.0
Stomach	28	1.9	Colon & rectum	28	1.4	Lymphoid neoplasms	37	1.6	Stomach	32	1.1	Cervix uteri	43	1.3
Myeloid neoplasms	24	1.6	Placenta	26	1.3	Placenta	34	1.4	Myeloid neoplasms	32	1.3	Bone	29	1.1
Colon & rectum	16	0.9	Stomach	23	1.2	Stomach	24	1.0	Brain & CNS	28	1.1	Brain & CNS	25	0.9
All sites	**448**	**28.4**	**All sites**	**547**	**28.4**	**All sites**	**723**	**30.2**	**All sites**	**879**	**32.0**	**All sites**	**953**	**32.4**
1993-1997			**1998-2002**			**2003-2007**			**2008-2012**			**2013-2017**		
SITE	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**
Female breast	205	5.7	Female breast	236	6.9	Female breast	243	7.1	Female breast	271	7.7	Female breast	278	7.9
Ovary & fallopian tube	158	5.7	Thyroid	156	5.8	Ovary & fallopian tube	170	6.6	Thyroid	189	6.4	Thyroid	211	7.1
Thyroid	138	4.8	Ovary & fallopian tube	149	5.6	Thyroid	149	5.1	Ovary & fallopian tube	163	6.0	Ovary & fallopian tube	196	6.9
Lymphoid neoplasms	73	2.7	Lymphoid neoplasms	96	3.8	Lymphoid neoplasms	123	5.0	Lymphoid neoplasms	139	5.0	Lymphoid neoplasms	182	6.8
Cervix uteri	59	1.6	Cervix uteri	54	1.7	Myeloid neoplasms	60	2.3	Myeloid neoplasms	52	1.9	Corpus uteri	101	3.0
Nasopharynx	52	1.6	Colon & rectum	47	1.6	Corpus uteri	55	1.7	Colon & rectum	51	1.7	Cervix uteri	74	2.1
Colon & rectum	46	1.5	Myeloid neoplasms	40	1.5	Cervix uteri	49	1.5	Cervix uteri	51	1.5	Myeloid neoplasms	56	1.9
Myeloid neoplasms	44	1.7	Nasopharynx	33	1.0	Brain & CNS	44	1.8	Corpus uteri	49	1.4	Colon & rectum	52	1.7
Brain & CNS	28	1.0	Corpus uteri	28	0.9	Nasopharynx	38	1.2	Brain & CNS	36	1.3	Brain & CNS	41	1.5
Non-melanoma skin	27	1.0	Brain & CNS	23	0.8	Colon & rectum	37	1.3	Connective tissue	34	1.2	Connective tissue	35	1.2
All sites	**1001**	**33.1**	**All sites**	**1056**	**36.1**	**All sites**	**1139**	**39.6**	**All sites**	**1257**	**41.3**	**All sites**	**1432**	**47.2**

Table 5.3.2(e): TEN MOST FREQUENT CANCERS AMONG FEMALES (35-64 YEARS) BY FIVE-YEAR PERIOD, 1968-2017

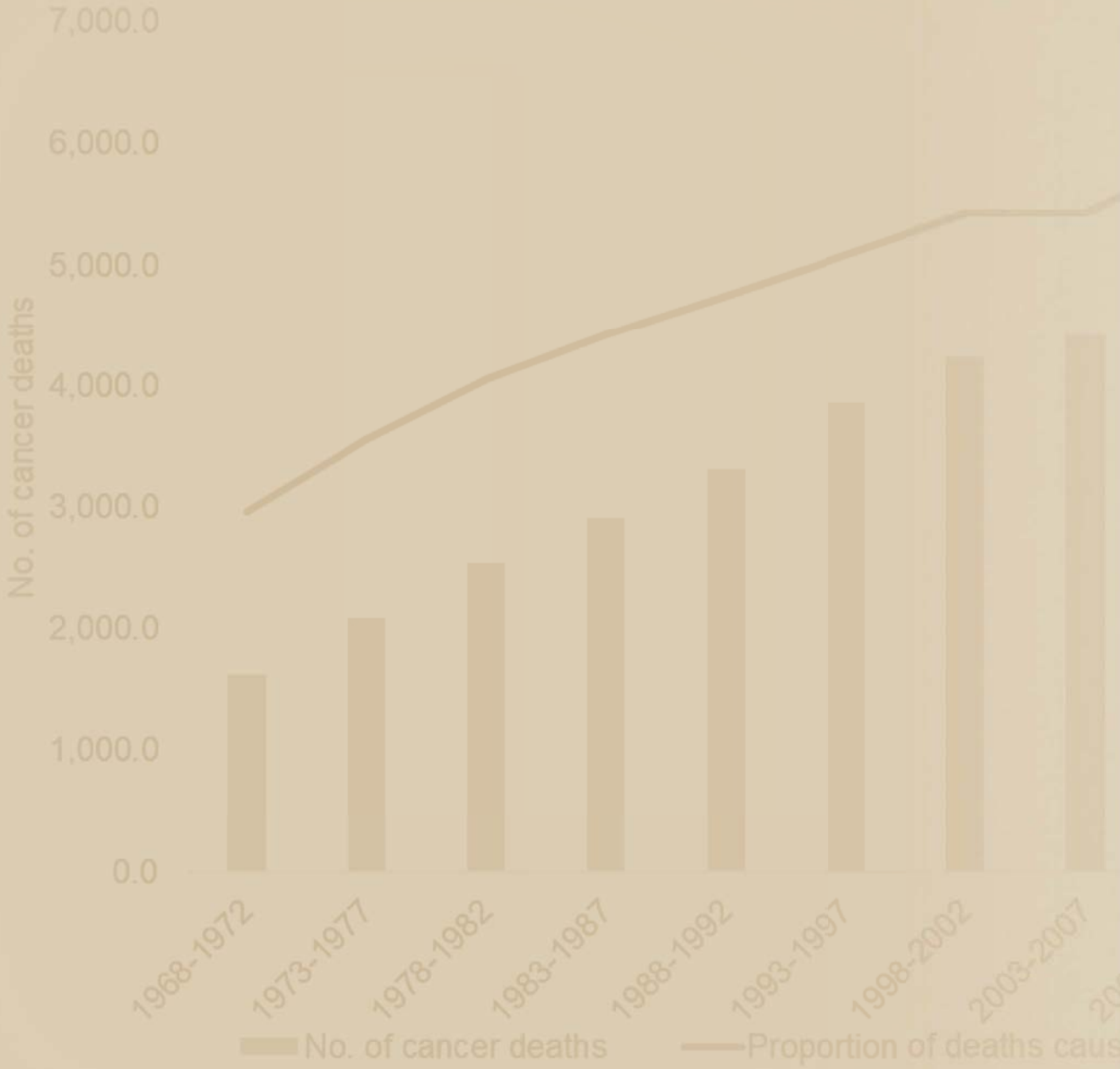
1968-1972			1973-1977			1978-1982			1983-1987			1988-1992		
SITE	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**
Female breast	496	46.3	Female breast	620	51.6	Female breast	871	63.2	Female breast	1233	73.8	Female breast	1909	92.1
Cervix uteri	447	42.1	Cervix uteri	520	43.6	Cervix uteri	562	41.3	Cervix uteri	672	40.5	Colon & rectum	750	40.1
Stomach	293	28.1	Colon & rectum	344	30.0	Colon & rectum	519	40.0	Colon & rectum	635	41.5	Cervix uteri	741	36.9
Colon & rectum	292	28.3	Lung	302	26.7	Lung	370	29.3	Lung	395	26.7	Ovary & fallopian tube	422	21.3
Lung	277	27.5	Stomach	291	25.0	Stomach	274	20.9	Ovary & fallopian tube	313	18.9	Lung	388	21.3
Nasopharynx	161	14.6	Nasopharynx	178	14.3	Ovary & fallopian tube	265	19.4	Stomach	304	20.0	Corpus uteri	336	17.1
Ovary & fallopian tube	146	13.8	Ovary & fallopian tube	164	13.4	Nasopharynx	215	15.5	Nasopharynx	254	15.0	Nasopharynx	314	14.9
Liver & intrahepatic bile ducts	131	13.0	Liver & intrahepatic bile ducts	124	10.9	Corpus uteri	150	11.2	Corpus uteri	240	15.3	Stomach	312	16.4
Corpus uteri	120	11.4	Corpus uteri	109	9.4	Liver & intrahepatic bile ducts	116	8.9	Thyroid	180	10.3	Thyroid	219	10.3
Oesophagus	94	9.3	Thyroid	90	7.5	Non-melanoma skin	104	8.0	Liver & intrahepatic bile ducts	143	9.6	Lymphoid neoplasms	187	9.7
All sites	**3040**	**290.5**	**All sites**	**3385**	**287.6**	**All sites**	**4188**	**313.5**	**All sites**	**5237**	**327.4**	**All sites**	**6617**	**334.6**

1993-1997			1998-2002			2003-2007			2008-2012			2013-2017		
SITE	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**
Female breast	2740	107.3	Female breast	4331	137.2	Female breast	5250	143.1	Female breast	6414	150.4	Female breast	7511	162.5
Colon & rectum	925	40.9	Colon & rectum	1090	38.8	Colon & rectum	1350	39.7	Colon & rectum	1616	38.2	Colon & rectum	1879	39.0
Cervix uteri	812	32.3	Cervix uteri	740	24.3	Corpus uteri	1004	27.7	Corpus uteri	1364	31.6	Corpus uteri	1877	39.9
Ovary & fallopian tube	541	21.4	Ovary & fallopian tube	700	22.6	Ovary & fallopian tube	902	24.7	Ovary & fallopian tube	1081	25.4	Ovary & fallopian tube	1251	26.9
Lung	477	21.1	Corpus uteri	680	22.4	Lung	687	20.5	Lung	824	19.4	Lung	1008	21.0
Corpus uteri	452	18.7	Lung	502	18.0	Cervix uteri	640	17.7	Thyroid	629	14.8	Thyroid	919	20.4
Stomach	320	13.8	Thyroid	396	12.1	Lymphoid neoplasms	452	12.9	Cervix uteri	583	13.8	Cervix uteri	698	15.2
Nasopharynx	304	11.5	Stomach	335	11.7	Thyroid	408	11.1	Lymphoid neoplasms	523	12.2	Lymphoid neoplasms	691	14.6
Thyroid	266	9.8	Nasopharynx	298	9.1	Nasopharynx	296	8.0	Stomach	334	7.9	Stomach	373	7.8
Lymphoid neoplasms	239	9.8	Lymphoid neoplasms	298	10.0	Stomach	287	8.3	Non-melanoma skin	324	7.7	Non-melanoma skin	360	7.6
All sites	**8324**	**340.0**	**All sites**	**10893**	**358.7**	**All sites**	**13023**	**364.2**	**All sites**	**16072**	**377.7**	**All sites**	**19335**	**413.6**

Table 5.3.2(f): TEN MOST FREQUENT CANCERS AMONG FEMALES (65 YEARS+) BY FIVE-YEAR PERIOD, 1968-2017

1968-1972			1973-1977			1978-1982			1983-1987			1988-1992		
SITE	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**
Stomach	221	115.3	Lung	354	144.9	Colon & rectum	521	166.6	Colon & rectum	709	181.6	Colon & rectum	1046	218.5
Lung	201	106.1	Colon & rectum	340	140.2	Lung	513	165.4	Lung	663	171.0	Lung	766	160.0
Colon & rectum	169	90.0	Stomach	296	121.4	Stomach	345	111.3	Stomach	436	111.3	Female breast	542	119.9
Female breast	127	67.5	Female breast	171	70.4	Female breast	260	84.6	Female breast	350	93.7	Stomach	493	102.7
Cervix uteri	113	58.7	Cervix uteri	118	49.1	Non-melanoma skin	202	64.9	Non-melanoma skin	227	58.1	Non-melanoma skin	324	64.1
Liver & intrahepatic bile ducts	103	53.5	Liver & intrahepatic bile ducts	114	46.8	Liver & intrahepatic bile ducts	180	57.6	Liver & intrahepatic bile ducts	199	51.2	Liver & intrahepatic bile ducts	227	47.0
Oesophagus	92	49.1	Non-melanoma skin	108	44.5	Cervix uteri	135	43.6	Cervix uteri	159	42.3	Cervix uteri	218	48.9
Non-melanoma skin	90	47.9	Oesophagus	87	35.5	Oesophagus	90	28.9	Lymphoid neoplasms	110	28.1	Lymphoid neoplasms	157	34.5
Corpus uteri	35	18.6	Lymphoid neoplasms	47	19.2	Pancreas	72	22.8	Oesophagus	103	26.0	Ovary & fallopian tube	126	28.3
Urinary bladder	30	15.4	Ovary & fallopian tube	42	17.1	Ovary & fallopian tube	71	23.4	Pancreas	92	23.5	Pancreas	113	24.0
All sites	**1455**	**765.7**	**All sites**	**2093**	**859.4**	**All sites**	**2961**	**954.5**	**All sites**	**3782**	**981.3**	**All sites**	**5010**	**1059.8**
1993-1997			**1998-2002**			**2003-2007**			**2008-2012**			**2013-2017**		
SITE	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**	**SITE**	**NO.**	**ASIR**
Colon & rectum	1329	233.4	Colon & rectum	1656	237.0	Colon & rectum	1963	229.6	Colon & rectum	2252	209.5	Female breast	3035	242.5
Lung	952	165.4	Lung	1078	151.2	Female breast	1362	176.3	Female breast	1874	199.4	Colon & rectum	2903	208.1
Female breast	652	120.2	Female breast	1010	156.4	Lung	1203	140.2	Lung	1412	131.3	Lung	1766	125.4
Stomach	573	98.4	Stomach	613	87.4	Stomach	590	67.7	Non-melanoma skin	869	75.9	Non-melanoma skin	1115	74.8
Non-melanoma skin	420	69.3	Non-melanoma skin	526	71.4	Non-melanoma skin	547	62.5	Stomach	729	64.8	Lymphoid neoplasms	782	58.7
Cervix uteri	257	47.5	Liver & intrahepatic bile ducts	331	46.4	Liver & intrahepatic bile ducts	434	50.0	Liver & intrahepatic bile ducts	553	49.5	Stomach	763	52.4
Liver & intrahepatic bile ducts	254	44.8	Lymphoid neoplasms	265	40.2	Lymphoid neoplasms	345	42.1	Lymphoid neoplasms	508	49.7	Liver & intrahepatic bile ducts	763	53.0
Lymphoid neoplasms	195	34.9	Cervix uteri	244	37.8	Cervix uteri	326	42.1	Pancreas	438	41.0	Corpus uteri	632	51.9
Ovary & fallopian tube	172	32.6	Pancreas	228	32.0	Pancreas	319	37.0	Corpus uteri	374	40.8	Pancreas	593	42.8
Pancreas	157	27.5	Ovary & fallopian tube	206	31.9	Corpus uteri	297	39.5	Ovary & fallopian tube	362	37.8	Myeloid neoplasms	429	30.6
All sites	**6244**	**1099.9**	**All sites**	**7730**	**1122.3**	**All sites**	**9230**	**1108.1**	**All sites**	**11741**	**1127.4**	**All sites**	**15811**	**1169.8**

Figure 6.1.1: NUMBER OF CANCER DEATHS AND PROP
DEATHS CAUSED BY CANCER, 2008-2017



Source: Department of Statistics Table Builder, accessed

CHAPTER 6

TRENDS IN CANCER MORTALITY, 1968-2017

This chapter describes key trends in cancer mortality as well as shifts in mortality for the most common cancers from 1968-2017. With a greater number of individuals in the population being diagnosed with cancer, the number of deaths from cancer underwent a corresponding rise and cancer accounted for an increasing proportion of total deaths in the population over time.

6.1 MORTALITY OF CANCER IN TOTAL POPULATION, 1968-2017

The mean number of cancer deaths, crude annual cancer death rate, and proportion of deaths accounted for by cancer in the total population (inclusive of non-residents) in every five-year period from 1968-2017 are shown in Table 6.1.1. The mean annual number of cancer deaths more than tripled from 1,622.2 in 1968-1972 to 5,876.2 in 2013-2017. The crude death rate grew almost 1.5 times from 78.2 to 106.2 per 100,000 population during this period. Cancer accounted for an increasing proportion of all deaths in the population, doubling from 14.8% to 29.6% in the past fifty years (Figure 6.1.1) [68].

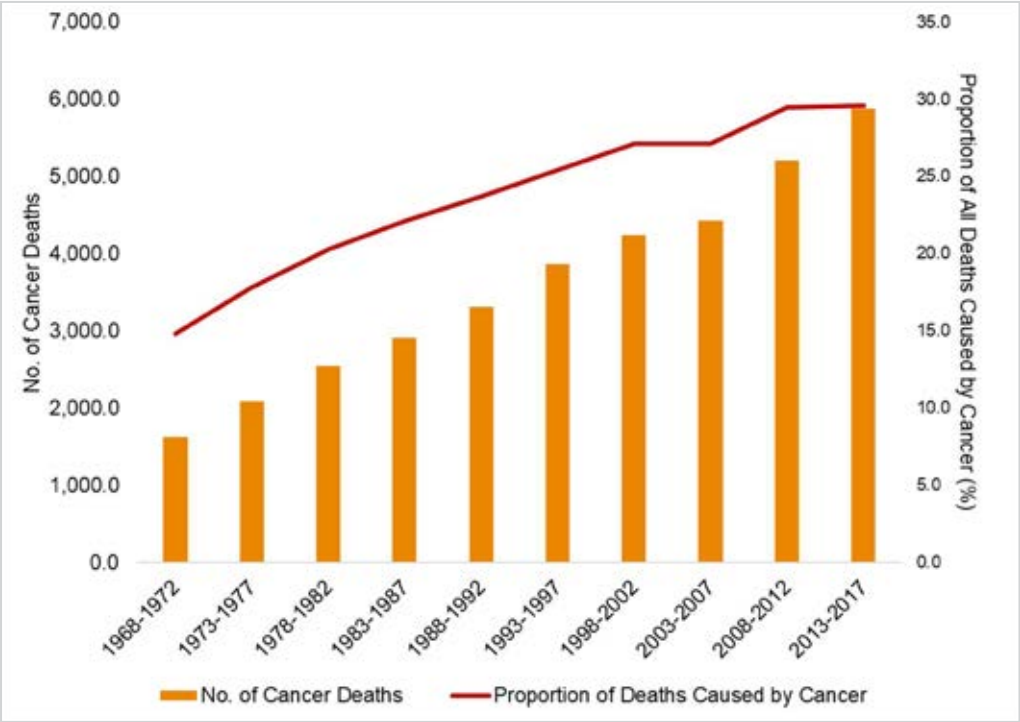
By the latest ten-year period, 2008-2017, cancer accounted for about 30% of the total deaths in the population annually. With three in every ten deaths caused by cancer, it was the leading cause of death in Singapore, followed by heart and hypertensive diseases which accounted for 20-25% of all deaths, and diseases of the respiratory system which accounted for 17-23% of all deaths every year (Figure 6.1.2) [68].

Table 6.1.1: CANCER DEATHS IN TOTAL POPULATION, 1968-2017

Period	Population-at-risk [a]	Mean annual number of cancer deaths [a]	Crude annual cancer death rate (per 100,000 mid-term population)	Proportion of cancer deaths among deaths from all causes
1968-1972	2074507	1622.2	78.2	14.8
1973-1977	2262600	2086.4	92.7	17.8
1978-1982	2413945	2543.8	105.4	20.3
1983-1987	2735957	2909.0	113.7	22.1
1988-1992	3047132	3312.6	108.7	23.7
1993-1997	3524506	3859.6	109.5	25.4
1998-2002	4027887	4237.2	105.2	27.1
2003-2007	4265762	4432.0	103.9	27.1
2008-2012	5076732	5209.8	102.6	29.5
2013-2017	5535002	5876.2	106.2	29.6

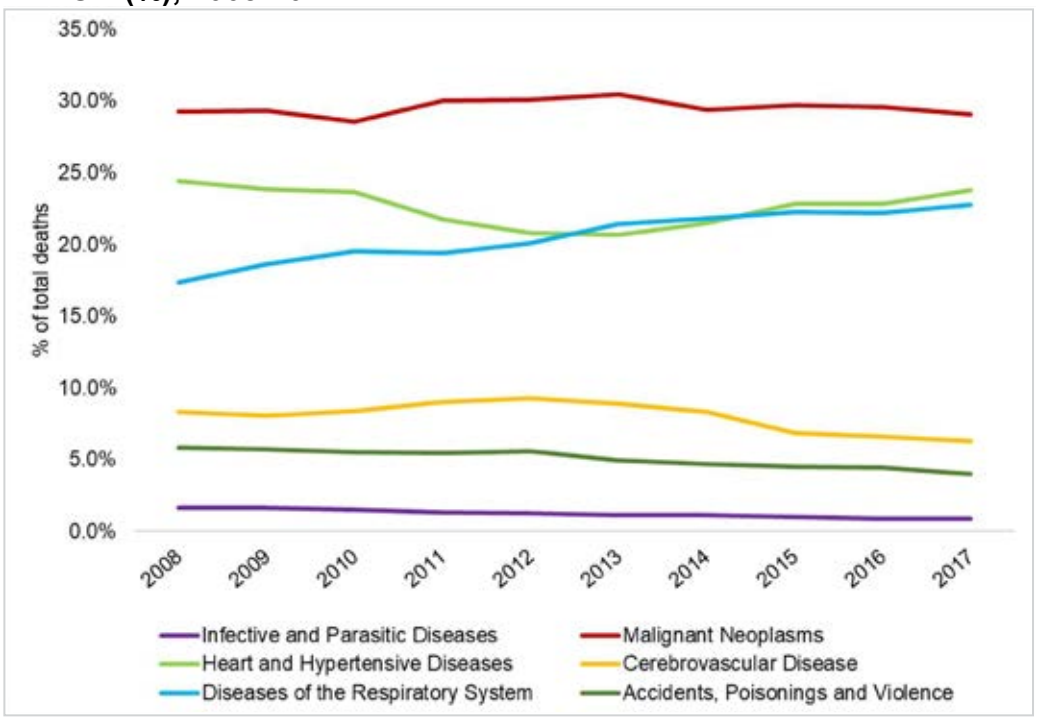
[a] Data downloaded from Department of Statistics Table Builder, accessed on 21 March 2019

Figure 6.1.1: NUMBER OF CANCER DEATHS AND PROPORTION (%) OF ALL DEATHS CAUSED BY CANCER, 1968-2017



Source: Department of Statistics Table Builder, accessed on 21 March 2019

Figure 6.1.2: PROPORTION OF BROAD CAUSES OF DEATH IN TOTAL POPULATION (%), 2008-2017



Source: Department of Statistics Table Builder, accessed on 21 March 2019

6.2 MORTALITY OF CANCER BY GENDER, 1968-2017

Trends in cancer mortality in Singapore's resident population in the past fifty years, with breakdown by gender, are shown in Table 6.2.1 and Figure 6.2.1. The number of cancer deaths increased by almost fivefold, from 5,866 in 1968-1972 to 27,730 in 2013-2017. For each of the five-year periods, the number of cancer deaths among males was higher compared to females. Notably, the proportion of females among cancer deaths rose over the years, from 37.4% in 1968-1972 to 45.2% in 2013-2017.

The crude mortality rate (CMR) from cancer increased from 58.2 to 142.1 per 100,000 population in the past fifty years. Among males, the CMR rose more than twofold, from 71.2 per 100,000 population in 1968-1972 to 158.5 per 100,000 population in 2013-2017. For females, the CMR of cancer rose nearly three times from 44.5 to 126.2 per 100,000 population over the same period.

The age-standardised mortality rate (ASMR), however, decreased from 93.8 to 82.1 per 100,000 population during the period under study. This decrease was contributed largely by the drop in ASMR among males – the ASMR rose from 122.8 per 100,000 population in 1968-1972 to peak at 165.0 per 100,000 population in 1978-1982, before declining to 99.4 per 100,000 population in 2013-2017. For females, the ASMR had a smaller initial rise from 68.0 per 100,000 population in 1968-1972 to 96.6 per 100,000 population in 1978-1982, followed by a slow decline to 68.4 per 100,000 population in 2013-2017.

Differing trends were observed when cancer mortality was further broken down by individual site. The numbers of deaths and ASMRs of the ten most frequent cancer deaths for males and females for each five-year period from 1968-2017 are shown in Tables 6.2.2(a) and 6.2.2(b).

Among males, lung cancer consistently accounted for the highest number of cancer deaths throughout 1968-2017 (Table 6.2.2(a)). Pancreatic cancer moved gradually from being the tenth leading cause of cancer death among males in 1968-1972 to sixth in 2013-2017. Liver cancer, on the other hand, remained at a fairly consistent second or third place among the ten leading causes of cancer mortality throughout the fifty-year period. Colorectal cancer, the fifth most common cause of cancer deaths in 1968-1972, rose steadily to second place by 1993-1997 where it remained until 2013-2017. Prostate cancer emerged among the ten most common cancers only in the 1980s. In the same decade, it made its first appearance among the top ten causes of cancer deaths among males in 1988-1992 and gradually moved from ninth to fourth place by 2013-2017.

Lung cancer was a leading cause of cancer deaths among females; it ranked first from 1978-2002 and stayed in second place for the remaining years (Table 6.2.2(b)). While breast cancer was the most common cancer in females throughout the 50 years (Table 5.1.2(b)), it became the leading cause of cancer deaths among females only from 2003-2007 onwards. Prior to that, for the years between 1968-2002, its ranking was between third to fifth. Stomach cancer was the leading cause of cancer deaths among females from 1968-1977, it fell to fourth place in 1978-2007, and was in sixth place by 2013-2017. As cervical cancer fell in ranking among the top ten cancers among females, its ranking for cancer mortality dropped from sixth in 1968-1972 to ninth in 2008-2017. Likewise, the rise of ovarian cancer from the ninth to seventh leading cause of cancer mortality in females mirrored the rise in its ranking among the most common cancers. In contrast, although liver cancer was no longer among the ten leading cancers in females by 1988-1992, it remained within the top ten causes of cancer mortality among females throughout 1968-2017, staying between third to sixth place in every five-year period.

Rankings of the most common cancers by mortality do not necessarily correspond to the rankings by incidence. Furthermore, when discussing trends, rankings by incidence and mortality should be interpreted within the context of incidence, mortality and survival rates (these are described in Chapter Nine's commentaries of specific sites).

Table 6.2.1: MORTALITY NUMBER AND RATE (PER 100,000 POPULATION) FOR CANCER BY GENDER AND FIVE-YEAR PERIOD, 1968-2017

Period	Gender	Number	%	CMR	ASMR
1968-1972	Male	3675	62.6	71.2	122.8
	Female	2191	37.4	44.5	68.0
	Total	5866	100	58.2	93.8
1973-1977	Male	5336	62.3	98.5	155.3
	Female	3225	37.7	62.0	86.5
	Total	8561	100	80.6	119.0
1978-1982	Male	6545	60.5	112.7	165.0
	Female	4281	39.5	76.1	96.6
	Total	10826	100	94.7	128.6
1983-1987	Male	7449	59.3	118.5	157.7
	Female	5105	40.7	83.5	95.1
	Total	12554	100	101.2	124.2
1988-1992	Male	9035	58.7	131.0	159.6
	Female	6366	41.3	94.6	96.5
	Total	15401	100	113.0	125.8
1993-1997	Male	9601	57.6	126.8	142.7
	Female	7056	42.4	94.1	88.8
	Total	16657	100	110.5	113.3
1998-2002	Male	11539	57.2	141.0	144.7
	Female	8621	42.8	105.0	89.1
	Total	20160	100	123.0	114.2
2003-2007	Male	11690	56.0	135.7	123.6
	Female	9181	44.0	105.0	78.0
	Total	20871	100	120.2	98.2
2008-2012	Male	13337	54.7	144.1	111.0
	Female	11041	45.3	116.2	74.7
	Total	24378	100	130.0	90.6
2013-2017	Male	15191	54.8	158.5	99.4
	Female	12539	45.2	126.2	68.4
	Total	27730	100	142.1	82.1

Figure 6.2.1: AGE-STANDARDISED MORTALITY RATE (PER 100,000 POPULATION) FOR CANCER BY GENDER AND FIVE-YEAR PERIOD, 1968-2017

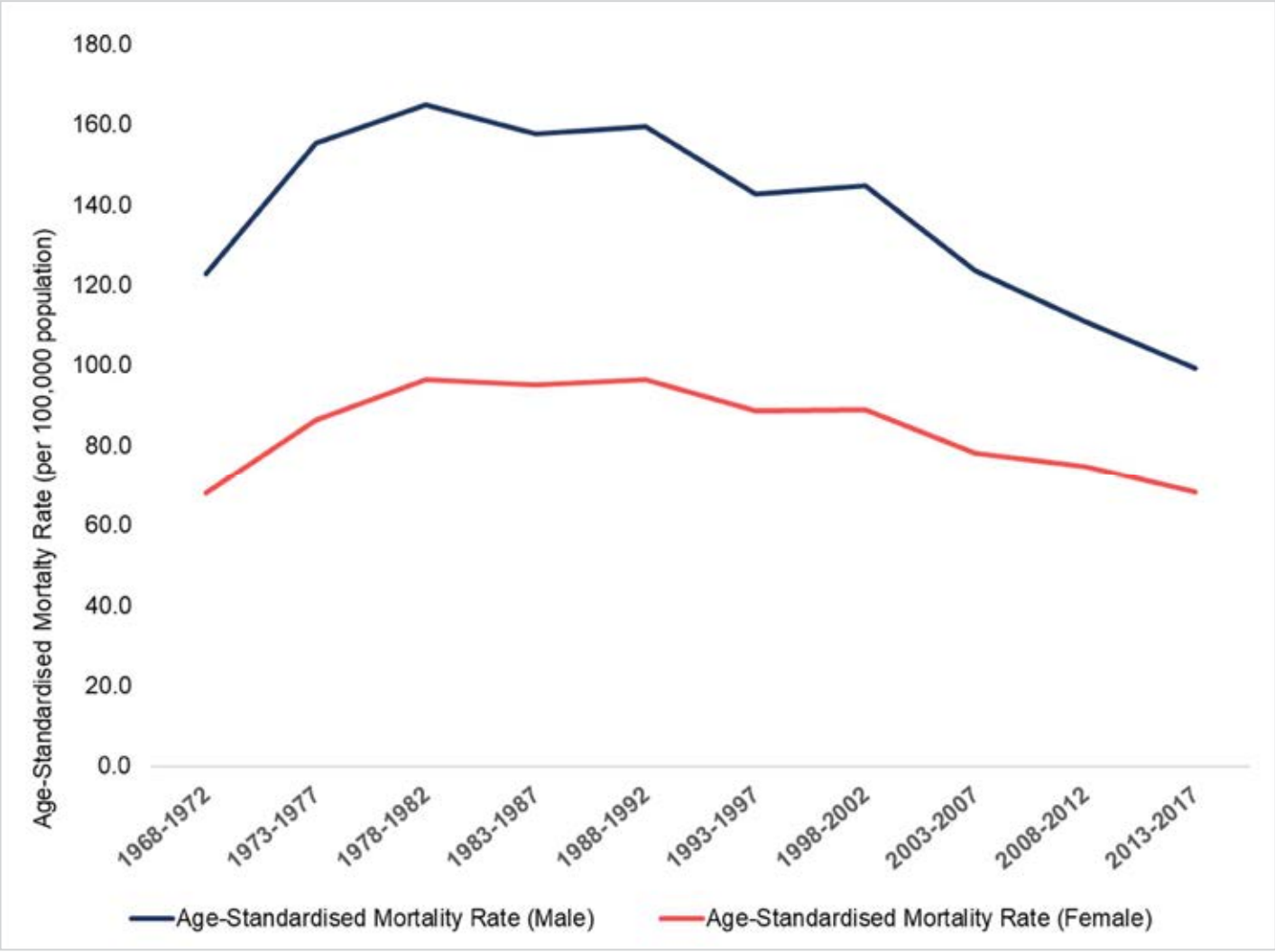


Table 6.2.2(a): TEN MOST FREQUENT CANCER DEATHS AMONG MALES BY FIVE-YEAR PERIOD, 1968-2017

1968-1972			1973-1977			1978-1982			1983-1987			1988-1992		
SITE	**NO.**	**ASMR**	**SITE**	**NO.**	**ASMR**	**SITE**	**NO.**	**ASMR**	**SITE**	**NO.**	**ASMR**	**SITE**	**NO.**	**ASMR**
Lung	807	28.3	Lung	1336	40.0	Lung	1881	48.8	Lung	2155	46.5	Lung	2607	47.4
Stomach	768	26.4	Stomach	938	28.3	Liver & intrahepatic bile ducts	1048	25.9	Liver & intrahepatic bile ducts	1292	27.4	Liver & intrahepatic bile ducts	1119	19.6
Liver & intrahepatic bile ducts	501	16.5	Liver & intrahepatic bile ducts	799	22.6	Stomach	911	23.7	Stomach	835	18.3	Stomach	1050	18.9
Oesophagus	286	10.7	Nasopharynx	417	10.3	Colon & rectum	566	14.6	Colon & rectum	606	13.0	Colon & rectum	1017	18.1
Colon & rectum	253	9.0	Colon & rectum	413	12.7	Nasopharynx	444	9.7	Nasopharynx	442	8.1	Nasopharynx	568	9.0
Nasopharynx	224	6.4	Oesophagus	347	10.9	Oesophagus	347	9.5	Oesophagus	307	6.8	Oesophagus	379	6.9
Gallbladder & extrahepatic bile ducts	76	2.3	Larynx	105	3.4	Lymphoid neoplasms	157	3.5	Brain & CNS	235	4.6	Lymphoid neoplasms	306	5.1
Larynx	65	2.5	Lymphoid neoplasms	88	2.0	Larynx	149	3.9	Lymphoid neoplasms	207	4.0	Pancreas	239	4.2
Lymphoid neoplasms	55	1.3	Urinary bladder	82	2.8	Pancreas	118	3.0	Pancreas	177	3.8	Prostate	198	3.6
Pancreas	50	1.7	Pancreas	73	2.1	Urinary bladder	88	2.3	Larynx	140	3.0	Larynx	163	3.0
All	**3675**	**122.8**	**All**	**5336**	**155.3**	**All**	**6545**	**165.0**	**All**	**7449**	**157.7**	**All**	**9035**	**159.6**
1993-1997			**1998-2002**			**2003-2007**			**2008-2012**			**2013-2017**		
SITE	**NO.**	**ASMR**	**SITE**	**NO.**	**ASMR**	**SITE**	**NO.**	**ASMR**	**SITE**	**NO.**	**ASMR**	**SITE**	**NO.**	**ASMR**
Lung	2623	40.0	Lung	3247	41.4	Lung	3375	36.1	Lung	3682	30.7	Lung	4046	26.1
Colon & rectum	1231	18.5	Colon & rectum	1509	19.1	Colon & rectum	1681	17.8	Colon & rectum	1911	15.9	Colon & rectum	2155	14.0
Liver & intrahepatic bile ducts	1177	17.2	Liver & intrahepatic bile ducts	1449	17.9	Liver & intrahepatic bile ducts	1505	15.8	Liver & intrahepatic bile ducts	1672	13.8	Liver & intrahepatic bile ducts	1954	12.7
Stomach	992	14.9	Stomach	988	12.5	Stomach	925	9.8	Stomach	924	7.7	Prostate	884	5.6
Nasopharynx	591	7.6	Nasopharynx	575	6.3	Nasopharynx	543	5.1	Pancreas	672	5.6	Stomach	867	5.6
Lymphoid neoplasms	369	5.2	Lymphoid neoplasms	467	5.8	Pancreas	532	5.6	Prostate	652	5.6	Pancreas	855	5.5
Oesophagus	334	5.2	Prostate	448	5.9	Prostate	436	4.8	Nasopharynx	533	4.2	Lymphoid neoplasms	691	4.7
Prostate	314	4.8	Pancreas	412	5.2	Lymphoid neoplasms	422	4.6	Lymphoid neoplasms	525	4.5	Nasopharynx	546	3.6
Pancreas	286	4.3	Oesophagus	353	4.6	Oesophagus	325	3.5	Oesophagus	367	3.0	Kidney & other urinary organs	460	3.0
Larynx	176	2.7	Urinary bladder	212	2.7	Kidney & other urinary organs	220	2.2	Kidney & other urinary organs	339	2.7	Oesophagus	397	2.6
All	**9601**	**142.7**	**All**	**11539**	**144.7**	**All**	**11690**	**123.6**	**All**	**13337**	**111.0**	**All**	**15191**	**99.4**

Table 6.2.2(b): TEN MOST FREQUENT CANCER DEATHS AMONG FEMALES BY FIVE-YEAR PERIOD, 1968-2017

1968-1972			1973-1977			1978-1982			1983-1987			1988-1992		
SITE	**NO.**	**ASMR**	**SITE**	**NO.**	**ASMR**	**SITE**	**NO.**	**ASMR**	**SITE**	**NO.**	**ASMR**	**SITE**	**NO.**	**ASMR**
Stomach	371	11.8	Stomach	485	13.2	Lung	687	16.0	Lung	980	18.6	Lung	1045	15.9
Lung	282	9.3	Lung	474	13.2	Colon & rectum	587	13.4	Colon & rectum	607	11.4	Colon & rectum	943	14.1
Colon & rectum	207	6.7	Colon & rectum	364	10.1	Female breast	517	11.6	Liver & intrahepatic bile ducts	543	10.3	Female breast	849	13.0
Female breast	193	5.8	Female breast	320	8.5	Stomach	510	11.5	Stomach	511	9.4	Stomach	637	9.5
Liver & intrahepatic bile ducts	176	5.7	Cervix uteri	261	7.0	Liver & intrahepatic bile ducts	332	7.5	Female breast	481	8.7	Liver & intrahepatic bile ducts	436	6.7
Cervix uteri	166	5.0	Liver & intrahepatic bile ducts	236	6.5	Cervix uteri	320	7.3	Cervix uteri	315	6.0	Cervix uteri	393	6.0
Oesophagus	136	4.5	Nasopharynx	140	3.6	Ovary & fallopian tube	172	3.8	Nasopharynx	182	3.3	Ovary & fallopian tube	230	3.6
Nasopharynx	70	2.0	Oesophagus	109	3.0	Nasopharynx	162	3.3	Ovary & fallopian tube	181	3.3	Lymphoid neoplasms	214	3.3
Ovary & fallopian tube	54	1.4	Ovary & fallopian tube	91	2.3	Oesophagus	112	2.6	Brain & CNS	158	2.9	Nasopharynx	209	3.1
Lymphoid neoplasms	48	1.2	Pancreas	55	1.5	Pancreas	90	2.1	Pancreas	136	2.5	Pancreas	198	3.1
All	**2191**	**68.0**	**All**	**3225**	**86.5**	**All**	**4281**	**96.6**	**All**	**5105**	**95.1**	**All**	**6366**	**96.5**

1993-1997			1998-2002			2003-2007			2008-2012			2013-2017		
SITE	**NO.**	**ASMR**	**SITE**	**NO.**	**ASMR**	**SITE**	**NO.**	**ASMR**	**SITE**	**NO.**	**ASMR**	**SITE**	**NO.**	**ASMR**
Lung	1186	14.9	Lung	1426	14.6	Female breast	1566	13.6	Female breast	1979	14.2	Female breast	2180	13.0
Colon & rectum	1052	13.0	Colon & rectum	1356	13.9	Lung	1556	13.0	Lung	1844	12.2	Lung	2018	10.4
Female breast	1010	12.5	Female breast	1346	13.9	Colon & rectum	1466	12.0	Colon & rectum	1634	10.5	Colon & rectum	1927	9.8
Stomach	648	8.0	Stomach	699	7.0	Stomach	622	5.0	Liver & intrahepatic bile ducts	702	4.5	Liver & intrahepatic bile ducts	842	4.2
Cervix uteri	424	5.5	Liver & intrahepatic bile ducts	481	4.9	Liver & intrahepatic bile ducts	519	4.3	Stomach	688	4.4	Pancreas	763	4.1
Liver & intrahepatic bile ducts	391	5.0	Cervix uteri	419	4.5	Ovary & fallopian tube	470	4.1	Pancreas	613	4.0	Stomach	679	3.5
Ovary & fallopian tube	305	4.0	Ovary & fallopian tube	380	4.0	Pancreas	447	3.8	Ovary & fallopian tube	555	3.9	Ovary & fallopian tube	645	3.8
Lymphoid neoplasms	236	3.0	Pancreas	339	3.5	Cervix uteri	381	3.4	Lymphoid neoplasms	368	2.6	Lymphoid neoplasms	485	2.7
Pancreas	235	3.0	Lymphoid neoplasms	281	3.0	Lymphoid neoplasms	321	2.9	Cervix uteri	360	2.5	Cervix uteri	359	2.1
Nasopharynx	202	2.4	Nasopharynx	166	1.7	Nasopharynx	155	1.3	Corpus uteri	203	1.5	Corpus uteri	321	1.9
All	**7056**	**88.8**	**All**	**8621**	**89.1**	**All**	**9181**	**78.0**	**All**	**11041**	**74.7**	**All**	**12539**	**68.4**

6.3 MORTALITY OF CANCER BY ETHNICITY, 1968- 2017

Similar to the trends outlined in Section 5.2 on the incidence of cancer, the Chinese accounted for a disproportionately higher number of cancer deaths in the resident population, between 83.0%-90.0% (Table 6.3.1). The Chinese had the highest CMR of cancer throughout the 50 years. Even though the ASMR of cancer for the Malays was initially the lowest among the three main ethnic groups in 1968-1972, it increased over the years and exceeded that of the Chinese for the first time in 2013-2017.

The ASMR of cancer in the Chinese saw an overall decrease across the 50-year period. It rose from 102.0 per 100,000 population in 1968-1972 to a peak of 140.3 per 100,000 population in 1978-1982, before dropping to 83.0 per 100,000 population in 2013-2017 (Figure 6.3.1(a)). The ASMR for the Indians also showed a similar pattern of an initial rise from 65.2 per 100,000 population in 1968-1972 to its highest at 90.2 per 100,000 population in 1978-1982, before declining to 58.5 per 100,000 population in 2013-2017. The Malays had the lowest ASMR of the three major ethnic groups in the beginning but saw it rise steadily to surpass that of the Indians in 1983-1987, and by 2013-2017, it also surpassed the ASMR of the Chinese.

Over the 50 years, the CMR and ASMR of cancer for males remained higher than that for females in all three main ethnic groups (Figures 6.3.1(b) - 6.3.1(c)). However, a minor variation was observed among the Indians where females had higher ASMR of cancer up till 1998-2002, after which it was surpassed by that of Indian males from 2003-2007 onwards.

Table 6.3.1: MORTALITY NUMBER AND RATE (PER 100,000 POPULATION) FOR CANCER BY ETHNICITY AND FIVE-YEAR PERIOD, 1968-2017

Period	Ethnic group	Number	%	CMR	ASMR
1968-1972	Chinese	5231	89.2	67.4	102.0
	Malay	330	5.6	22.1	45.5
	Indian	242	4.1	34.3	65.2
	Total	5866	100	58.2	93.8
1973-1977	Chinese	7600	88.8	92.1	129.4
	Malay	524	6.1	34.1	62.0
	Indian	350	4.1	50.3	78.8
	Total	8561	100	80.6	119.0
1978-1982	Chinese	9660	89.2	108.0	140.3
	Malay	634	5.9	38.6	65.3
	Indian	430	4.0	59.1	90.2
	Total	10826	100	94.7	128.6
1983-1987	Chinese	11146	88.8	115.2	136.1
	Malay	844	6.7	47.9	73.9
	Indian	468	3.7	56.0	73.0
	Total	12554	100	101.2	124.2
1988-1992	Chinese	13517	87.8	127.6	136.7
	Malay	1183	7.7	61.6	86.9
	Indian	557	3.6	57.9	67.8
	Total	15401	100	113.0	125.8
1993-1997	Chinese	14516	87.1	124.5	122.4
	Malay	1370	8.2	64.8	84.8
	Indian	574	3.4	51.8	55.8
	Total	16657	100	110.5	113.3
1998-2002	Chinese	17455	86.6	138.7	122.4
	Malay	1647	8.2	72.3	87.3
	Indian	739	3.7	57.2	58.7
	Total	20160	100	123.0	114.2
2003-2007	Chinese	17927	85.9	136.4	103.1
	Malay	1891	9.1	78.7	85.6
	Indian	856	4.1	58.8	61.2
	Total	20871	100	120.2	98.2
2008-2012	Chinese	20657	84.7	148.3	93.5
	Malay	2353	9.7	93.6	88.2
	Indian	1091	4.5	63.6	63.9
	Total	24378	100	130.0	90.6
2013-2017	Chinese	23063	83.2	159.1	83.0
	Malay	3053	11.0	117.1	92.4
	Indian	1253	4.5	70.6	58.5
	Total	27730	100	142.1	82.1

Figure 6.3.1(a): AGE-STANDARDISED MORTALITY RATE (PER 100,000 POPULATION) FOR CANCER BY ETHNICITY AND FIVE-YEAR PERIOD, 1968-2017 (ALL)

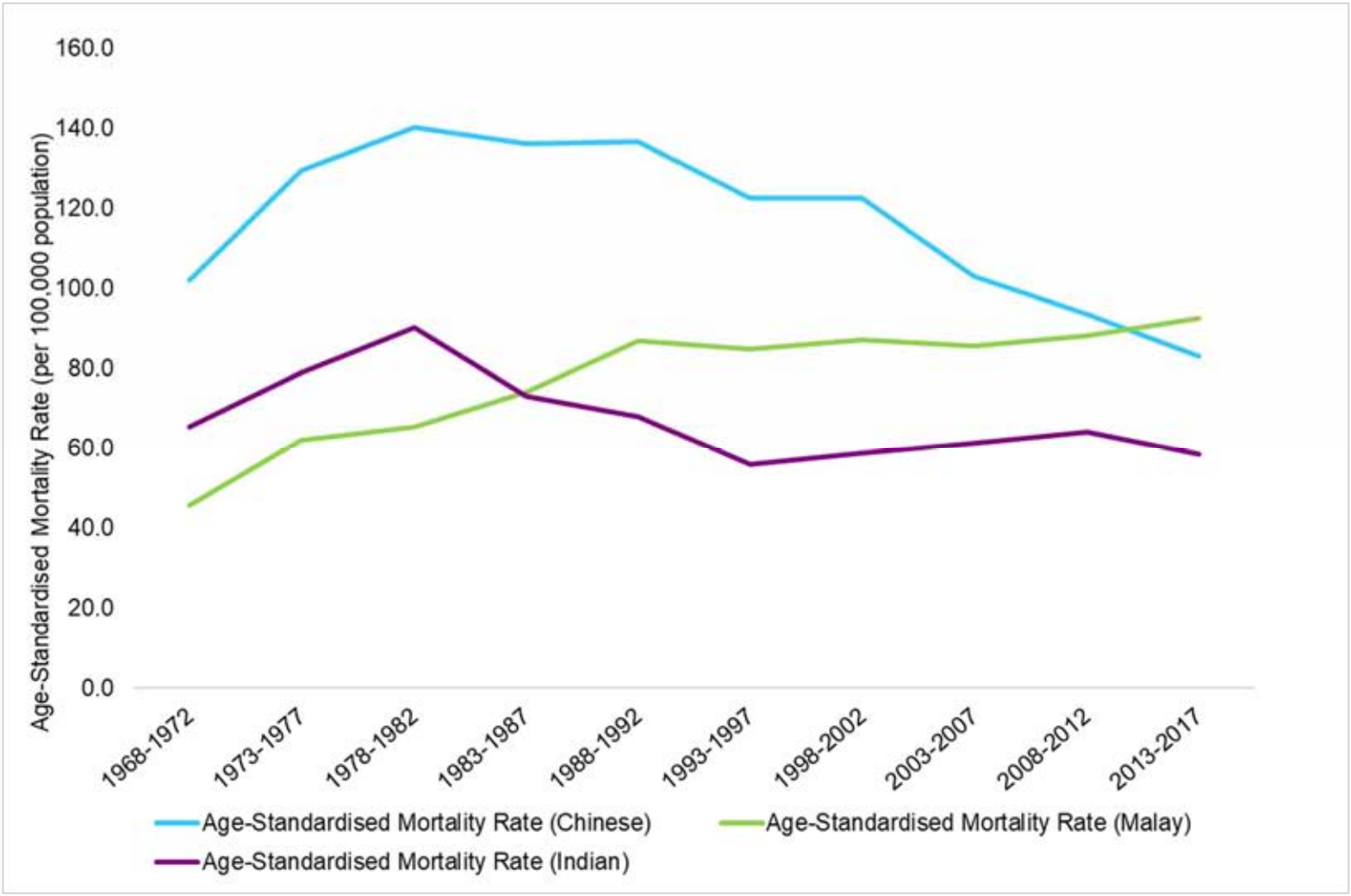


Figure 6.3.1(b): AGE-STANDARDISED MORTALITY RATE (PER 100,000 POPULATION) FOR CANCER BY ETHNICITY AND FIVE-YEAR PERIOD, 1968-2017 (MALES)

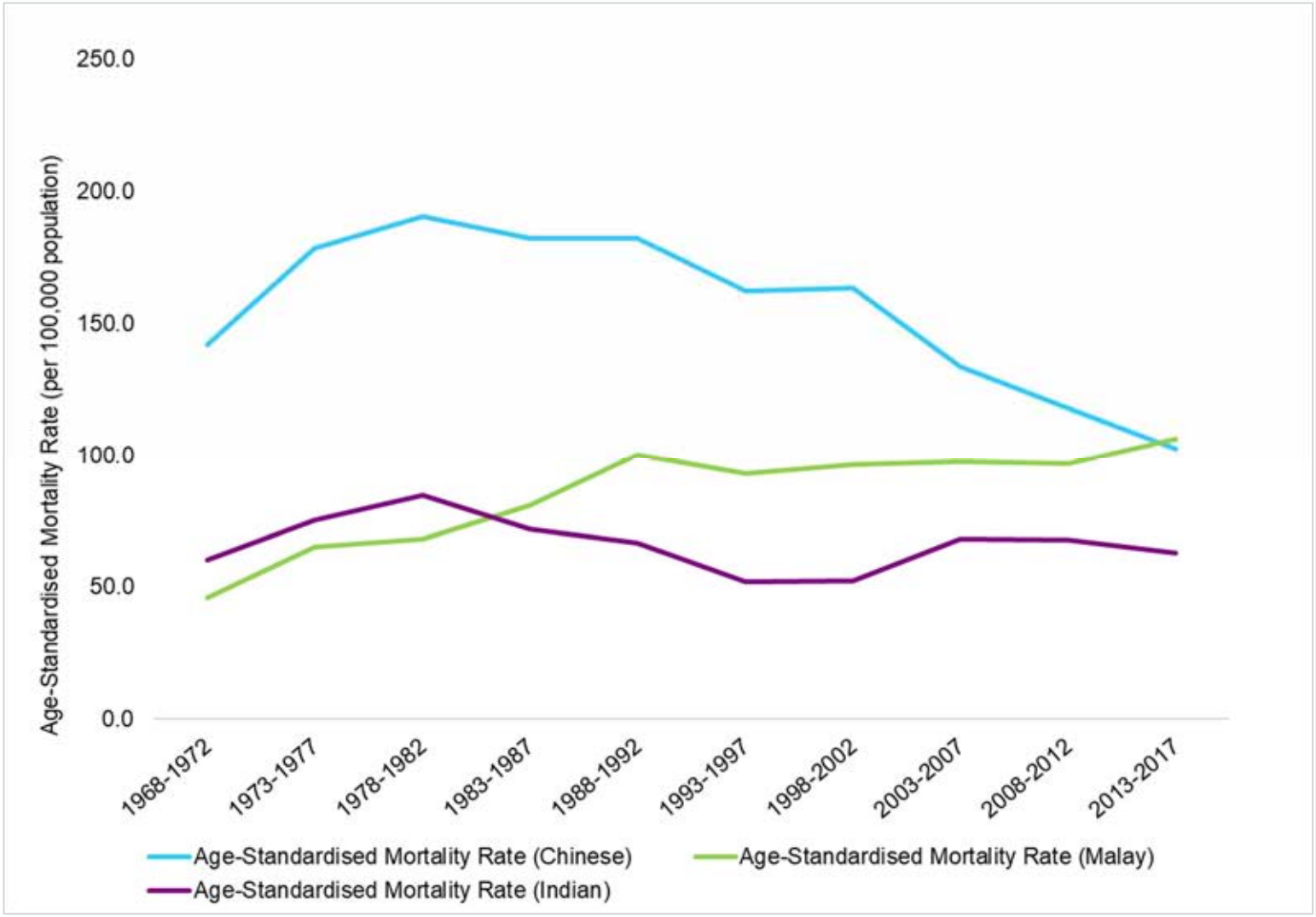
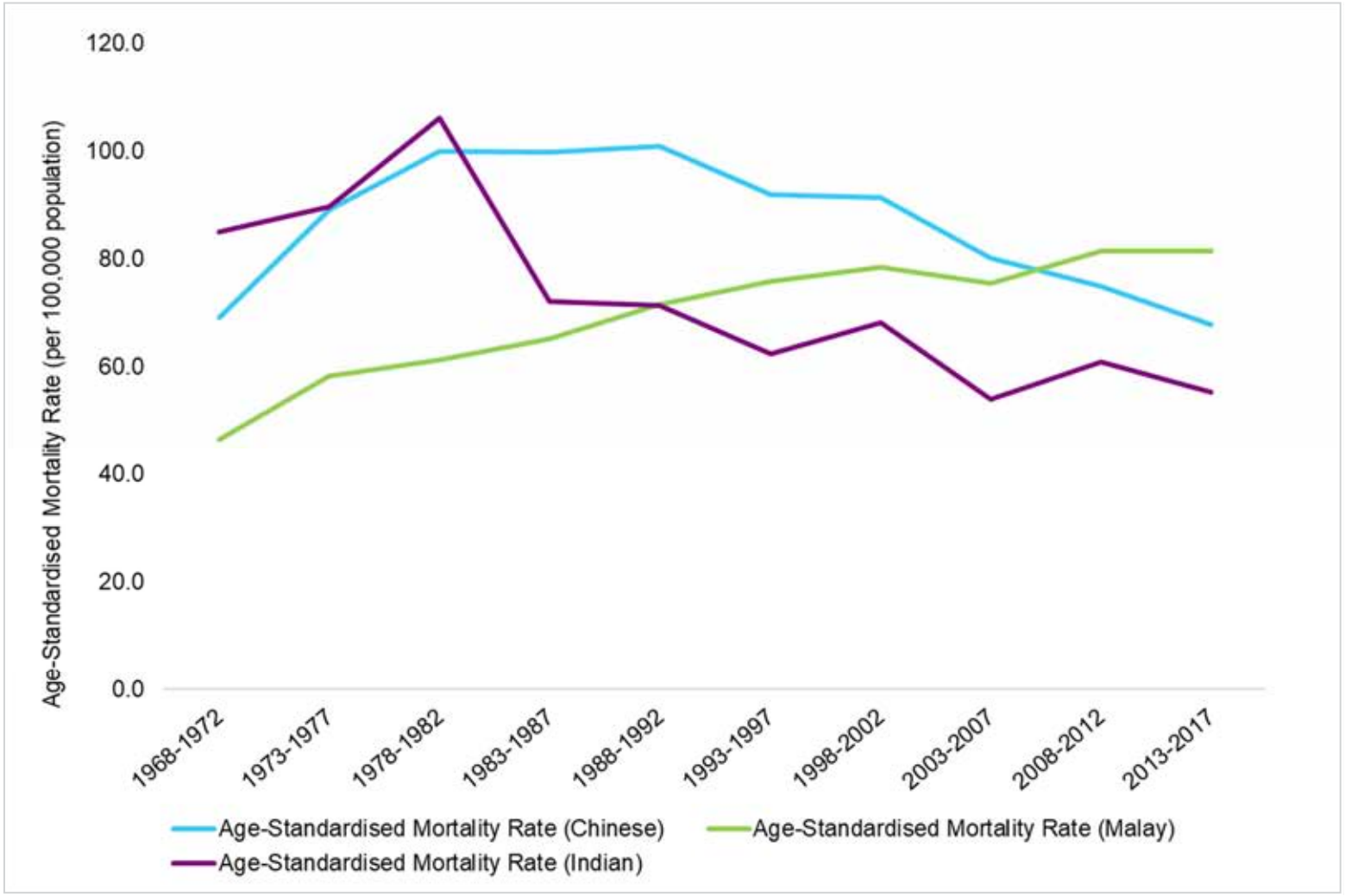


Figure 6.3.1(c): AGE-STANDARDISED MORTALITY RATE (PER 100,000 POPULATION) FOR CANCER BY ETHNICITY AND FIVE-YEAR PERIOD, 1968-2017 (FEMALES)



6.4 MORTALITY OF CANCER BY AGE GROUP, 1968- 2017

The 15-34 years age group contributed the least to overall cancer mortality, declining from 4.9% of all cancer deaths in 1968-1972 to 0.9% by 2013-2017 (Table 6.4.1). In contrast, the percentage of all cancer deaths accounted for by those aged 65 years and above doubled from 33.5% in 1968-1972 to 65.8% in 2013-2017.

The CMRs and ASMRs of the three age bands in every five-year period also reflected the above trends – those aged 15-34 years had the lowest age-specific mortality rates, whereas those aged 65 years and above had mortality rates that were the highest vis-à-vis the other two age groups regardless of gender (Figures 6.4.1(a)-6.4.1(c)).

Table 6.4.1: MORTALITY NUMBER AND RATE (PER 100,000 POPULATION) FOR CANCER BY AGE GROUP AND FIVE-YEAR PERIOD, 1968-2017

Period	Age group	Number	%	CMR	ASMR
1968-1972	15-34 years	286	4.9	8.3	8.7
	35-64 years	3481	59.3	148.6	160.2
	65 years+	1965	33.5	575.3	577.1
	Total	5866	100	58.2	93.8
1973-1977	15-34 years	388	4.5	9.5	9.7
	35-64 years	4636	54.2	179.6	194.8
	65 years+	3368	39.3	770.7	772.5
	Total	8561	100	80.6	119.0
1978-1982	15-34 years	492	4.5	10.2	10.1
	35-64 years	5185	47.9	180.3	196.9
	65 years+	5044	46.6	906.7	905.8
	Total	10826	100	94.7	128.6
1983-1987	15-34 years	507	4.0	9.8	9.2
	35-64 years	5718	45.5	162.6	185.3
	65 years+	6190	49.3	911.8	893.1
	Total	12554	100	101.2	124.2
1988-1992	15-34 years	509	3.3	9.8	8.7
	35-64 years	6560	42.6	147.4	176.2
	65 years+	8174	53.1	995.8	955.7
	Total	15401	100	113.0	125.8
1993-1997	15-34 years	418	2.5	8.2	7.2
	35-64 years	6595	39.6	118.2	145.4
	65 years+	9512	57.1	968.9	925.9
	Total	16657	100	110.5	113.3
1998-2002	15-34 years	364	1.8	7.4	6.4
	35-64 years	7542	37.4	112.6	137.2
	65 years+	12144	60.2	1035.5	981.8
	Total	20160	100	123.0	114.2
2003-2007	15-34 years	287	1.4	5.8	5.3
	35-64 years	7715	37.0	102.8	115.7
	65 years+	12782	61.2	917.6	857.1
	Total	20871	100	120.2	98.2
2008-2012	15-34 years	301	1.2	5.6	5.1
	35-64 years	8771	36.0	104.0	104.2
	65 years+	15243	62.5	888.5	803.0
	Total	24378	100	130.0	90.6
2013-2017	15-34 years	263	0.9	4.9	4.5
	35-64 years	9180	33.1	103.6	95.2
	65 years+	18244	65.8	793.2	725.5
	Total	27730	100	142.1	82.1

Figure 6.4.1(a): AGE-SPECIFIC MORTALITY RATE (PER 100,000 POPULATION) FOR CANCER BY AGE GROUP AND FIVE-YEAR PERIOD, 1968-2017 (ALL)

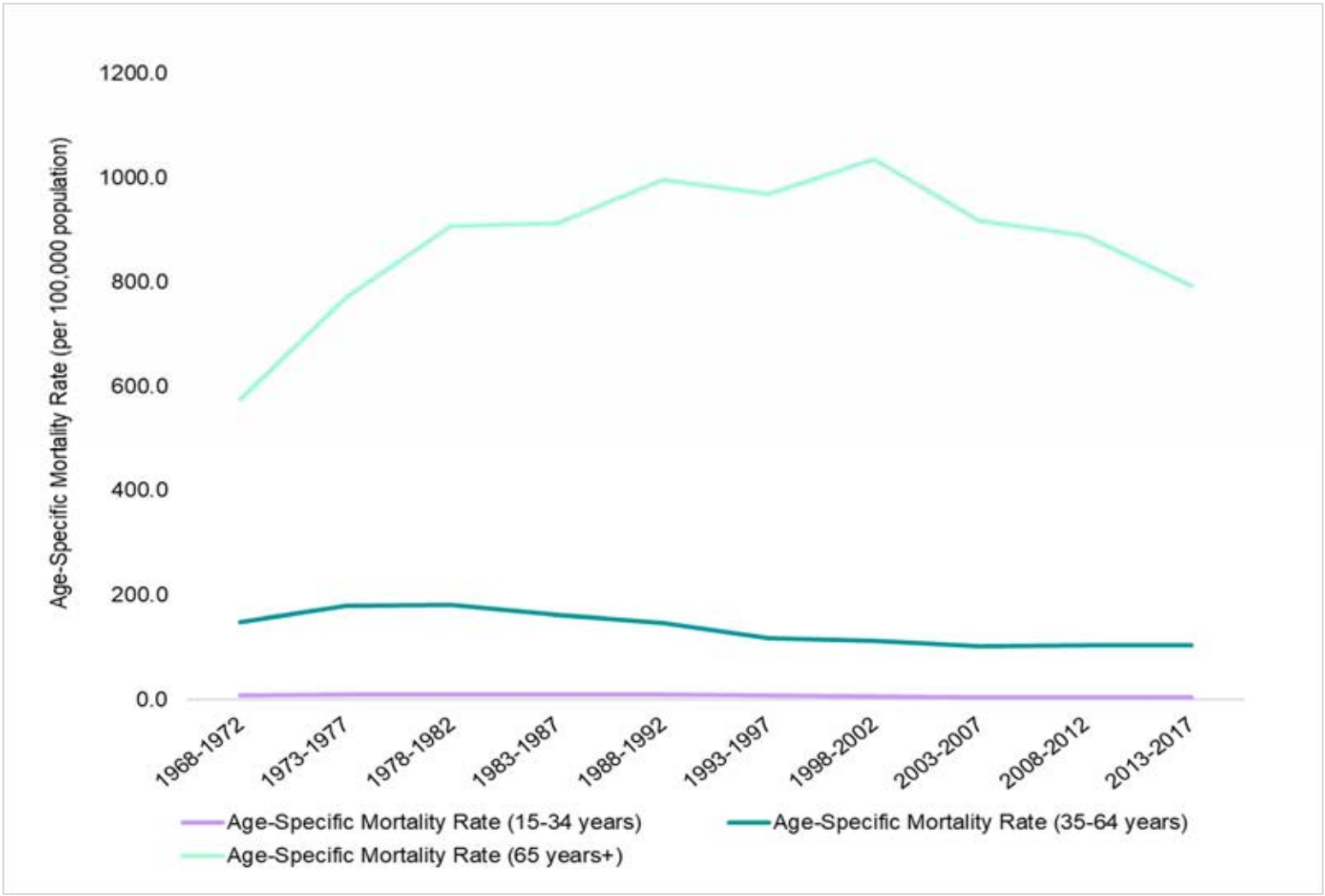


Figure 6.4.1(b): AGE-SPECIFIC MORTALITY RATE (PER 100,000 POPULATION) FOR CANCER BY AGE GROUP AND FIVE-YEAR PERIOD, 1968-2017 (MALES)

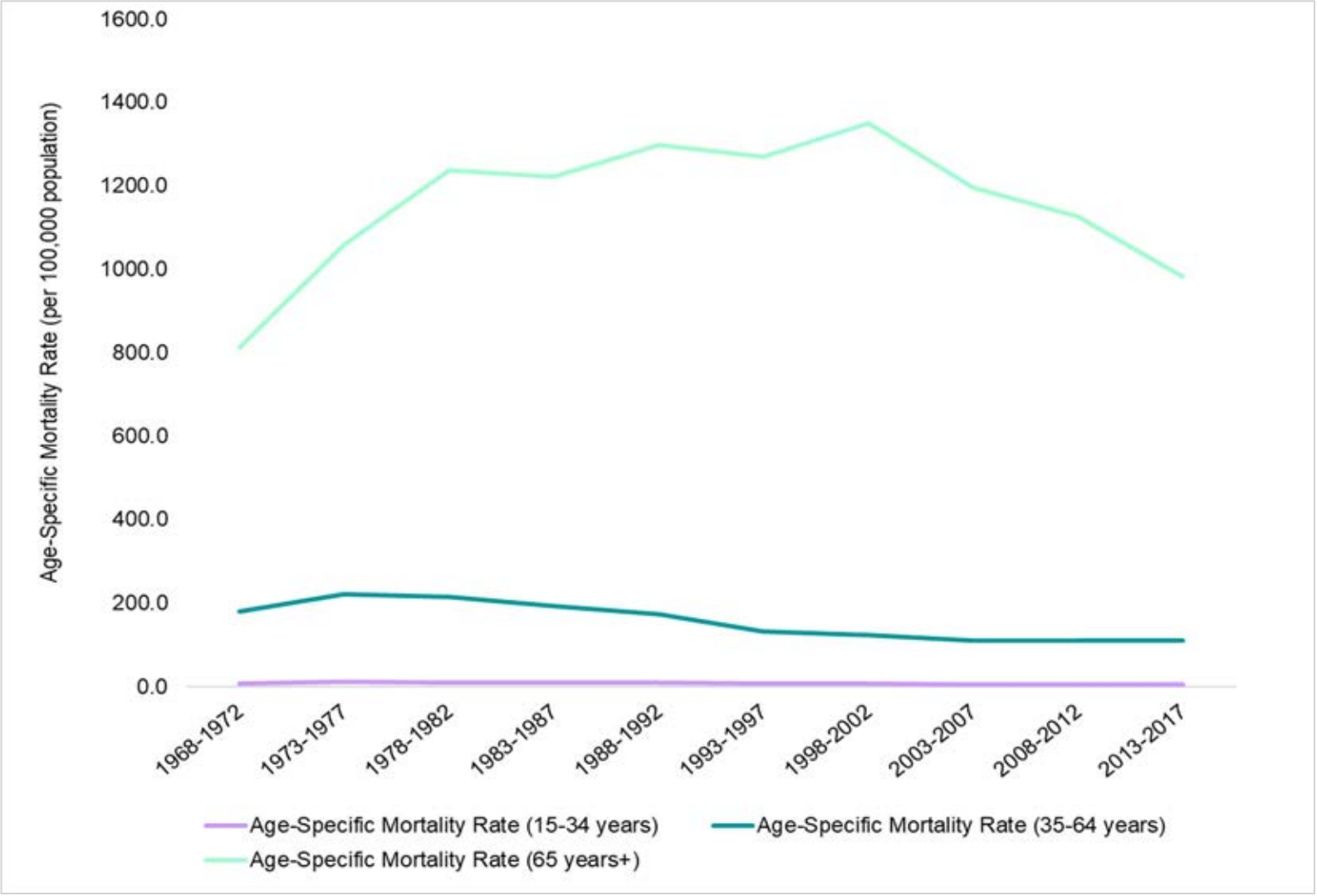


Figure 6.4.1(c): AGE-SPECIFIC MORTALITY RATE (PER 100,000 POPULATION) FOR CANCER BY AGE GROUP AND FIVE-YEAR PERIOD, 1968-2017 (FEMALES)

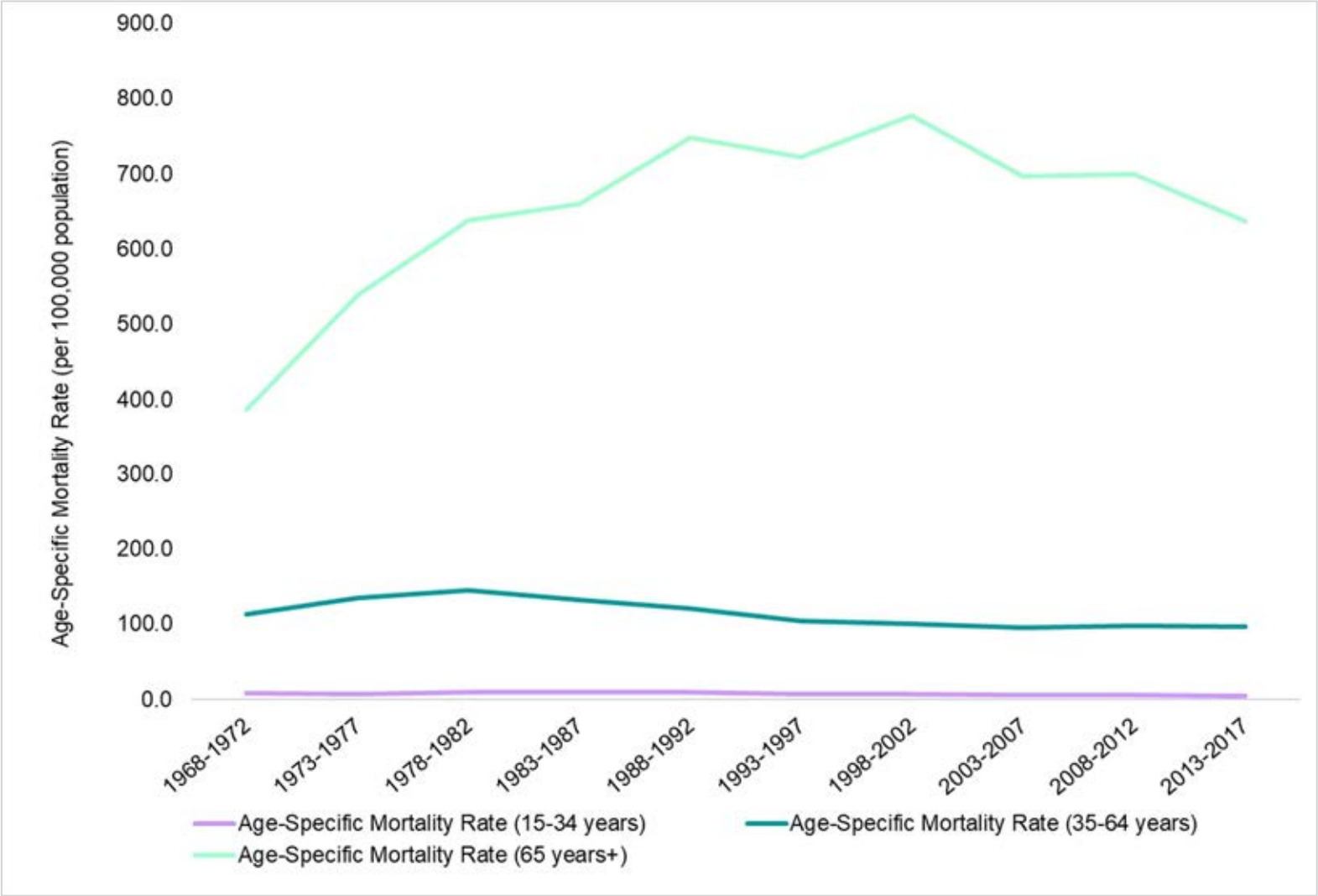
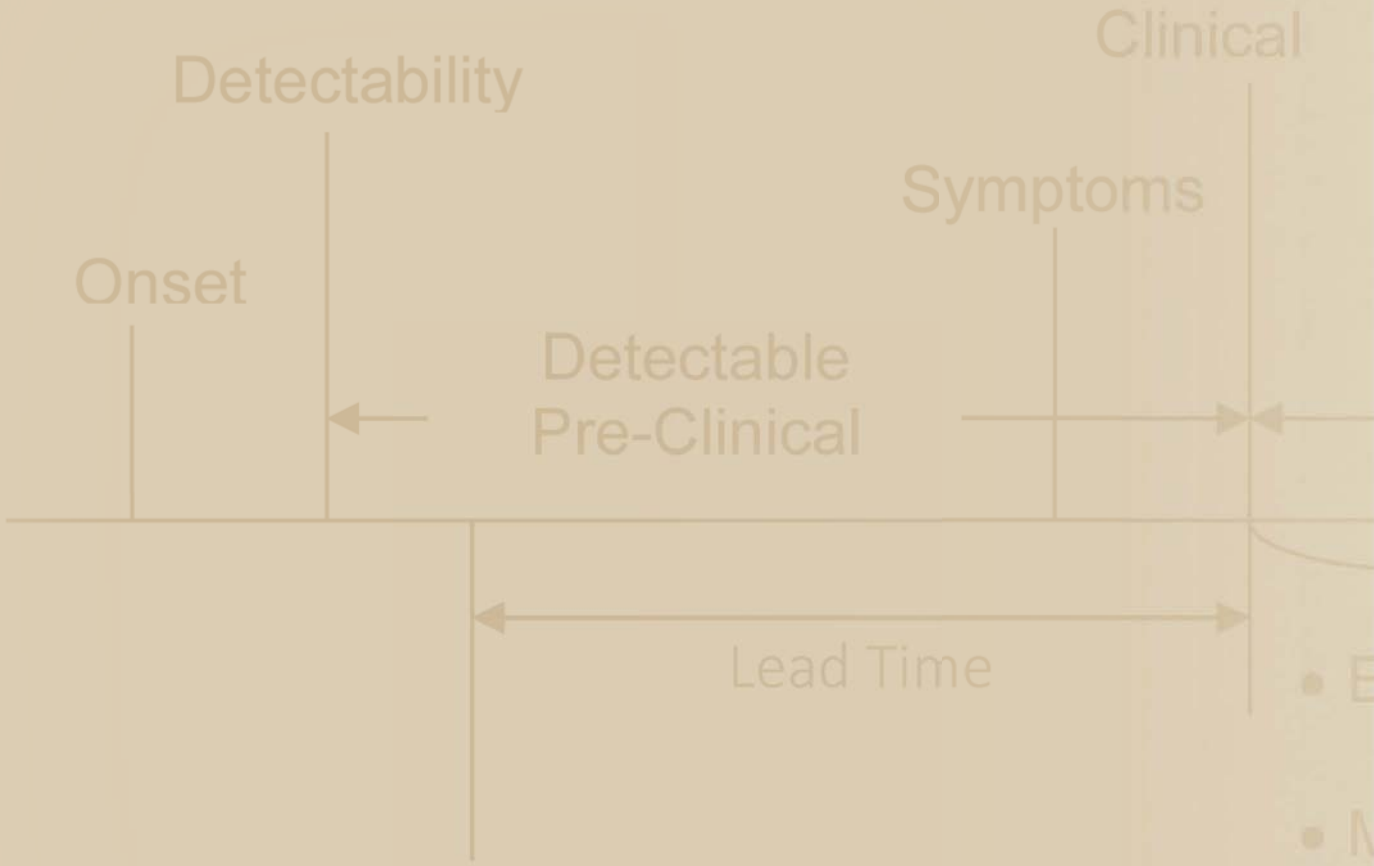


Figure 7.5.1: SCHEMATIC REPRESENTATION O



CHAPTER 7

CANCER SURVIVAL, 1968-2017

This chapter highlights the key trends in cancer survival, with breakdown by gender, ethnicity, age group and cancer staging. The interpretation of cancer survival estimates has to be done within the context of cancer incidence and mortality, which have been presented in Chapters Five and Six respectively.

7.1 CANCER SURVIVAL BY GENDER, 1968-2017

There was an overall improvement in the age-standardised relative survival (ASRS) for all cancers combined among both genders. The upward trends for short-term (five-year ASRS) and long-term survival (ten-year ASRS) were fairly similar for both genders (Figures 7.1.1 and 7.1.2). For males, the five-year ASRS improved from 13.2% in 1973-1977 to 51.2% in 2013-2017, while the ten-year ASRS improved from 12.9% in 1978-1982 to 46.0% in 2013-2017. Similarly, for females, the five-year ASRS improved from 28.0% in 1973-1977 to 60.1% in 2013-2017, and the ten-year ASRS improved from 25.8% in 1978-1982 to 54.3% in 2013-2017.

Figure 7.1.1: FIVE-YEAR AGE-STANDARDISED RELATIVE SURVIVAL RATE (%) FOR CANCER BY GENDER AND FIVE-YEAR PERIOD, 1968-2017

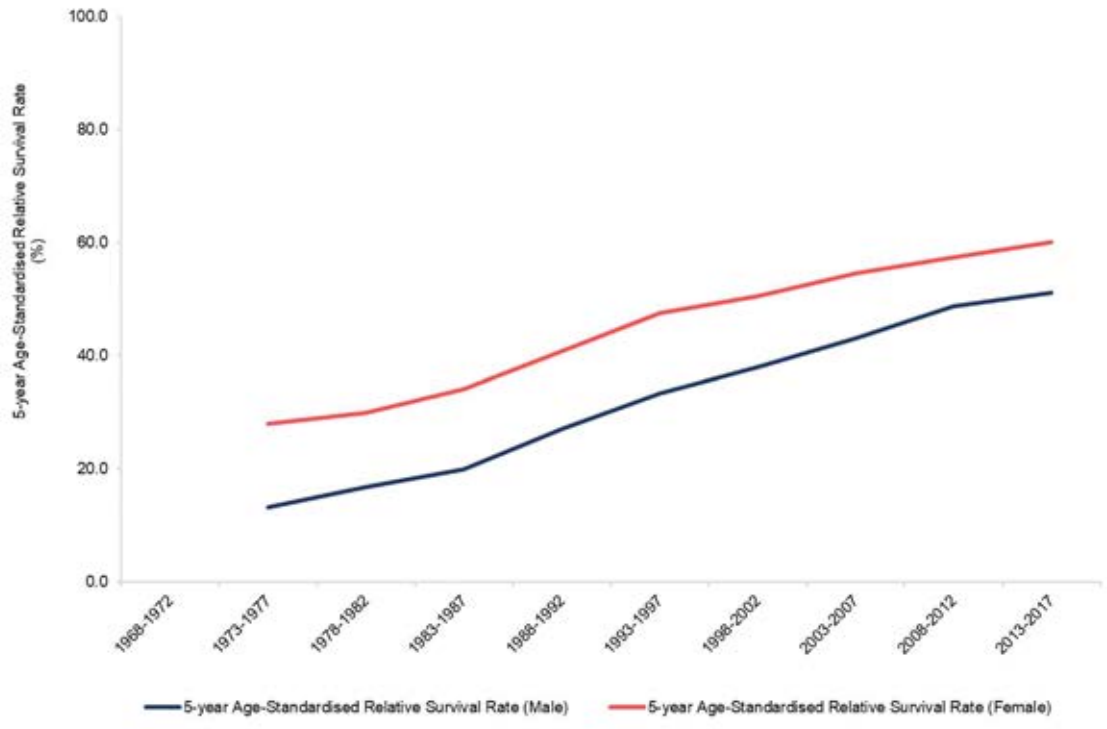
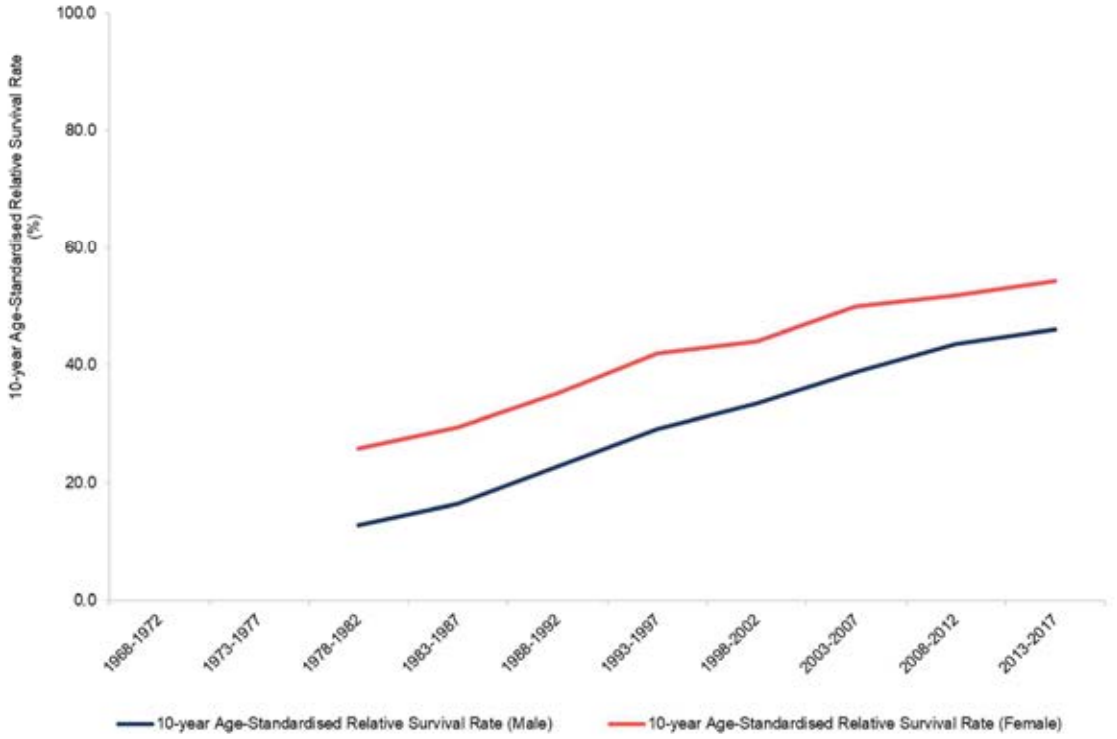


Figure 7.1.2: TEN-YEAR AGE-STANDARDISED RELATIVE SURVIVAL RATE (%) FOR CANCER BY GENDER AND FIVE-YEAR PERIOD, 1968-2017



7.2 CANCER SURVIVAL BY ETHNICITY, 1968-2017

Improvements in the ASRS for all three ethnic groups were observed during the period under study (Figures 7.2.1 and 7.2.2). However, the ASRS for all cancers combined was lower for the Malays than for the Chinese and Indians. For the Malays, the five-year ASRS improved from 16.9% in 1973-1977 to 44.7% in 2013-2017, while the ten-year ASRS improved from 12.9% in 1978-1982 to 37.4% in 2013-2017. By comparison, for the Chinese, the five-year ASRS improved from 19.6% in 1973-1977 to 56.5% in 2013-2017, and the ten-year ASRS improved from 19.1% in 1978-1982 to 51.3% in 2013-2017; and for the Indians, the five-year ASRS improved from 24.5% in 1973-1977 to 56.7% in 2013-2017 and the ten-year ASRS improved from 13.6% in 1978-1982 to 50.1% in 2013-2017.

Figure 7.2.1: FIVE-YEAR AGE-STANDARDISED RELATIVE SURVIVAL RATE (%) FOR CANCER BY ETHNICITY AND FIVE-YEAR PERIOD, 1968-2017

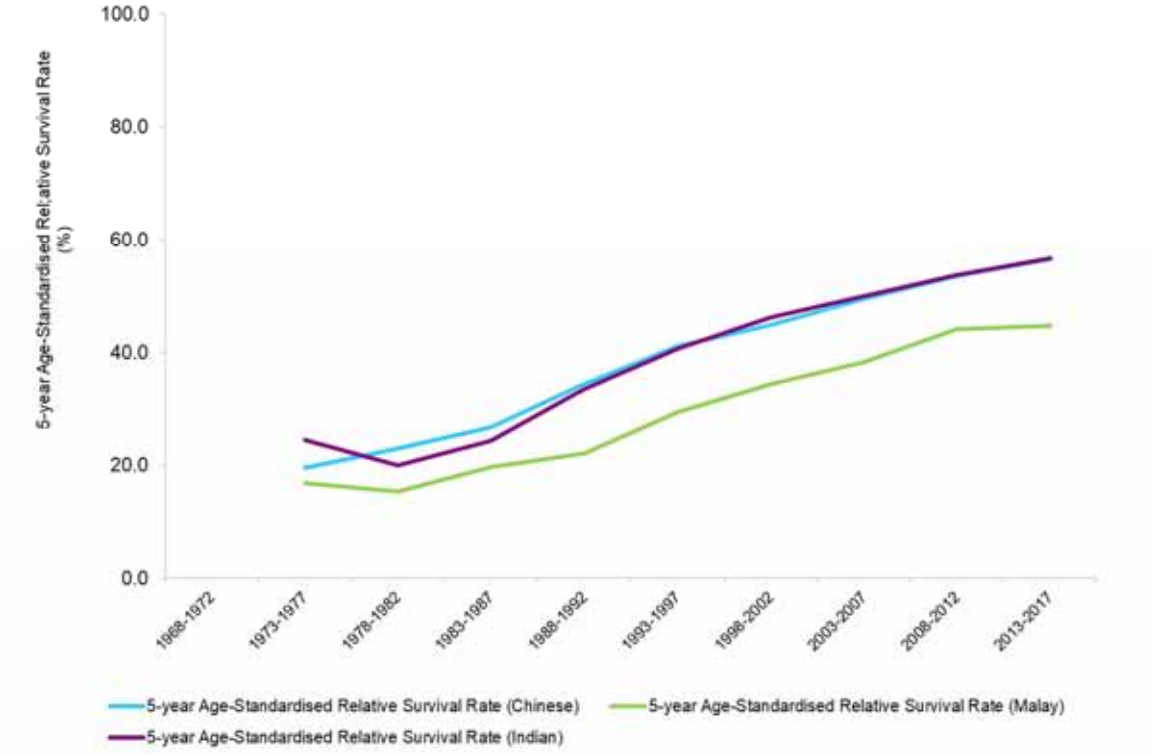
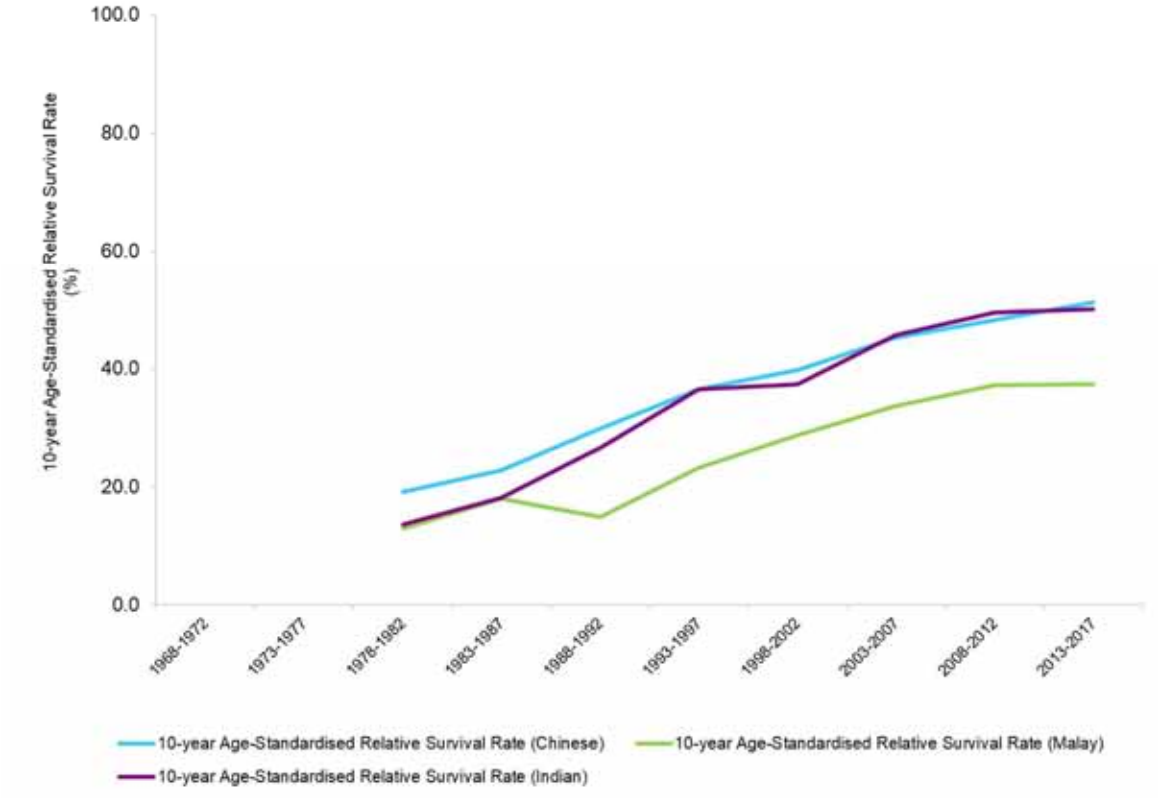


Figure 7.2.2: TEN-YEAR AGE-STANDARDISED RELATIVE SURVIVAL RATE (%) FOR CANCER BY ETHNICITY AND FIVE-YEAR PERIOD, 1968-2017



7.3 CANCER SURVIVAL BY AGE GROUP, 1968-2017

Improvements in the relative survival for all age groups were seen during the period under study (Figures 7.3.1 and 7.3.2). Relative survival was observed to decrease with age. Comparing the periods 1973-1977 and 2013-2017, the five-year relative survival increased from 43.3% to 83.7% for those aged 15-34 years, 23.1% to 68.7% for those aged 35-64 years, and 14.4% to 48.3% for those aged 65 years and above. Comparing the periods 1978-1982 and 2013-2017, the ten-year relative survival increased from 39.1% to 80.2% for those aged 15-34 years, 22.3% to 62.8% for those aged 35-64 years, and 14.5% to 42.8% for those aged 65 years and above.

Figure 7.3.1: FIVE-YEAR RELATIVE SURVIVAL RATE (%) FOR CANCER BY AGE GROUP AND FIVE-YEAR PERIOD, 1968-2017

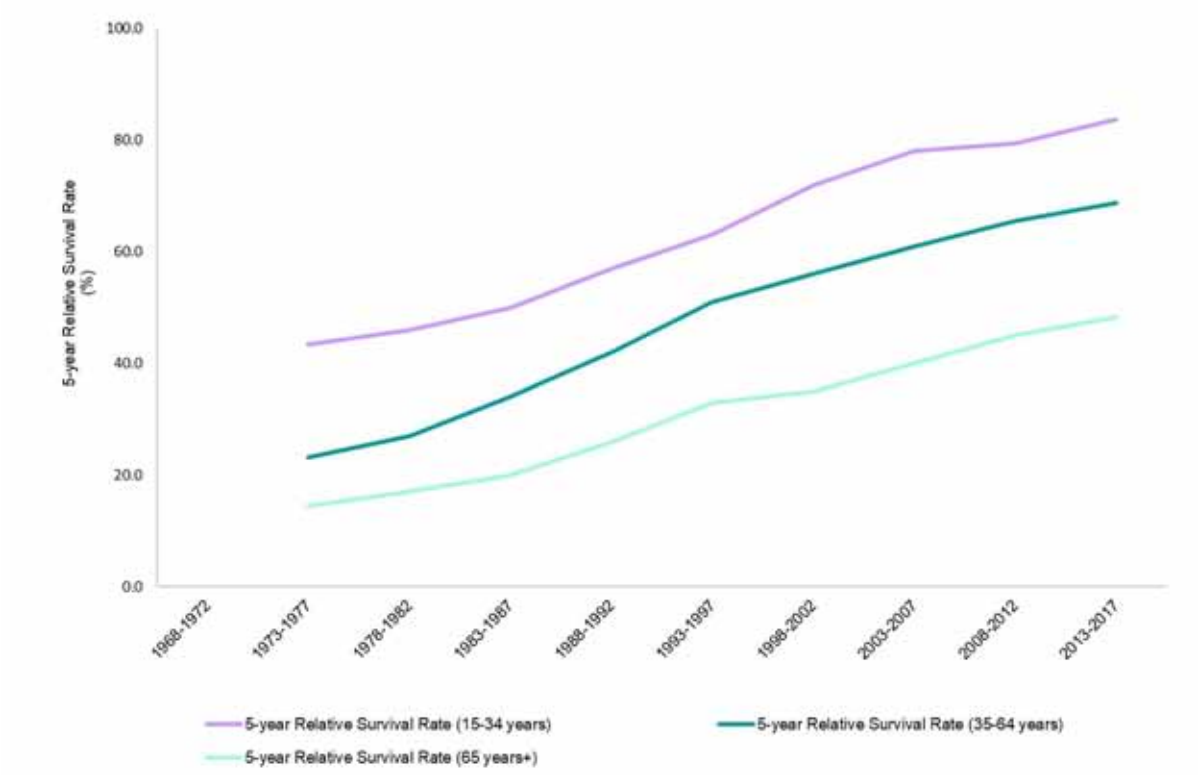
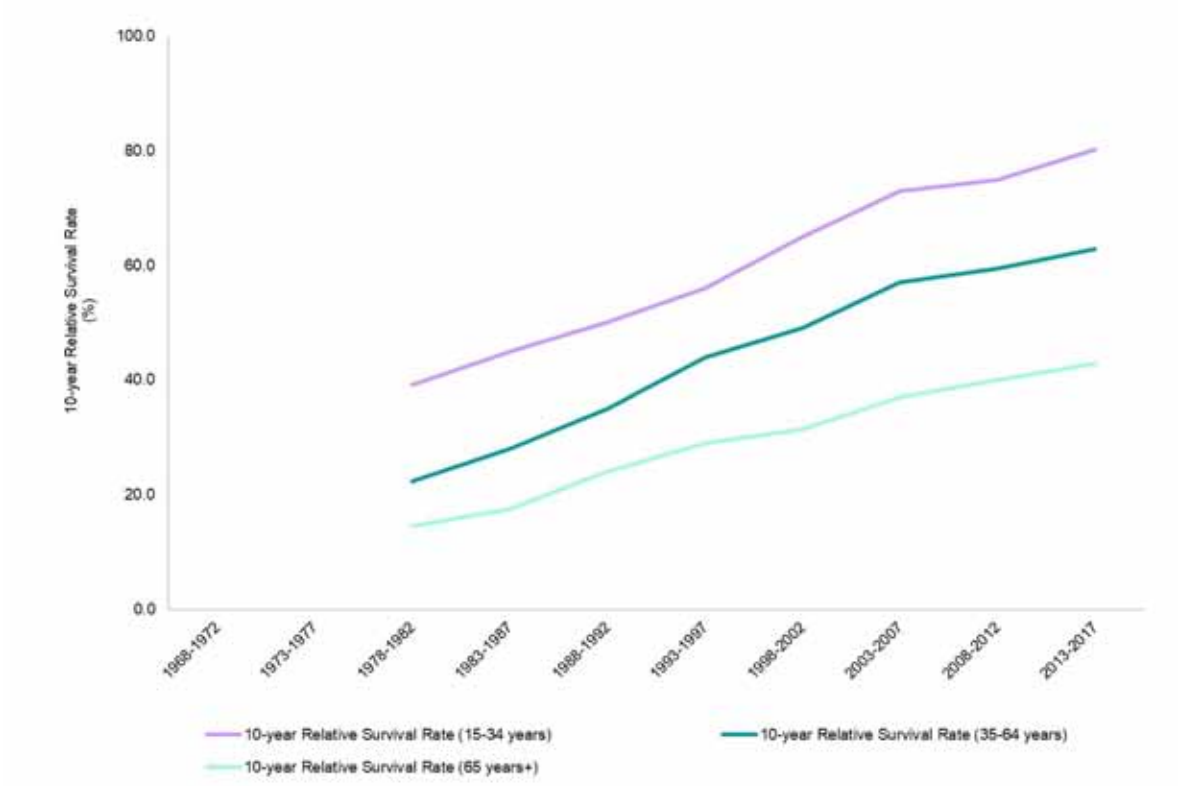


Figure 7.3.2: TEN-YEAR RELATIVE SURVIVAL RATE (%) FOR CANCER BY AGE GROUP AND FIVE-YEAR PERIOD, 1968-2017



7.4 CANCER SURVIVAL BY STAGE, 2008-2017

Stage-specific analyses showed substantial differences in the ASRS for cancers diagnosed at different stages. In 2013-2017, the five-year ASRS for cancers diagnosed at Stages I, II, III and IV were 91.7%, 81.4%, 56.0% and 18.6% respectively (Figure 7.4.1). The ten-year ASRS for cancers diagnosed at Stages I, II, III and IV were 87.6%, 76.1%, 47.4% and 13.7% respectively (Figure 7.4.2).

Figure 7.4.1: FIVE-YEAR AGE-STANDARDISED RELATIVE SURVIVAL RATE (%) FOR CANCER BY STAGE, 2008-2017

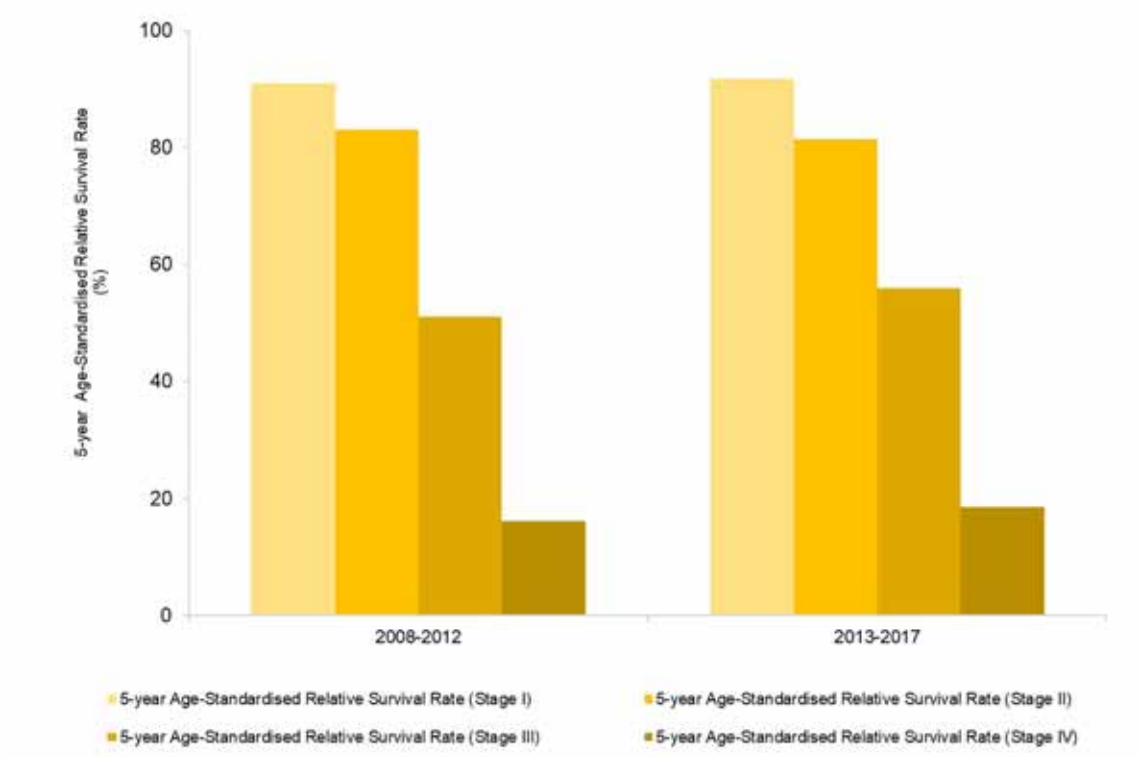
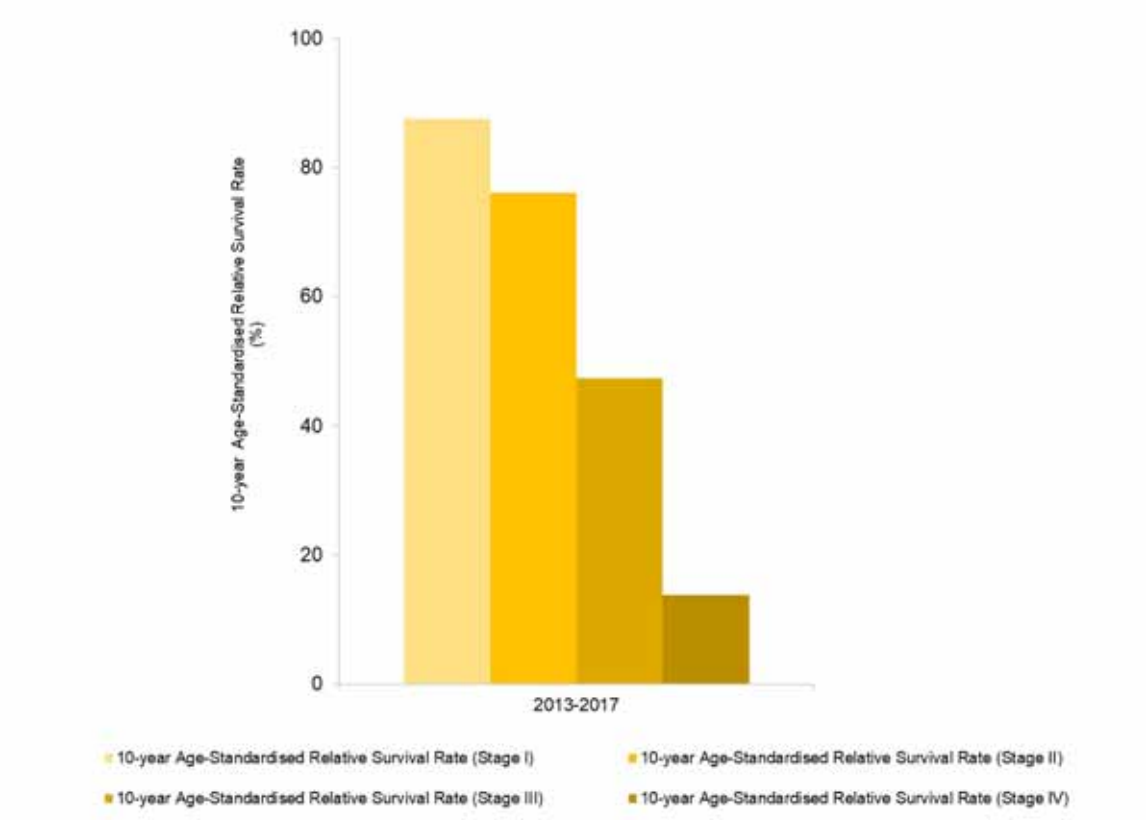


Figure 7.4.2: TEN-YEAR AGE-STANDARDISED RELATIVE SURVIVAL RATE (%) FOR CANCER BY STAGE, 2013-2017



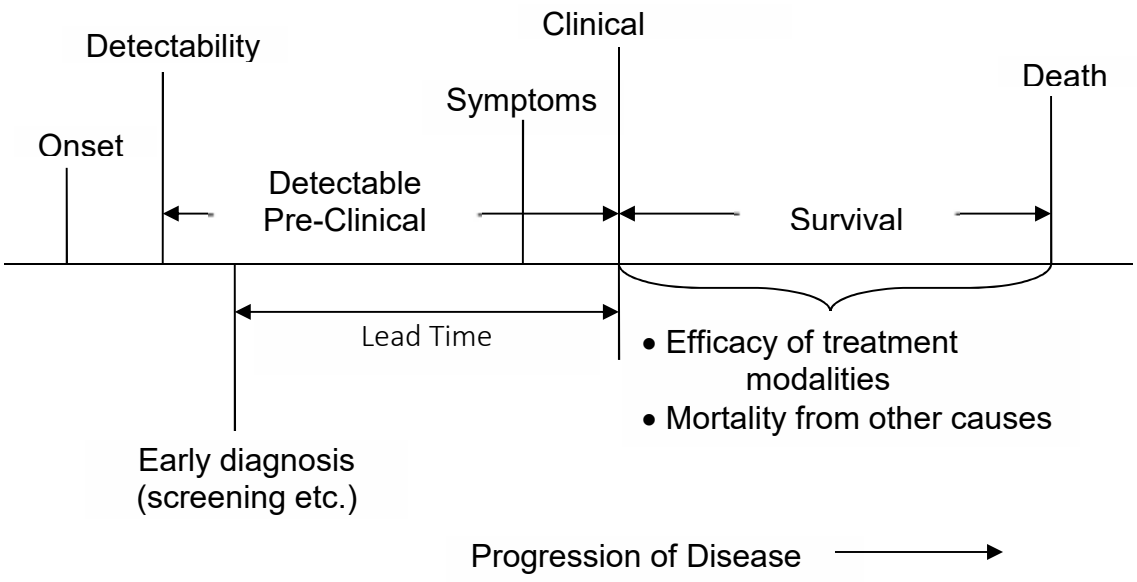
7.5 INTERPRETATION OF SURVIVAL ESTIMATES

While relative survival estimates are useful public health indicators [69], it should be noted that several factors can influence the survival estimates and trends observed. An increasing survival trend does not necessarily imply advancement in treatment modalities. It may instead be due to early detection of the cancer resulting in lead-time bias; differences in the tools used to classify cancer stage resulting in a stage migration phenomenon [52] [70]; or changes in the cancer distribution, for instance, less lethal cancers becoming relatively more common over the years [71]. Therefore, trends in survival must be interpreted in conjunction with trends in incidence and mortality rates.

Lead-time bias

Since survival time is the duration between the dates of diagnosis and death, 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 a cancer is detected even before the symptoms of the disease begin. This is generally introduced by screening programmes, improved diagnostic tools, and greater general public awareness. A schematic diagram for lead-time bias is shown in Figure 7.5.1.

Figure 7.5.1: 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. This makes the survival rate appear to be more optimistic at each cancer stage but it does not have any implication on the survival rates obtained from a non-stage-specific analysis [72].

In view of the above factors, a holistic analysis looking at relative survival, incidence and mortality trends is needed to evaluate therapeutic progress more precisely [73].

Table 8.1: MULTIPLE PRIMARY CANCERS IN ORDER OCCURRENCES, 1968-2017

Site	As first primary	As second primary
Female breast	2244	1343
Colon	1879	1642
Lung (incl. trachea & bronchus)	633	2299
Non-melanoma skin cancer	1419	1027
Rectosigmoid & rectum	1159	978
Prostate	964	924
Stomach	771	1097
Lymphoid neoplasms	809	823
Corpus uteri	796	646
Ovary & fallopian tube	545	625
Urinary bladder	590	478
Nasopharynx	824	233
Kidney (incl. renal pelvis, ureter & urethra)	461	560
Cervix uteri	757	247
Thyroid	545	431
Liver & intrahepatic bile ducts	277	650
Myeloid neoplasms	316	416
Larynx	400	171
Oesophagus	157	318

CHAPTER 8

MULTIPLE PRIMARY CANCERS, 1968-2017

The registry's criteria for the inclusion of cases of multiple primary cancers are as below, following the guidelines listed in the ICD-O-3:

(a) Recognition of the existence of multiple primary cancers is independent of time.

(b) A new primary cancer originates in a primary site or tissue and is not an extension, recurrence, or metastasis.

(c) For paired organs, only one tumour is recognised.

(d) A new incidence in the same organ of another histology but the same histological group will not be counted.

The registry adopted the international rules for multiple primary cancers from the ICD-O-3 and the IARC for data collection of multiple primaries of solid tumours [74], and the Haematopoietic and Lymphoid Neoplasm Coding Manual for reporting multiple primaries of haematolymphoid neoplasms [75].

Table 8.1 lists the number of multiple primary cancers by site and order of occurrence. A total of 35,040 multiple primary cancers were registered between 1968-2017. Among individuals with multiple primary cancers, the female breast was the most common site where the first primary cancer occurred, followed by the colon and lung. Among second primary cancers, the lung was the most frequent site of occurrence, followed by the colon and female breast. For third primary cancers or beyond, the lung remained as the most frequent site of occurrence, followed by the colon and skin (non-melanoma).

Tables 8.2(a) and 8.2(b) present the site distribution of the second and subsequent cancers in relation to the first primary cancer. Of note, the occurrence of multiple primary cancer cases reflected the prevailing incidence of the most common cancers in the resident population. For instance, among individuals with the first primary occurring in the female breast, the subsequent primaries were most likely to occur in the colon and lung, which were also among the leading cancers in women. Among individuals whose first primary cancer occurred in the colon, the subsequent primaries were most likely to occur in the lung, stomach, rectum, prostate, or female breast, which were all leading cancers in the resident population as well.

Table 8.1: MULTIPLE PRIMARY CANCERS IN ORDER OF TOTAL OCCURRENCES, 1968-2017

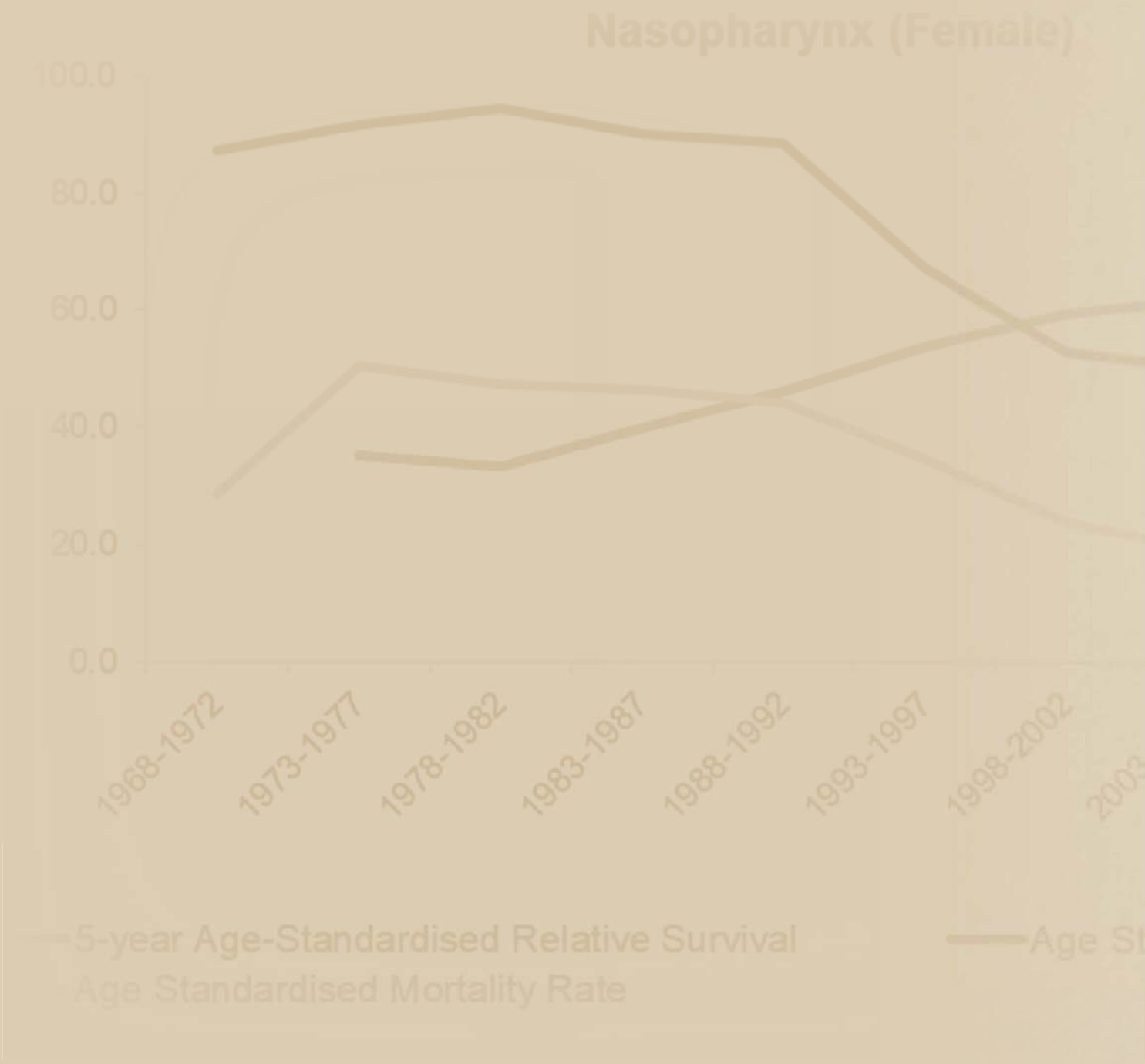
Site	As first primary	As second primary	As third primary or later	Total
Female breast	2244	1343	53	3640
Colon	1879	1642	89	3610
Lung (incl. trachea & bronchus)	633	2299	142	3074
Non-melanoma skin	1419	1027	87	2533
Rectosigmoid & rectum	1159	978	51	2188
Prostate	964	924	60	1948
Stomach	771	1097	63	1931
Lymphoid neoplasms	809	823	67	1699
Corpus uteri	796	646	31	1473
Ovary & fallopian tube	545	625	24	1194
Urinary bladder	590	478	21	1089
Nasopharynx	824	233	12	1069
Kidney & other urinary organs	461	560	39	1060
Cervix uteri	757	247	8	1012
Thyroid	545	431	32	1008
Liver & intrahepatic bile ducts	277	650	39	966
Myeloid neoplasms	316	416	29	761
Larynx	400	171	10	581
Oesophagus	157	318	23	498
Pancreas	77	389	24	490
Pharynx (incl. tonsils, oropharynx & hypopharynx)	146	158	15	319
Tongue	134	164	11	309
Connective & soft tissues (incl. peripheral nerves)	141	131	13	285
Mouth	127	132	9	268
Gallbladder & extrahepatic bile ducts	67	162	8	237
Small intestines	58	123	16	197
Brain & central nervous system (CNS)	79	94	5	178
Major salivary glands (incl. parotid gland)	94	67	7	168
Vulva & vagina	58	86	6	150
Nasal cavity, middle ear, & accessory sinuses	52	81	6	139
Others & unspecified	429	513	24	966
Total:	**17008**	**17008**	**1024**	**35040**

Table 8.2(a): DISTRIBUTION OF SUBSEQUENT PRIMARIES IN RELATION TO FIRST PRIMARY SITE, 1968-2017

		Site of subsequent primary cancers															
Site of first primary cancer		C01-C02	C07-C08	C03-C06	C09-C10, C12-C14.2	C11	C15	C16	C17	C18	C19-C20	C22	C23 - C24	C25	C30-C31	C32	C33-C34
Tongue	C01- C02	0	0	8	12	2	19	11	2	8	7	2	0	2	0	9	25
Major salivary glands (includes parotid gland)	C07-C08	4	0	1	3	5	2	6	0	9	2	1	0	1	2	1	13
Mouth	C03-C06	9	0	3	6	0	15	9	0	8	8	3	1	2	2	7	28
Pharynx (incl. tonsils, oropharynx and hypopharynx)	C09-C10, C12-C14.2	9	0	6	4	5	26	4	0	7	6	9	0	1	0	3	34
Nasopharynx	C11	67	10	26	27	0	6	29	3	48	38	27	9	12	45	13	120
Oesophagus	C15	1	0	8	16	1	1	40	1	10	10	6	0	1	1	8	25
Stomach	C16	0	2	7	9	15	18	19	13	152	74	35	5	24	1	12	112
Small intestines	C17	0	0	0	0	1	0	4	0	12	5	1	0	4	0	0	7
Colon	C18	13	3	9	10	28	36	189	28	10	186	98	28	44	3	18	266
Rectosigmoid & rectum	C19-C20	5	0	5	8	15	23	97	15	123	13	64	12	22	2	19	189
Liver & intrahepatic bile ducts	C22	2	1	3	3	7	11	21	1	37	12	5	4	9	0	2	39
Gallbladder & extrahepatic bile ducts	C23 - C24	0	0	0	0	2	2	6	0	12	4	5	2	5	0	0	11
Pancreas	C25	1	1	2	1	1	0	8	2	7	7	4	1	2	0	0	9
Nasal cavity, middle ear & accessory sinuses	C30-C31	1	1	1	1	0	0	2	0	4	3	2	1	0	1	0	9
Larynx	C32	3	1	3	10	5	34	21	1	42	25	20	1	3	4	0	124
Lung (incl. trachea & bronchus)	C33-C34	9	2	5	14	18	23	57	7	74	39	23	7	10	4	18	6
Connective & soft tissues (incl. peripheral nerves)	C47 & C49	2	0	0	0	4	4	15	1	14	8	8	0	3	0	1	22
Non-melanoma skin	C44	10	14	9	13	12	20	125	8	183	80	65	16	38	4	22	259
Female breast	C50	8	20	17	1	31	31	139	15	285	126	65	29	63	3	1	272
Cervix uteri	C53	1	1	3	5	12	7	45	6	89	62	14	5	14	3	3	134
Corpus uteri	C54	1	2	1	1	4	1	24	5	81	47	19	11	16	1	3	68
Ovary & fallopian tube	C56 - C57.0	0	2	0	2	5	3	16	2	65	40	9	2	17	0	0	41
Vulva & vagina	C51-C52	1	0	0	0	0	0	4	0	8	3	2	0	0	0	1	3
Prostate	C61	3	2	7	7	18	17	83	5	149	69	56	14	30	2	15	174
Urinary bladder	C67	2	2	1	0	8	12	38	4	72	35	30	4	11	2	2	112
Kidney & other urinary organs	C64 - C66 & C68	1	3	4	2	5	3	34	2	44	23	21	9	17	0	2	53
Brain & Central Nervous System (CNS)	C70, C71-C72	0	1	1	0	0	1	2	0	7	6	1	0	6	1	0	5
Thyroid	C73	6	5	0	3	14	2	23	5	41	27	11	3	10	4	5	54
Lymphoid neoplasms	C81-C85, C88, C90-C91, C96	11	0	6	10	19	12	39	10	63	34	36	3	25	1	4	95
Myeloid neoplasms	C92-C93	2	1	3	1	2	5	12	1	25	14	20	2	5	2	6	39
Others & unspecified	OTHERS	2	1	2	1	6	7	33	3	35	10	23	1	12	0	4	74

Table 8.2(b): DISTRIBUTION OF SUBSEQUENT PRIMARIES IN RELATION TO FIRST PRIMARY SITE, 1968-2017

		Site of subsequent primary cancers														
Site of first primary cancer		C47 & C49	C44	C50	C53	C54	C56 - C57.0	C51-C52	C61	C67	C64 - C66 & C68	C70, C71-C72	C73	C81-C85, C88, C90-C91, C96	C92-C93	OTHERS
Tongue	C01- C02	1	7	6	1	1	1	1	6	1	3	1	3	2	1	3
Major salivary glands (includes parotid gland)	C07-C08	0	10	10	3	0	0	0	4	0	2	2	6	6	2	5
Mouth	C03-C06	0	12	2	2	1	0	0	4	3	1	1	3	2	2	6
Pharynx (incl. tonsils, oropharynx and hypopharynx)	C09-C10, C12-C14.2	0	12	4	0	0	0	0	4	4	4	0	4	6	1	4
Nasopharynx	C11	15	86	46	11	19	7	0	54	10	19	11	21	39	20	32
Oesophagus	C15	0	8	3	1	0	0	0	9	5	2	0	2	6	1	1
Stomach	C16	5	60	47	13	4	10	1	56	13	29	4	9	34	12	17
Small intestines	C17	0	3	0	0	1	5	1	3	0	2	0	3	7	2	1
Colon	C18	8	146	167	39	62	52	3	181	58	92	6	51	75	37	54
Rectosigmoid & rectum	C19-C20	7	78	110	15	38	15	3	111	42	53	6	22	53	22	34
Liver & intrahepatic bile ducts	C22	1	22	18	3	3	2	1	19	9	14	1	5	14	7	9
Gallbladder & extrahepatic bile ducts	C23 - C24	0	4	5	2	4	2	0	0	0	1	0	0	2	3	2
Pancreas	C25	0	2	11	0	0	2	0	4	0	5	0	2	2	2	2
Nasal cavity, middle ear & accessory sinuses	C30-C31	0	6	5	2	1	0	0	1	1	1	0	3	2	2	2
Larynx	C32	4	28	1	1	0	0	0	32	9	5	1	15	22	3	11
Lung (incl. trachea & bronchus)	C33-C34	7	45	46	5	11	12	0	57	29	28	1	27	34	15	18
Connective & soft tissues (incl. peripheral nerves)	C47 & C49	1	10	21	1	0	1	0	6	1	3	0	4	8	2	9
Non-melanoma skin	C44	9	0	113	18	20	13	6	140	52	36	5	31	85	20	67
Female breast	C50	29	153	7	86	311	193	23	0	35	66	18	101	121	56	57
Cervix uteri	C53	7	34	116	1	37	37	38	0	28	16	5	15	33	7	25
Corpus uteri	C54	6	24	180	8	2	239	3	0	12	24	2	23	16	9	15
Ovary & fallopian tube	C56 - C57.0	1	15	152	12	87	5	5	0	11	14	1	17	21	11	14
Vulva & vagina	C51-C52	0	5	9	6	2	2	0	0	2	4	0	3	1	0	2
Prostate	C61	9	89	0	0	0	0	0	2	60	50	4	12	82	27	38
Urinary bladder	C67	6	36	16	0	3	1	0	130	2	30	3	8	22	13	13
Kidney & other urinary organs	C64 - C66 & C68	3	36	25	1	2	7	2	53	64	3	4	12	19	7	15
Brain & Central Nervous System (CNS)	C70, C71-C72	1	6	11	0	1	0	0	3	1	7	3	5	6	2	3
Thyroid	C73	8	27	138	7	35	21	1	26	9	23	5	1	27	18	18
Lymphoid neoplasms	C81-C85, C88, C90-C91, C96	6	79	52	8	13	13	0	44	16	23	10	29	127	29	28
Myeloid neoplasms	C92-C93	0	20	30	4	3	3	1	13	6	10	1	5	27	49	9
Others & unspecified	OTHERS	6	44	36	4	8	7	3	22	14	17	5	17	27	12	16


Nasopharynx (Female)
100.0
80.0
60.0
40.0
20.0
0.0
1968-1972
1973-1977
1978-1982
1983-1987
1988-1992
1993-1997
1998-2002
5-year Age-Standardised Relative Survival
Age Standardised Mortality Rate

CHAPTER 9

COMMENTARY ON SELECTED CANCERS, 1968-2017

9.1 NASOPHARYNX (ICD-10: C11)

Nasopharyngeal cancer occurs in the cells lining the upper part of the throat behind the nose. Among males, nasopharyngeal cancer was one of the most commonly diagnosed cancers in the past fifty years, though its ranking fell from fourth place in 1968-1972 to tenth place in 2013-2017 (Table 5.1.2(a)). It was less common among females, appearing among the ten most frequent cancers only for 1968-1992, hovering at sixth to ninth place during each five-year period and falling out of the top ten cancers thereafter (Table 5.1.2(b)).

A downward trend in the ASIR of nasopharyngeal cancer for both genders was observed over the past fifty years – for males, the ASIR was reduced by half, from 15.0 to 7.5 per 100,000 population during this period; similarly for females, the ASIR fell from 6.1 to 2.6 per 100,000 population (Figure 9.1.1, Tables 9.1.1(a) and 9.1.1(b)). In 2013-2017, a total of 1,457 cases of nasopharyngeal cancer were diagnosed in the resident population - 1,079 cases among males (accounting for 3.1% of all cancers diagnosed among males) and 378 cases among females (accounting for 1.0% of all cancers diagnosed among females).

There was an overall increase in the male-to-female ratio of nasopharyngeal cancer from 2.5:1 in 1968-1972 to 2.9:1 in 2013-2017, with a peak of 3.2:1 in 2008-2012. Among the three major ethnic groups, the Chinese were noted to be at highest risk of nasopharyngeal cancer and of the six gender and ethnic-specific groups, Chinese males had the highest ASIR of nasopharyngeal cancer throughout all fifty years from 1968-2017. A possible risk factor is the common presence of salted and preserved foods (such as salted fish and vegetables) in the Chinese (particularly the Cantonese) diet, which are high in nitrosamines – carcinogenic compounds linked to nasopharyngeal cancer [76] [77]. The age-specific incidence rate of nasopharyngeal cancer was observed to rise with age, peaking at 50-59 years, before falling again thereafter (Figure 9.1.2).

As nasopharyngeal cancer became less common over the years, the ASMR also declined for both males and females (Figure 9.1.3, Tables 9.1.2(a) and 9.1.2(b)). The ASMR of nasopharyngeal cancer peaked at 10.3 and 3.6 per 100,000 population for males and females respectively in 1973-1977, before gradually declining to a low of 3.6 and 0.9 per 100,000 population respectively in 2013-2017. Nevertheless, nasopharyngeal cancer remained one of the ten most frequent causes of cancer deaths among males, ranking between fourth to eighth place in every five-year period (Table 6.2.2(a)). For females, it ranked among the top ten causes of cancer mortality up till 2003-2007, ranking between seventh to tenth place in every five-year period (Table 6.2.2(b)).

It is challenging to diagnose nasopharyngeal cancer due to its anatomic isolation and the variable non-specific symptoms – for instance, painless lumps in the neck, nosebleeds and hearing changes, resulting in individuals seeking medical treatment late [78]. On average, from 2008-2017, about three-quarters of diagnoses of nasopharyngeal cancer with known staging were diagnosed at Stage III or IV (Table 9.1.3). Nevertheless, the ASRS of nasopharyngeal cancer improved significantly for both males and females since 1973-1977 (Figures 9.1.4(a) and 9.1.4(b)). For males, the ASRS increased from 23.0% in 1973-1997 to 55.0% in 2013-2017; for females, it increased from 35.2% to 70.6% over the same period.

In comparison to selected countries in 'Cancer Incidence in Five Continents (Volume XI)' [64], in 2008-2012, Chinese males in Singapore were observed to have one of the highest ASIRs of nasopharyngeal cancer, surpassed only by Malaysia (Penang) and Hong Kong (Figure 9.1.5). A similar pattern was observed for Singapore Chinese females. Hawaiian Chinese were also observed to have higher ASIR of nasopharyngeal cancer compared to their Caucasian or African American counterparts in the USA. There is evidence of a genetic predisposition for nasopharyngeal cancer, that in combination with dietary factors, put Chinese at a higher risk for nasopharyngeal cancer. The cancer has been documented to be endemic in Asian countries like China, Hong Kong and Malaysia [76] [77].

Figure 9.1.1: AGE-STANDARDISED INCIDENCE RATE (PER 100,000 POPULATION) FOR NASOPHARYNGEAL CANCER BY GENDER AND FIVE-YEAR PERIOD, 1968-2017

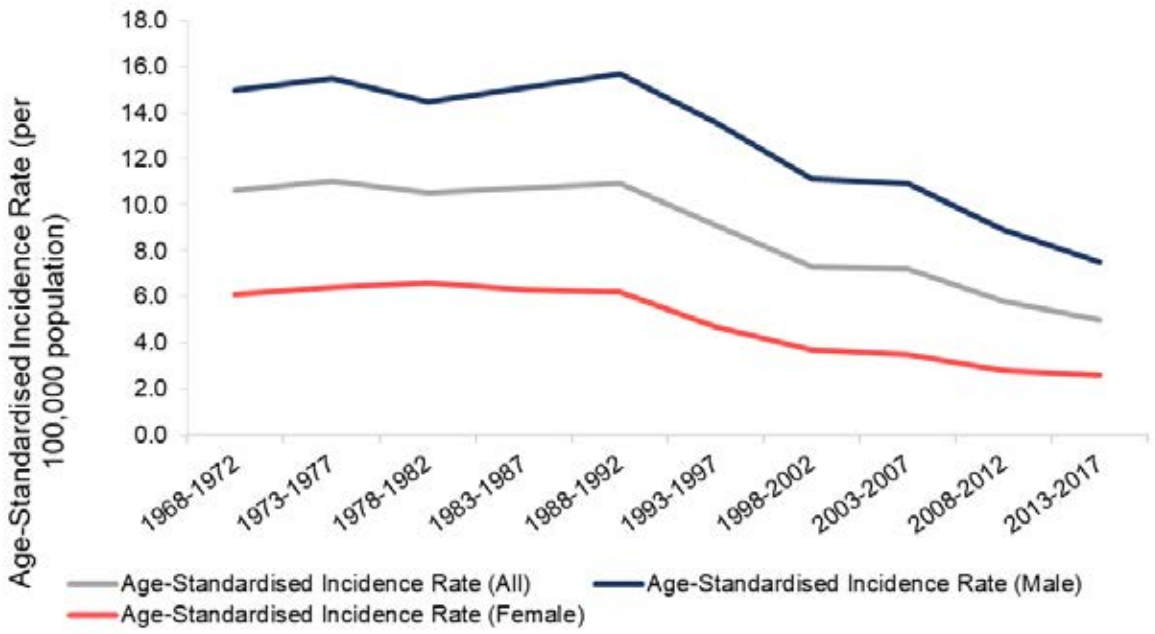


Table 9.1.1(a): INCIDENCE NUMBER AND RATE (PER 100,000 POPULATION) AND RELATIVE RISK FOR NASOPHARYNGEAL CANCER IN MALES BY ETHNICITY AND FIVE-YEAR PERIOD, 1968-2017

Period		1968-1972	1973-1977	1978-1982	1983-1987	1988-1992
All	Number (%)	569 (100.0%)	672 (100.0%)	705 (100.0%)	868 (100.0%)	1069 (100.0%)
	CIR	11.1	12.4	12.2	13.8	15.5
	ASIR	15.0	15.5	14.5	15.1	15.7
Chinese	Number (%)	538 (94.6%)	641 (95.4%)	679 (96.3%)	827 (95.3%)	1012 (94.7%)
	CIR	13.7	15.4	15.1	17.0	19.0
	ASIR	19.3	19.6	18.1	18.4	18.8
	RR	1.00	1.00	1.00	1.00	1.00
Malay	Number (%)	25 (4.4%)	26 (3.9%)	23 (3.3%)	30 (3.5%)	51 (4.8%)
	CIR	3.3	3.3	2.8	3.3	5.2
	ASIR	4.6	5.4	3.8	4.3	6.6
	RR and 95% CI	0.26 (0.18-0.37)	0.24 (0.16-0.36)	0.21 (0.14-0.31)	0.24 (0.16-0.35)	0.34 (0.25-0.47)
Indian	Number (%)	3 (0.5%)	3 (0.4%)	2 (0.3%)	5 (0.6%)	1 (0.1%)
	CIR	0.7	0.7	0.5	1.1	0.2
	ASIR	0.7	0.9	0.6	0.9	0.2
	RR and 95% CI	0.03 (0.01-0.09)	0.03 (0.01-0.09)	0.03 (0.00-0.16)	0.06 (0.02-0.14)	0.01 (0.00-0.06)
Period		**1993-1997**	**1998-2002**	**2003-2007**	**2008-2012**	**2013-2017**
All	Number (%)	1131 (100.0%)	1104 (100.0%)	1212 (100.0%)	1147 (100.0%)	1079 (100.0%)
	CIR	14.9	13.5	14.1	12.4	11.3
	ASIR	13.6	11.1	10.9	8.9	7.5
Chinese	Number (%)	1054 (93.2%)	1018 (92.2%)	1113 (91.8%)	1037 (90.4%)	965 (89.4%)
	CIR	18.1	16.3	17.1	15.2	13.6
	ASIR	16.0	12.9	12.6	10.3	8.7
	RR	1.00	1.00	1.00	1.00	1.00
Malay	Number (%)	60 (5.3%)	63 (5.7%)	84 (6.9%)	86 (7.5%)	90 (8.3%)
	CIR	5.6	5.5	7.0	6.9	6.9
	ASIR	6.6	5.6	6.9	6.1	5.4
	RR and 95% CI	0.39 (0.31-0.50)	0.43 (0.36-0.51)	0.52 (0.44-0.62)	0.57 (0.45-0.72)	0.64 (0.50-0.82)
Indian	Number (%)	9 (0.8%)	14 (1.3%)	8 (0.7%)	12 (1.0%)	14 (1.3%)
	CIR	1.5	2.1	1.1	1.4	1.5
	ASIR	1.3	1.8	1.1	1.1	1.2
	RR and 95% CI	0.08 (0.04-0.17)	0.14 (0.09-0.20)	0.07 (0.03-0.17)	0.11 (0.07-0.15)	0.13 (0.08-0.20)

Table 9.1.1(b): INCIDENCE NUMBER AND RATE (PER 100,000 POPULATION) AND RELATIVE RISK FOR NASOPHARYNGEAL CANCER IN FEMALES BY ETHNICITY AND FIVE-YEAR PERIOD, 1968-2017

Period		1968-1972	1973-1977	1978-1982	1983-1987	1988-1992
All	Number (%)	222 (100.0%)	274 (100.0%)	326 (100.0%)	374 (100.0%)	444 (100.0%)
	CIR	4.5	5.3	5.8	6.1	6.6
	ASIR	6.1	6.4	6.6	6.3	6.2
Chinese	Number (%)	218 (98.2%)	267 (97.4%)	314 (96.3%)	360 (96.3%)	423 (95.3%)
	CIR	5.7	6.5	7.1	7.5	8.0
	ASIR	7.3	7.5	7.8	7.4	7.3
	RR	1.00	1.00	1.00	1.00	1.00
Malay	Number (%)	3 (1.4%)	7 (2.6%)	8 (2.5%)	12 (3.2%)	19 (4.3%)
	CIR	0.4	0.9	1.0	1.4	2.0
	ASIR	0.6	1.5	1.4	1.4	2.0
	RR and 95% CI	0.09 (0.05-0.18)	0.18 (0.08-0.39)	0.17 (0.09-0.32)	0.23 (0.13-0.38)	0.31 (0.19-0.51)
Indian	Number (%)	0 (0.0%)	0 (0.0%)	2 (0.6%)	1 (0.3%)	1 (0.2%)
	CIR	0.0	0.0	0.6	0.3	0.2
	ASIR	0.0	0.0	1.5	0.2	0.6
	RR and 95% CI	0.00 (0.00-0.00)	0.00 (0.00-0.00)	0.10 (0.03-0.40)	0.04 (0.01-0.27)	0.03 (0.00-0.25)
Period		**1993-1997**	**1998-2002**	**2003-2007**	**2008-2012**	**2013-2017**
All	Number (%)	406 (100.0%)	381 (100.0%)	407 (100.0%)	369 (100.0%)	378 (100.0%)
	CIR	5.4	4.6	4.7	3.9	3.8
	ASIR	4.7	3.7	3.5	2.8	2.6
Chinese	Number (%)	385 (94.8%)	353 (92.7%)	385 (94.6%)	337 (91.3%)	341 (90.2%)
	CIR	6.6	5.6	5.8	4.8	4.6
	ASIR	5.5	4.2	4.1	3.3	2.9
	RR	1.00	1.00	1.00	1.00	1.00
Malay	Number (%)	19 (4.7%)	25 (6.6%)	17 (4.2%)	25 (6.8%)	31 (8.2%)
	CIR	1.8	2.2	1.4	2.0	2.4
	ASIR	2.0	2.2	1.4	1.5	1.9
	RR and 95% CI	0.34 (0.25-0.47)	0.48 (0.34-0.70)	0.30 (0.21-0.45)	0.50 (0.30-0.83)	0.61 (0.44-0.85)
Indian	Number (%)	1 (0.2%)	1 (0.3%)	2 (0.5%)	3 (0.8%)	2 (0.5%)
	CIR	0.2	0.2	0.3	0.4	0.2
	ASIR	0.1	0.1	0.3	0.3	0.2
	RR and 95% CI	0.03 (0.00-0.21)	0.03 (0.01-0.19)	0.06 (0.02-0.22)	0.10 (0.04-0.24)	0.06 (0.02-0.21)

Figure 9.1.2: AGE-SPECIFIC INCIDENCE RATE (PER 100,000 POPULATION) FOR NASOPHARYNGEAL CANCER BY AGE GROUP, 1968-1972, 1988-1992, 2013-2017

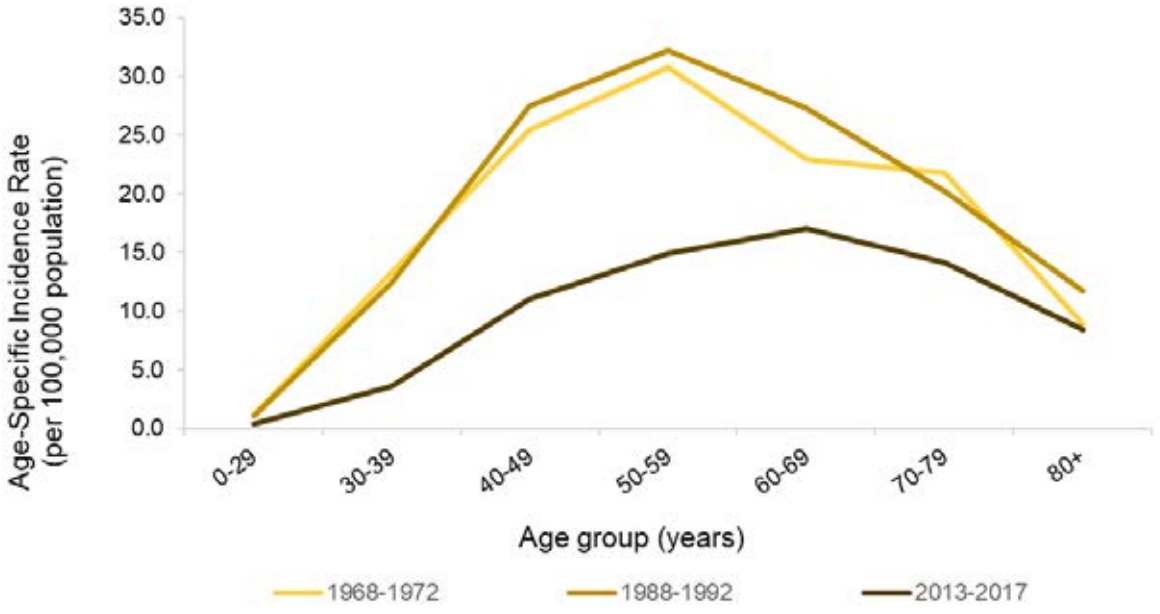


Figure 9.1.3: AGE-STANDARDISED MORTALITY RATE (PER 100,000 POPULATION) FOR NASOPHARYNGEAL CANCER BY GENDER AND FIVE-YEAR PERIOD, 1968-2017

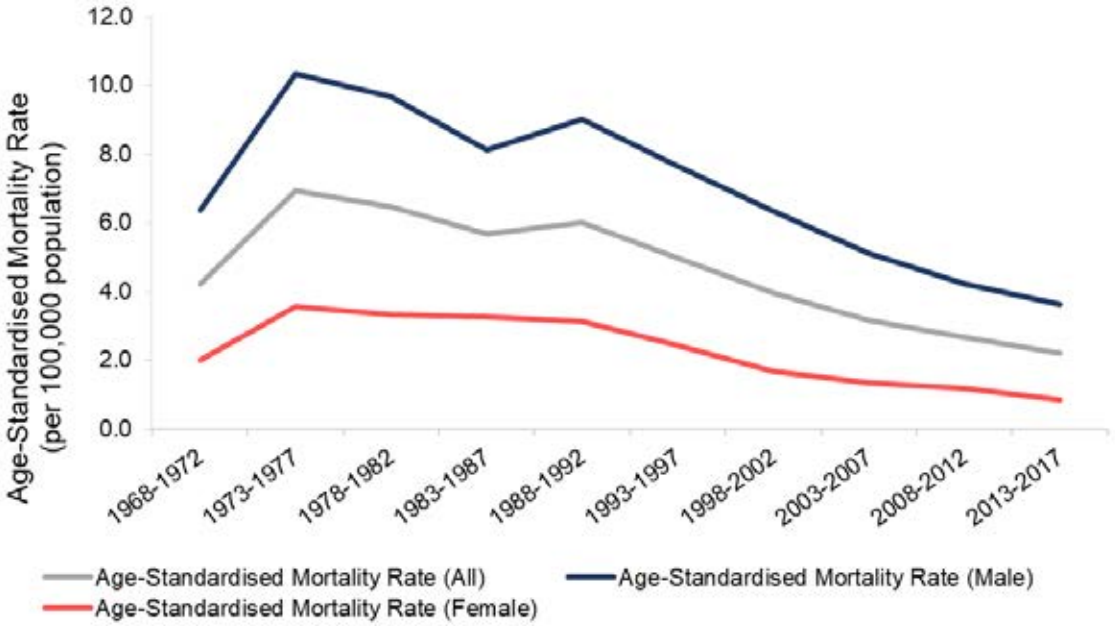


Table 9.1.2(a): MORTALITY NUMBER AND RATE (PER 100,000 POPULATION) FOR NASOPHARYNGEAL CANCER IN MALES BY ETHNICITY AND FIVE-YEAR PERIOD, 1968-2017

Period		1968-1972	1973-1977	1978-1982	1983-1987	1988-1992
All	Number (%)	224 (100.0%)	417 (100.0%)	444 (100.0%)	442 (100.0%)	568 (100.0%)
	CMR	4.3	7.7	7.6	7.0	8.2
	ASMR	6.4	10.3	9.7	8.1	9.0
Chinese	Number (%)	216 (96.4%)	395 (94.7%)	418 (94.1%)	418 (94.6%)	535 (94.2%)
	CMR	5.5	9.5	9.3	8.6	10.0
	ASMR	8.2	13.0	11.8	10.0	10.9
Malay	Number (%)	5 (2.2%)	18 (4.3%)	21 (4.7%)	18 (4.1%)	28 (4.9%)
	CMR	0.7	2.3	2.5	2.0	2.9
	ASMR	1.3	3.6	3.8	2.6	3.5
Indian	Number (%)	3 (1.3%)	2 (0.5%)	5 (1.1%)	2 (0.5%)	4 (0.7%)
	CMR	0.7	0.5	1.2	0.4	0.8
	ASMR	0.5	0.6	1.8	0.4	0.8
Period		**1993-1997**	**1998-2002**	**2003-2007**	**2008-2012**	**2013-2017**
All	Number (%)	591 (100.0%)	575 (100.0%)	543 (100.0%)	533 (100.0%)	546 (100.0%)
	CMR	7.8	7.0	6.3	5.8	5.7
	ASMR	7.6	6.3	5.1	4.2	3.6
Chinese	Number (%)	551 (93.2%)	526 (91.5%)	491 (90.4%)	482 (90.4%)	481 (88.1%)
	CMR	9.4	8.4	7.6	7.1	6.8
	ASMR	9.0	7.3	5.8	4.8	4.1
Malay	Number (%)	28 (4.7%)	33 (5.7%)	43 (7.9%)	40 (7.5%)	61 (11.2%)
	CMR	2.6	2.9	3.6	3.2	4.7
	ASMR	3.5	3.3	3.6	2.9	3.7
Indian	Number (%)	3 (0.5%)	9 (1.6%)	5 (0.9%)	8 (1.5%)	4 (0.7%)
	CMR	0.5	1.3	0.7	0.9	0.4
	ASMR	0.5	1.4	0.7	1.0	0.4

Table 9.1.2(b): MORTALITY NUMBER AND RATE (PER 100,000 POPULATION) FOR NASOPHARYNGEAL CANCER IN FEMALES BY ETHNICITY AND FIVE-YEAR PERIOD, 1968-2017

Period		1968-1972	1973-1977	1978-1982	1983-1987	1988-1992
All	Number (%)	70 (100.0%)	140 (100.0%)	162 (100.0%)	182 (100.0%)	209 (100.0%)
	CMR	1.4	2.7	2.9	3.0	3.1
	ASMR	2.0	3.6	3.3	3.3	3.1
Chinese	Number (%)	69 (98.6%)	136 (97.1%)	157 (96.9%)	172 (94.5%)	199 (95.2%)
	CMR	1.8	3.3	3.5	3.6	3.8
	ASMR	2.4	4.1	3.9	3.7	3.6
Malay	Number (%)	0 (0.0%)	3 (2.1%)	3 (1.9%)	7 (3.8%)	9 (4.3%)
	CMR	0.0	0.4	0.4	0.8	1.0
	ASMR	0.0	0.8	0.4	1.1	1.0
Indian	Number (%)	0 (0.0%)	0 (0.0%)	2 (1.2%)	1 (0.5%)	1 (0.5%)
	CMR	0.0	0.0	0.6	0.3	0.2
	ASMR	0.0	0.0	1.8	0.5	0.5
Period		**1993-1997**	**1998-2002**	**2003-2007**	**2008-2012**	**2013-2017**
All	Number (%)	202 (100.0%)	166 (100.0%)	155 (100.0%)	165 (100.0%)	138 (100.0%)
	CMR	2.7	2.0	1.8	1.7	1.4
	ASMR	2.4	1.7	1.3	1.2	0.9
Chinese	Number (%)	189 (93.6%)	150 (90.4%)	148 (95.5%)	148 (89.7%)	124 (89.9%)
	CMR	3.2	2.4	2.2	2.1	1.7
	ASMR	2.8	1.9	1.6	1.3	1.0
Malay	Number (%)	10 (5.0%)	14 (8.4%)	6 (3.9%)	11 (6.7%)	12 (8.7%)
	CMR	1.0	1.2	0.5	0.9	0.9
	ASMR	1.0	1.3	0.5	0.7	0.7
Indian	Number (%)	2 (1.0%)	1 (0.6%)	0 (0.0%)	2 (1.2%)	2 (1.4%)
	CMR	0.4	0.2	0.0	0.2	0.2
	ASMR	0.7	0.1	0.0	0.2	0.2

Figure 9.1.4(a): TRENDS IN AGE-STANDARDISED INCIDENCE RATE (PER 100,000 POPULATION), AGE-STANDARDISED MORTALITY RATE (PER 100,000 POPULATION), AND FIVE-YEAR AGE-STANDARDISED RELATIVE SURVIVAL RATE (%) FOR NASOPHARYNGEAL CANCER IN MALES BY FIVE-YEAR PERIOD, 1968-2017

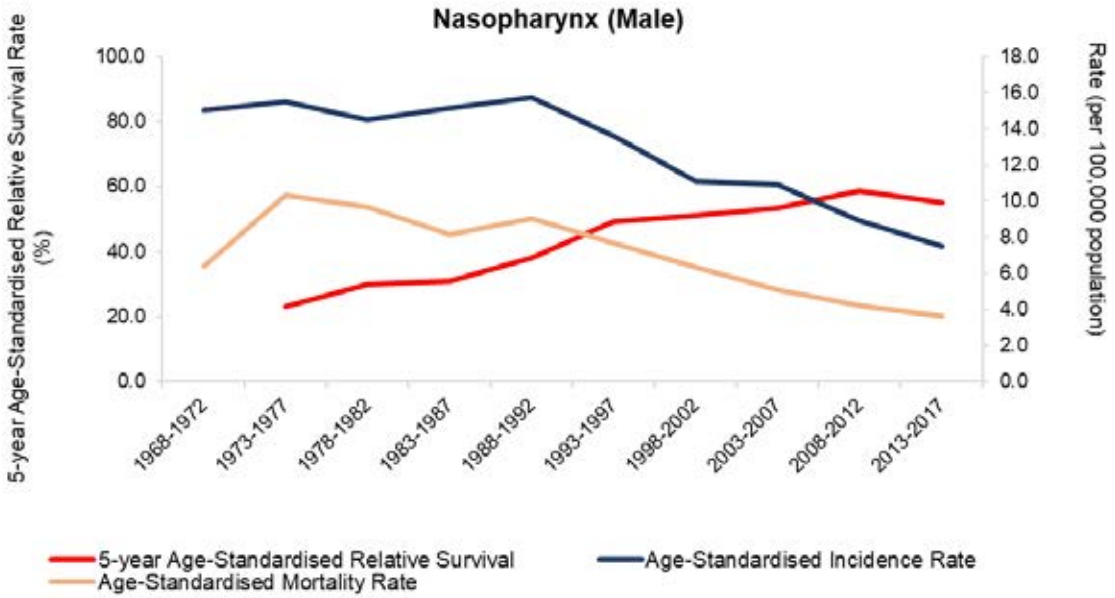


Figure 9.1.4(b): TRENDS IN AGE-STANDARDISED INCIDENCE RATE (PER 100,000 POPULATION), AGE-STANDARDISED MORTALITY RATE (PER 100,000 POPULATION), AND FIVE-YEAR AGE-STANDARDISED RELATIVE SURVIVAL RATE (%) FOR NASOPHARYNGEAL CANCER IN FEMALES BY FIVE-YEAR PERIOD, 1968-2017

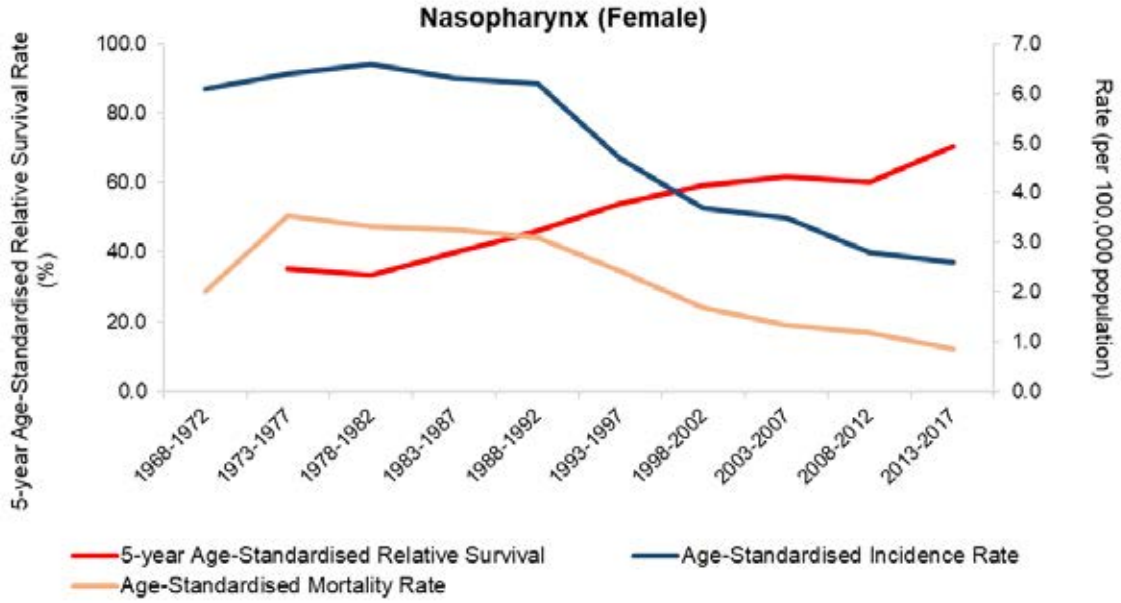
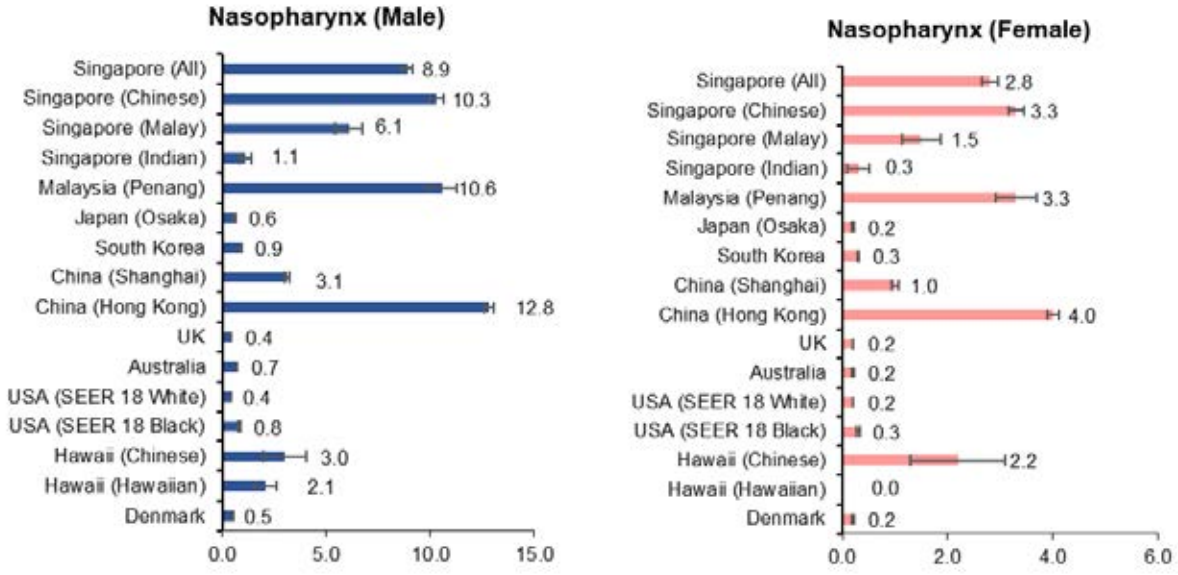


Table 9.1.3: STAGE DISTRIBUTION OF NASOPHARYNGEAL CANCER, 2008-2017

Year	Stage I		Stage II		Stage III		Stage IV	
	Number	%	Number	%	Number	%	Number	%
2008	18	6.5	53	19.1	88	31.8	118	42.6
2009	23	8.0	61	21.2	91	31.6	113	39.2
2010	16	5.9	38	14.1	95	35.2	121	44.8
2011	11	3.9	42	15.1	93	33.3	133	47.7
2012	17	6.3	42	15.4	91	33.5	122	44.9
2013	22	8.2	38	14.1	88	32.7	121	45.0
2014	20	7.5	44	16.4	85	31.7	119	44.4
2015	17	7.4	46	20.0	65	28.3	102	44.3
2016	12	4.1	55	18.9	87	29.9	137	47.1
2017	18	7.3	43	17.5	62	25.2	123	50.0

Figure 9.1.5: AGE-STANDARDISED INCIDENCE RATE (PER 100,000 POPULATION) FOR NASOPHARYNGEAL CANCER IN SELECTED COUNTRIES, 2008-2012



9.2 STOMACH (ICD-10:C16)

In Singapore, stomach cancer was once among the top three leading cancers for both genders in 1968-1972 (Tables 5.1.2(a) and 5.1.2(b)). In 2013-2017, it fell to being the seventh most common cancer among males (1,551 cases, accounting for 4.5% of all cancers diagnosed among males) and the ninth among females (1,147 cases, accounting for 3.1% of all cancers diagnosed among females). Stomach cancer accounted for a higher percentage of cancer deaths than its percentage among all incident cancers; this was due to its relatively lower survival rate. In 2013-2017, it was the fifth leading cause of cancer deaths among males (867 deaths, accounting for 5.7% of all cancer deaths among males) and the sixth among females (679 deaths, accounting for 5.4% of all cancer deaths among females) (Tables 6.2.2(a) and 6.2.2(b)).

Over the past fifty years, the ASIR of stomach cancer declined significantly, with a steeper decline observed among males (Figure 9.2.1). This was likely due to various factors including changes in dietary patterns (usage of refrigerators led to increased availability of fresh food and less reliance on salted and preserved food), and reduced prevalence of *Helicobacter pylori* (*H. pylori*) infection due to improved public health measures and serendipitous eradication of the infection [79] [80]. The ASIR was consistently higher among males for the past fifty years, although a narrowing of the gender gap over the years was observed – the male-to-female ratio for the ASIR decreased from 2.2:1 in 1968-1972 to 1.6:1 in 2013-2017. The Chinese had the highest risk of developing stomach cancer compared to the Malays and Indians for both genders (Tables 9.2.1(a) and 9.2.1(b)). In 2013-2017, the age-adjusted relative risk was 0.53 (95% CI: 0.43-0.66) for Malay males and 0.64 (95% CI: 0.47-0.87) for Indian males, and the relative risk was 0.46 (95% CI: 0.33-0.65) for Malay females and 0.59 (95% CI: 0.39-0.89) for Indian females. Studies found that the seroprevalence rate of H. pylori infection was similar between the Chinese and Indians, but much lower among the Malays. The ethnic difference in the incidence rate between the Chinese and Malays probably mirrored the difference in *H. pylori* infection. However, the Indians had high *H. pylori* infection but low incidence rate. This might be explained by host susceptibility and concomitant environmental factors such as diet and smoking [81] [82]. The risk of developing stomach cancer increased with age, and it was observed to peak among those in the oldest age band in 2013-2017 (Figure 9.2.2). In 2013-2017, 23.2% of stomach cancer occurred among those aged 80 years and above.

In line with the declining ASIR of stomach cancer, the ASMR also gradually decreased from 1973-1977 onwards for both genders (Figure 9.2.3). The mortality rate of stomach cancer closely mirrored the incidence rate for both genders (Figures 9.2.4(a)

and 9.2.4(b)), pointing to the high case fatality rate of stomach cancer. However, moderate improvements in the five-year ASRS were observed in the past decades - from 4.8% in 1973-1977 to 32.2% in 2013-2017 for males and from 6.4% to 35.3% for females during the same period. As most early-stage stomach cancers are asymptomatic, patients are frequently diagnosed at advanced stages [83]. In 2017, 58.2% of the cases were diagnosed at Stages III-IV, a decrease from 70% in 2008 (Table 9.2.3). For stomach cancer diagnosed at late stages, the five-year ASRS was much lower (below 40.0% for Stages III-IV), compared with cases diagnosed at earlier stages (above 68.0% for Stages I-II).

The ASIR of stomach cancer (2008-2012) in Singapore for both genders were much lower than those in Japan, South Korea and China (Shanghai), but higher than those in UK, Australia, USA and Denmark (Figure 9.2.5). Based on the data from 'Global Surveillance of Trends in Cancer Survival 2000-14 (CONCORD-3)' [45], the age-standardised five-year net survival (2010-2014) of stomach cancer in Singapore was comparable to those in Malaysia (Penang), Australia and USA, but lower than those in Japan and South Korea (Figure 9.2.6). The high survival rates in Japan and Korea were partly attributable to the intense screening practice through national endoscopic screening programmes which led to early detection of stomach cancer [84].

Figure 9.2.1: AGE-STANDARDISED INCIDENCE RATE (PER 100,000 POPULATION) FOR STOMACH CANCER BY GENDER AND FIVE-YEAR PERIOD, 1968-2017

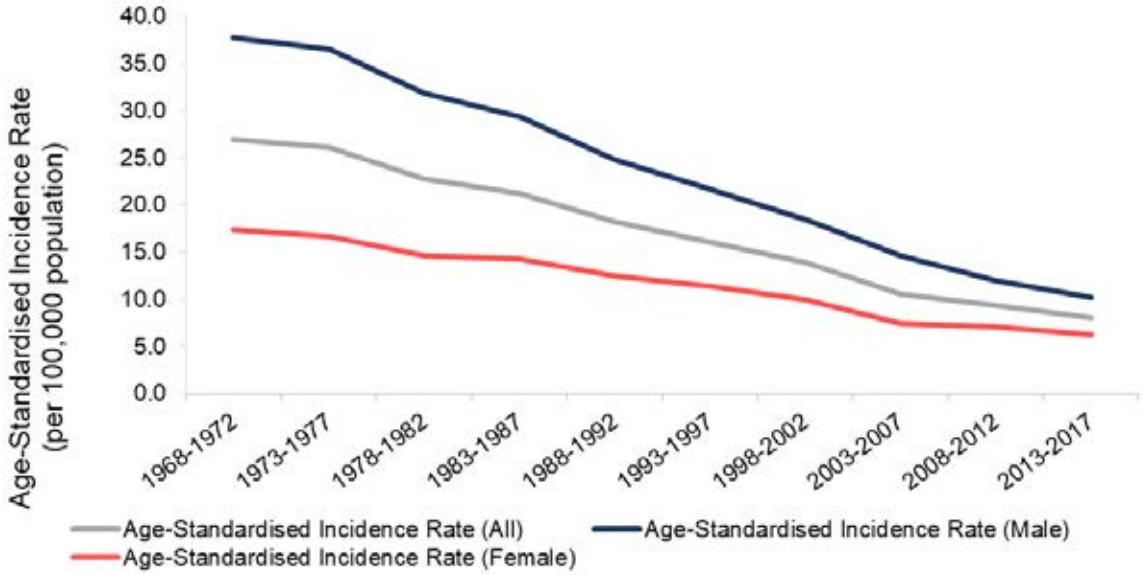


Table 9.2.1(a): INCIDENCE NUMBER AND RATE (PER 100,000 POPULATION) AND RELATIVE RISK FOR STOMACH CANCER IN MALES BY ETHNICITY AND FIVE-YEAR PERIOD, 1968-2017

Period		1968-1972	1973-1977	1978-1982	1983-1987	1988-1992
All	Number (%)	1094 (100.0%)	1216 (100.0%)	1233 (100.0%)	1334 (100.0%)	1374 (100.0%)
	CIR	21.3	22.5	21.3	21.2	19.9
	ASIR	37.7	36.5	31.8	29.3	24.8
Chinese	Number (%)	1002 (91.6%)	1105 (90.9%)	1129 (91.6%)	1220 (91.5%)	1251 (91.0%)
	CIR	25.6	26.6	25.1	25.1	23.5
	ASIR	43.7	42.3	37.5	34.7	29.7
	RR	1.00	1.00	1.00	1.00	1.00
Malay	Number (%)	33 (3.0%)	36 (3.0%)	41 (3.3%)	33 (2.5%)	56 (4.1%)
	CIR	4.3	4.6	4.9	3.7	5.7
	ASIR	10.2	9.7	9.7	6.0	8.3
	RR and 95% CI	0.23 (0.15-0.35)	0.22 (0.16-0.32)	0.23 (0.15-0.36)	0.17 (0.13-0.23)	0.29 (0.25-0.34)
Indian	Number (%)	54 (4.9%)	73 (6.0%)	56 (4.5%)	70 (5.2%)	57 (4.1%)
	CIR	12.7	18.0	13.7	15.3	11.0
	ASIR	20.5	22.6	16.0	15.8	10.1
	RR and 95% CI	0.41 (0.32-0.52)	0.56 (0.45-0.69)	0.41 (0.34-0.50)	0.46 (0.38-0.56)	0.34 (0.25-0.46)
Period		**1993-1997**	**1998-2002**	**2003-2007**	**2008-2012**	**2013-2017**
All	Number (%)	1442 (100.0%)	1452 (100.0%)	1380 (100.0%)	1450 (100.0%)	1551 (100.0%)
	CIR	19.0	17.7	16.0	15.7	16.2
	ASIR	21.7	18.5	14.6	12.0	10.2
Chinese	Number (%)	1325 (91.9%)	1319 (90.8%)	1241 (89.9%)	1299 (89.6%)	1367 (88.1%)
	CIR	22.7	21.1	19.1	19.0	19.3
	ASIR	26.1	21.9	16.5	13.4	11.0
	RR	1.00	1.00	1.00	1.00	1.00
Malay	Number (%)	52 (3.6%)	63 (4.3%)	53 (3.8%)	56 (3.9%)	89 (5.7%)
	CIR	4.9	5.5	4.4	4.5	6.9
	ASIR	6.6	6.5	5.0	4.5	5.7
	RR and 95% CI	0.26 (0.19-0.36)	0.33 (0.25-0.43)	0.32 (0.23-0.43)	0.34 (0.27-0.44)	0.53 (0.43-0.66)
Indian	Number (%)	57 (4.0%)	62 (4.3%)	70 (5.1%)	78 (5.4%)	77 (5.0%)
	CIR	9.7	9.2	9.4	8.8	8.5
	ASIR	8.5	7.9	9.4	8.5	6.7
	RR and 95% CI	0.32 (0.24-0.43)	0.35 (0.27-0.46)	0.55 (0.41-0.74)	0.65 (0.49-0.85)	0.64 (0.47-0.87)

Table 9.2.1(b): INCIDENCE NUMBER AND RATE (PER 100,000 POPULATION) AND RELATIVE RISK FOR STOMACH CANCER IN FEMALES BY ETHNICITY AND FIVE-YEAR PERIOD, 1968-2017

Period		1968-1972	1973-1977	1978-1982	1983-1987	1988-1992
All	Number (%)	542 (100.0%)	610 (100.0%)	643 (100.0%)	772 (100.0%)	826 (100.0%)
	CIR	11.1	11.7	11.4	12.6	12.3
	ASIR	17.4	16.6	14.6	14.3	12.5
Chinese	Number (%)	492 (90.8%)	568 (93.1%)	583 (90.7%)	719 (93.1%)	766 (92.7%)
	CIR	12.8	13.9	13.1	15.0	14.5
	ASIR	18.1	17.8	15.3	15.6	13.6
	RR	1.00	1.00	1.00	1.00	1.00
Malay	Number (%)	31 (5.7%)	24 (3.9%)	28 (4.4%)	29 (3.8%)	35 (4.2%)
	CIR	4.2	3.2	3.5	3.4	3.7
	ASIR	9.4	7.3	6.6	5.3	5.4
	RR and 95% CI	0.60 (0.41-0.89)	0.40 (0.32-0.51)	0.45 (0.28-0.71)	0.37 (0.27-0.49)	0.41 (0.30-0.55)
Indian	Number (%)	16 (3.0%)	12 (2.0%)	21 (3.3%)	17 (2.2%)	23 (2.8%)
	CIR	5.7	4.1	6.6	4.5	5.2
	ASIR	19.5	9.4	15.9	9.1	7.7
	RR and 95% CI	1.00 (0.66-1.50)	0.62 (0.37-1.02)	0.94 (0.60-1.49)	0.54 (0.34-0.85)	0.61 (0.45-0.83)
Period		**1993-1997**	**1998-2002**	**2003-2007**	**2008-2012**	**2013-2017**
All	Number (%)	917 (100.0%)	969 (100.0%)	891 (100.0%)	1075 (100.0%)	1147 (100.0%)
	CIR	12.2	11.8	10.2	11.3	11.5
	ASIR	11.4	10.0	7.4	7.1	6.2
Chinese	Number (%)	850 (92.7%)	886 (91.4%)	817 (91.7%)	971 (90.3%)	1026 (89.5%)
	CIR	14.6	14.0	12.3	13.7	13.8
	ASIR	12.6	10.9	9.2	7.7	6.7
	RR	1.00	1.00	1.00	1.00	1.00
Malay	Number (%)	34 (3.7%)	42 (4.3%)	35 (3.9%)	58 (5.4%)	56 (4.9%)
	CIR	3.3	3.7	2.9	4.6	4.3
	ASIR	4.1	3.8	2.7	4.1	3.1
	RR and 95% CI	0.35 (0.26-0.47)	0.41 (0.27-0.64)	0.36 (0.27-0.50)	0.52 (0.43-0.62)	0.46 (0.33-0.65)
Indian	Number (%)	25 (2.7%)	34 (3.5%)	32 (3.6%)	35 (3.3%)	44 (3.8%)
	CIR	4.8	5.5	4.5	4.2	5.1
	ASIR	7.3	6.1	4.9	4.0	4.0
	RR and 95% CI	0.53 (0.38-0.72)	0.62 (0.44-0.87)	0.60 (0.47-0.77)	0.53 (0.42-0.68)	0.59 (0.39-0.89)

Figure 9.2.2: AGE-SPECIFIC INCIDENCE RATE (PER 100,000 POPULATION) FOR STOMACH CANCER BY AGE GROUP, 1968-1972, 1988-1992, 2013-2017

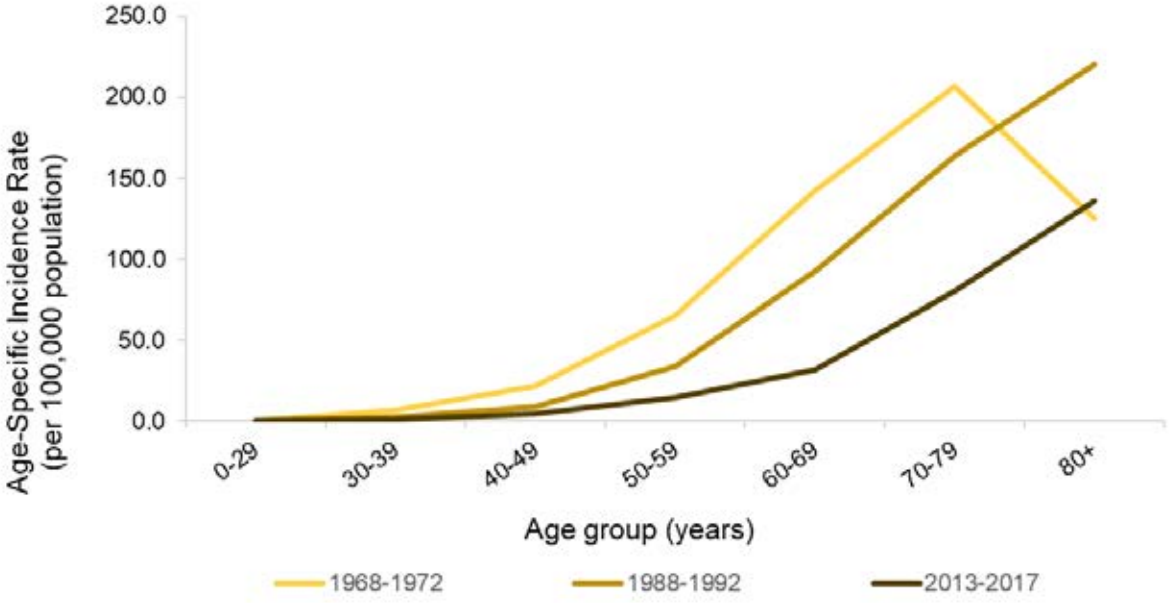


Figure 9.2.3: AGE-STANDARDISED MORTALITY RATE (PER 100,000 POPULATION) FOR STOMACH CANCER BY GENDER AND FIVE-YEAR PERIOD, 1968-2017

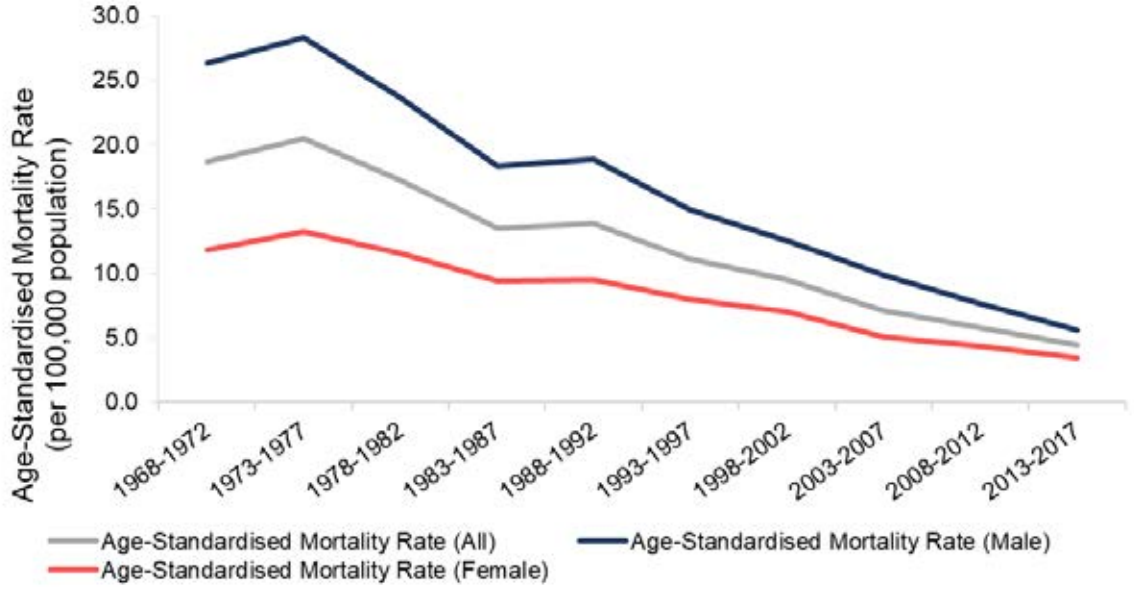


Table 9.2.2(a): MORTALITY NUMBER AND RATE (PER 100,000 POPULATION) FOR STOMACH CANCER IN MALES BY ETHNICITY AND FIVE-YEAR PERIOD, 1968-2017

Period		1968-1972	1973-1977	1978-1982	1983-1987	1988-1992
All	Number (%)	768 (100.0%)	938 (100.0%)	911 (100.0%)	835 (100.0%)	1050 (100.0%)
	CMR	14.9	17.3	15.7	13.3	15.2
	ASMR	26.4	28.3	23.7	18.3	18.9
Chinese	Number (%)	703 (91.5%)	868 (92.5%)	843 (92.5%)	762 (91.3%)	958 (91.2%)
	CMR	18.0	20.9	18.7	15.6	18.0
	ASMR	30.6	33.6	28.0	21.6	22.7
Malay	Number (%)	30 (3.9%)	28 (3.0%)	31 (3.4%)	28 (3.4%)	50 (4.8%)
	CMR	3.9	3.6	3.7	3.1	5.1
	ASMR	9.1	7.4	7.8	5.2	7.4
Indian	Number (%)	32 (4.2%)	39 (4.2%)	33 (3.6%)	39 (4.7%)	35 (3.3%)
	CMR	7.5	9.6	8.1	8.5	6.7
	ASMR	15.5	12.1	10.3	9.2	6.7
Period		**1993-1997**	**1998-2002**	**2003-2007**	**2008-2012**	**2013-2017**
All	Number (%)	992 (100.0%)	988 (100.0%)	925 (100.0%)	924 (100.0%)	867 (100.0%)
	CMR	13.1	12.1	10.7	10.0	9.0
	ASMR	14.9	12.5	9.8	7.7	5.6
Chinese	Number (%)	905 (91.2%)	903 (91.4%)	838 (90.6%)	825 (89.3%)	767 (88.5%)
	CMR	15.5	14.4	12.9	12.1	10.8
	ASMR	17.7	14.9	11.2	8.5	6.1
Malay	Number (%)	37 (3.7%)	40 (4.0%)	40 (4.3%)	39 (4.2%)	50 (5.8%)
	CMR	3.5	3.5	3.3	3.1	3.9
	ASMR	4.7	4.1	3.6	3.1	3.1
Indian	Number (%)	40 (4.0%)	35 (3.5%)	41 (4.4%)	55 (6.0%)	41 (4.7%)
	CMR	6.8	5.2	5.5	6.2	4.5
	ASMR	5.8	4.9	5.2	5.9	3.6

Table 9.2.2(b): MORTALITY NUMBER AND RATE (PER 100,000 POPULATION) FOR STOMACH CANCER IN FEMALES BY ETHNICITY AND FIVE-YEAR PERIOD, 1968-2017

Period		1968-1972	1973-1977	1978-1982	1983-1987	1988-1992
All	Number (%)	371 (100.0%)	485 (100.0%)	510 (100.0%)	511 (100.0%)	637 (100.0%)
	CMR	7.5	9.3	9.1	8.4	9.5
	ASMR	11.8	13.2	11.5	9.4	9.5
Chinese	Number (%)	332 (89.5%)	448 (92.4%)	466 (91.4%)	466 (91.2%)	577 (90.6%)
	CMR	8.6	10.9	10.5	9.7	11.0
	ASMR	12.2	14.0	12.2	10.0	10.1
Malay	Number (%)	24 (6.5%)	18 (3.7%)	20 (3.9%)	25 (4.9%)	40 (6.3%)
	CMR	3.3	2.4	2.5	2.9	4.2
	ASMR	6.7	5.7	4.4	4.6	6.3
Indian	Number (%)	11 (3.0%)	16 (3.3%)	18 (3.5%)	15 (2.9%)	19 (3.0%)
	CMR	3.9	5.5	5.6	4.0	4.3
	ASMR	13.5	13.0	13.8	7.9	6.7
Period		**1993-1997**	**1998-2002**	**2003-2007**	**2008-2012**	**2013-2017**
All	Number (%)	648 (100.0%)	699 (100.0%)	622 (100.0%)	688 (100.0%)	679 (100.0%)
	CMR	8.6	8.5	7.1	7.2	6.8
	ASMR	8.0	7.0	5.0	4.4	3.5
Chinese	Number (%)	596 (92.0%)	641 (91.7%)	575 (92.4%)	620 (90.1%)	620 (91.3%)
	CMR	10.2	10.1	8.6	8.7	8.4
	ASMR	8.8	7.6	5.6	4.7	3.8
Malay	Number (%)	25 (3.9%)	31 (4.4%)	29 (4.7%)	33 (4.8%)	34 (5.0%)
	CMR	2.4	2.7	2.4	2.6	2.6
	ASMR	3.1	2.8	2.3	2.2	1.9
Indian	Number (%)	22 (3.4%)	21 (3.0%)	15 (2.4%)	30 (4.4%)	19 (2.8%)
	CMR	4.2	3.4	2.1	3.6	2.2
	ASMR	6.0	3.7	2.4	3.5	1.7

Figure 9.2.4(a): TRENDS IN AGE-STANDARDISED INCIDENCE RATE (PER 100,000 POPULATION), AGE-STANDARDISED MORTALITY RATE (PER 100,000 POPULATION), AND FIVE-YEAR AGE-STANDARDISED RELATIVE SURVIVAL RATE (%) FOR STOMACH CANCER IN MALES BY FIVE-YEAR PERIOD, 1968-2017

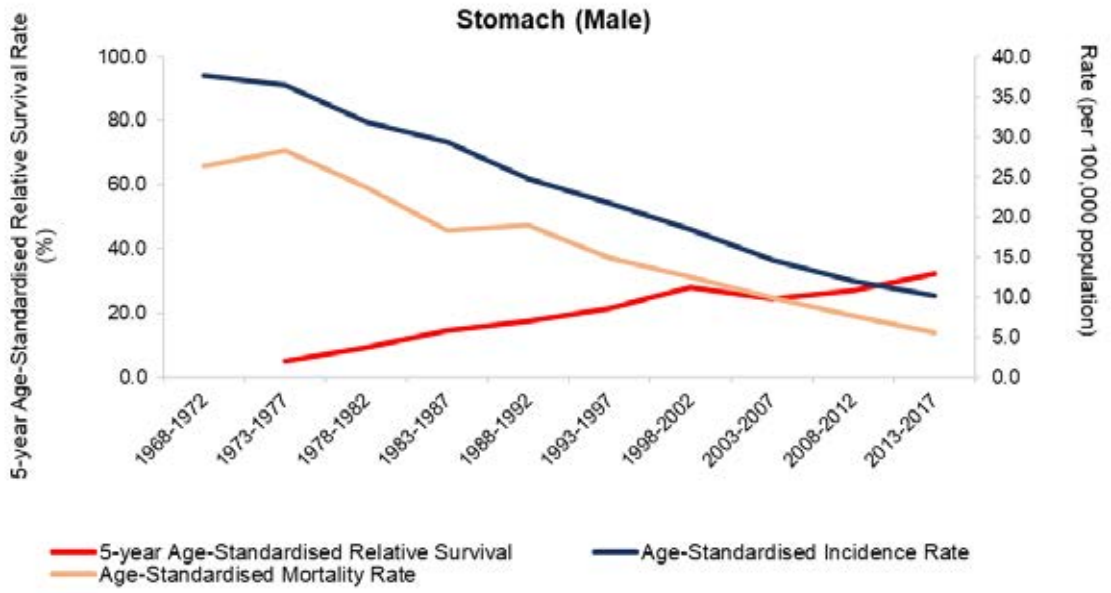


Figure 9.2.4(b): TRENDS IN AGE-STANDARDISED INCIDENCE RATE (PER 100,000 POPULATION), AGE-STANDARDISED MORTALITY RATE (PER 100,000 POPULATION), AND FIVE-YEAR AGE-STANDARDISED RELATIVE SURVIVAL RATE (%) FOR STOMACH CANCER IN FEMALES BY FIVE-YEAR PERIOD, 1968-2017

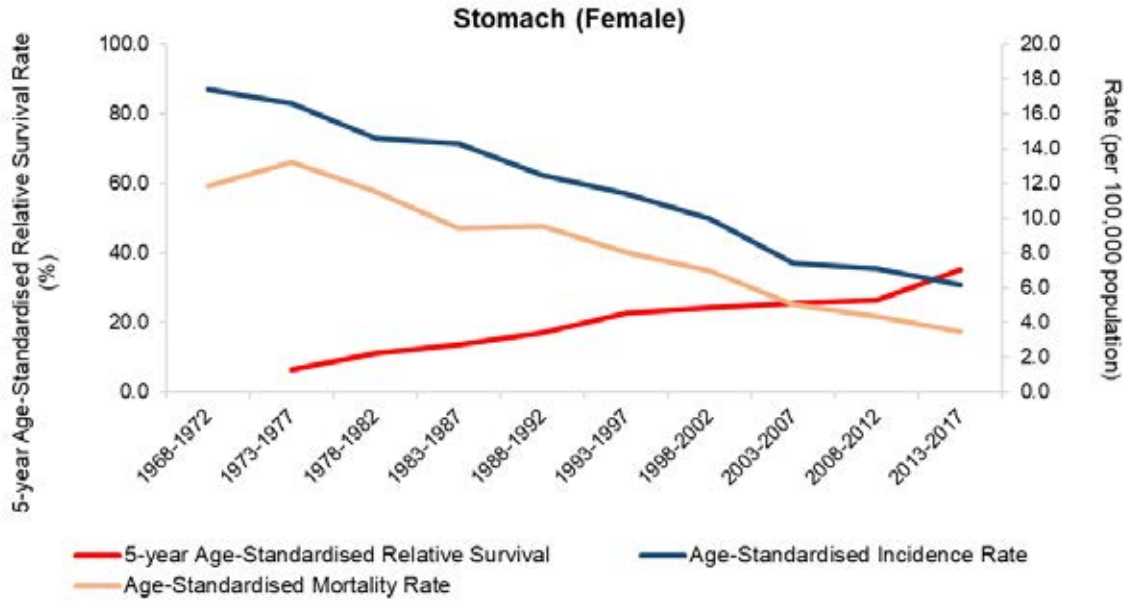


Table 9.2.3: STAGE DISTRIBUTION OF STOMACH CANCER, 2008-2017

Year	Stage I		Stage II		Stage III		Stage IV	
	Number	%	Number	%	Number	%	Number	%
2008	67	18.5	42	11.6	74	20.4	180	49.6
2009	73	20.0	29	7.9	61	16.7	202	55.3
2010	57	15.0	58	15.2	118	31.0	148	38.8
2011	69	18.2	40	10.5	91	23.9	180	47.4
2012	70	16.2	44	10.2	118	27.3	200	46.3
2013	66	17.2	45	11.7	96	25.0	177	46.1
2014	81	19.4	55	13.2	104	24.9	177	42.4
2015	99	22.2	53	11.9	98	22.0	195	43.8
2016	127	26.7	59	12.4	91	19.1	199	41.8
2017	115	28.3	55	13.5	86	21.1	151	37.1

Figure 9.2.5: AGE-STANDARDISED INCIDENCE RATE (PER 100,000 POPULATION) FOR STOMACH CANCER IN SELECTED COUNTRIES, 2008-2012

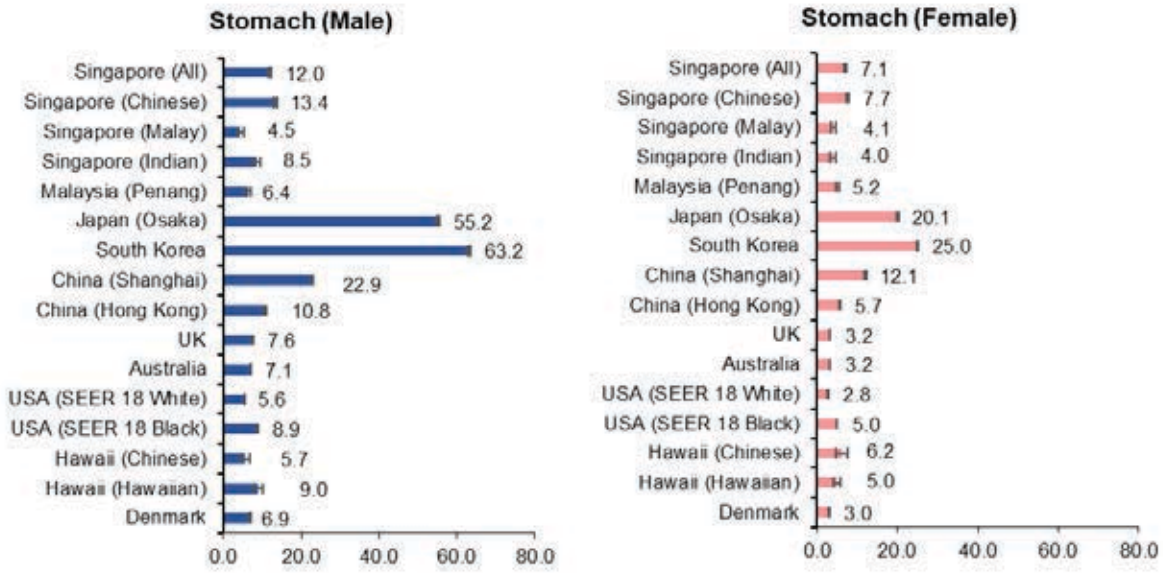
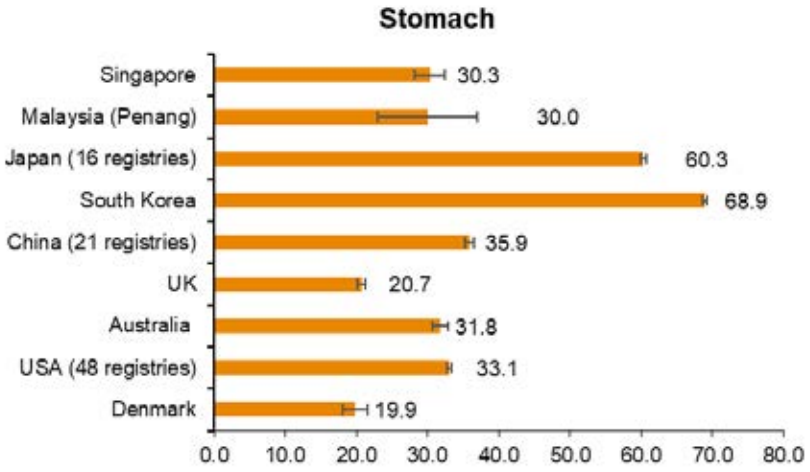


Figure 9.2.6: FIVE-YEAR AGE-STANDARDISED NET SURVIVAL (%) FOR STOMACH CANCER IN SELECTED COUNTRIES, 2010-2014



9.3 COLON & RECTUM (ICD-10: C18-C20)

In Singapore, colorectal cancer was consistently among the leading cancers in the past fifty years. Colorectal cancer remained the most common cancer since 2008-2012 among males (Table 5.1.2(a)), and the second most common cancer since 1973-1977 among females (Table 5.1.2(b)). In 2013-2017, there were 10,634 new cases diagnosed (nearly six cases per day) and 4,082 deaths (more than two deaths per day) (Table 6.2.2(a) and 6.2.2(b)). In the past fifty years, colon cancer made up more than half of the cases of colorectal cancer, and its percentage continued to rise throughout. Similar trends were also observed in other countries [85] [86].

9.3.1 COLON (ICD-10: C18)

The ASIR of colon cancer rose sharply from 1968 to 1987 and plateaued from 1988-1992 onwards (Figure 9.3.1.1). The ASIR was slightly higher among males, with a gender ratio of 1.1:1 in 1968-1972 and 1.2:1 in 2013-2017. The Chinese were consistently at the highest risk of developing colon cancer compared to the Malays and Indians (Tables 9.3.1.1(a) and 9.3.1.1(b)). The age-adjusted relative risk was 0.75 (95% CI: 0.66-0.85) for Malay males and 0.47 (95% CI: 0.38-0.58) for Indian males; and the relative risk was 0.84 (95% CI: 0.75-0.94) for Malay females and 0.48 (95% CI: 0.44-0.53) for Indian females. The risk of developing colon cancer increased sharply with age (especially after age 50) – in 2013-2017, those aged 80 years and above had the highest age-specific incidence rate (Figure 9.3.1.2). Similar age-related patterns were seen in other countries [87] [88]. In 2013-2017, 20.4% of colon cancers occurred among those aged 80 years and above.

In line with the plateauing of the ASIR of colon cancer in the latter part of the study period, a downward trend in the ASMR was observed from 1998-2002 onwards for both genders (Figure 9.3.1.3). The decline in mortality rate was likely due to improvements in treatment and early detection by screening [89], although the stage distribution did not change in the last decade (Table 9.3.1.3). The five-year ASRS increased from 25.5% in 1973-1977 to 60.2% in 2013-2017 among males (Figure 9.3.1.4(a)) and from 30.4% to 60.5% among females during the same period (Figure 9.3.1.4(b)).

The ASIR of colon cancer for the Chinese in Singapore (2008-2012) was one of the highest among the developed countries, comparable to countries such as Japan

(Osaka), South Korea and China (Hong Kong). The ASIR of Singaporean Malays, and more so for Singaporean Indians, were among the lowest in the cross-country comparison (Figure 9.3.1.5). The age-standardised five-year net survival (2010-2014) of colon cancer in Singapore was comparable to those in UK and Denmark, and slightly lower than those in Japan, South Korea, Australia and the USA (Figure 9.3.1.6).

Figure 9.3.1.1: AGE-STANDARDISED INCIDENCE RATE (PER 100,000 POPULATION) FOR COLON CANCER BY GENDER AND FIVE-YEAR PERIOD, 1968-2017

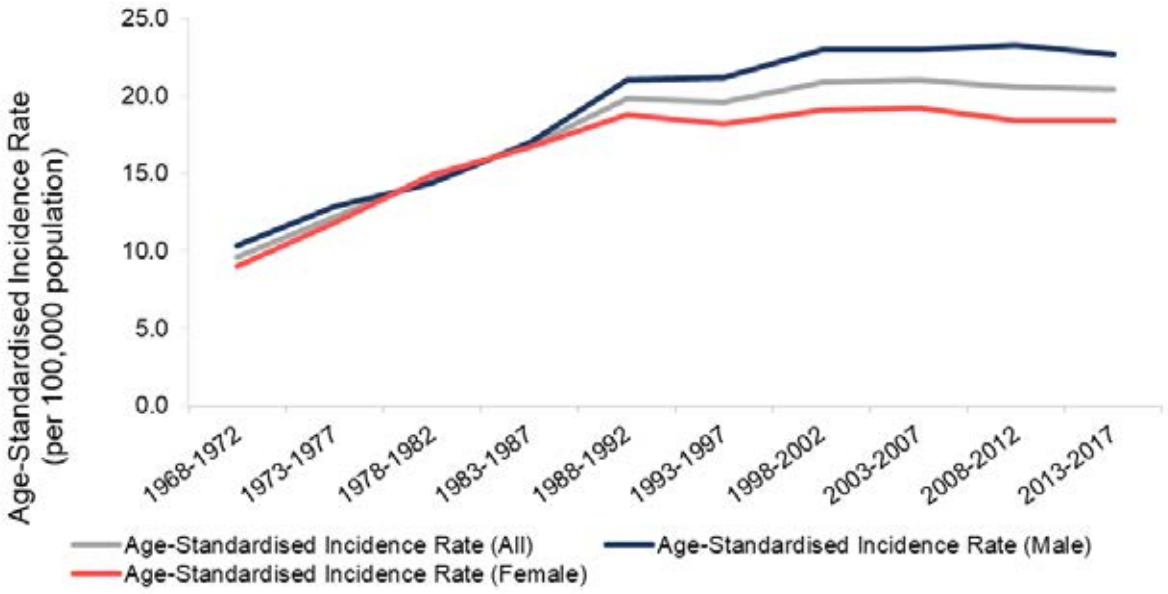


Table 9.3.1.1(a): INCIDENCE NUMBER AND RATE (PER 100,000 POPULATION) AND RELATIVE RISK FOR COLON CANCER IN MALES BY ETHNICITY AND FIVE-YEAR PERIOD, 1968-2017

Period		1968-1972	1973-1977	1978-1982	1983-1987	1988-1992
All	Number (%)	297 (100.0%)	426 (100.0%)	575 (100.0%)	815 (100.0%)	1195 (100.0%)
	CIR	5.8	7.9	9.9	13.0	17.3
	ASIR	10.3	12.9	14.4	17.0	21.0
Chinese	Number (%)	261 (87.9%)	373 (87.6%)	513 (89.2%)	735 (90.2%)	1066 (89.2%)
	CIR	6.7	9.0	11.4	15.1	20.0
	ASIR	11.6	14.4	16.6	19.9	24.3
	RR	1.00	1.00	1.00	1.00	1.00
Malay	Number (%)	12 (4.0%)	20 (4.7%)	26 (4.5%)	37 (4.5%)	72 (6.0%)
	CIR	1.6	2.6	3.1	4.1	7.4
	ASIR	3.6	4.8	5.2	6.3	10.7
	RR and 95% CI	0.31 (0.18-0.55)	0.36 (0.24-0.54)	0.33 (0.26-0.42)	0.32 (0.24-0.43)	0.45 (0.35-0.56)
Indian	Number (%)	19 (6.4%)	23 (5.4%)	24 (4.2%)	36 (4.4%)	41 (3.4%)
	CIR	4.5	5.7	5.9	7.9	7.9
	ASIR	5.0	9.2	7.6	7.7	8.2
	RR and 95% CI	0.54 (0.35-0.84)	0.52 (0.38-0.71)	0.39 (0.23-0.66)	0.40 (0.30-0.52)	0.30 (0.23-0.39)
Period		**1993-1997**	**1998-2002**	**2003-2007**	**2008-2012**	**2013-2017**
All	Number (%)	1432 (100.0%)	1861 (100.0%)	2193 (100.0%)	2831 (100.0%)	3456 (100.0%)
	CIR	18.9	22.7	25.5	30.6	36.1
	ASIR	21.2	23.0	23.0	23.3	22.7
Chinese	Number (%)	1295 (90.4%)	1675 (90.0%)	1963 (89.5%)	2506 (88.5%)	3005 (87.0%)
	CIR	22.2	26.8	30.2	36.7	42.5
	ASIR	25.1	26.8	25.7	25.6	24.4
	RR	1.00	1.00	1.00	1.00	1.00
Malay	Number (%)	81 (5.7%)	102 (5.5%)	145 (6.6%)	184 (6.5%)	278 (8.0%)
	CIR	7.6	8.9	12.1	14.7	21.4
	ASIR	9.9	11.2	14.5	14.9	17.9
	RR and 95% CI	0.42 (0.33-0.52)	0.43 (0.35-0.51)	0.56 (0.47-0.66)	0.58 (0.51-0.66)	0.75 (0.66-0.85)
Indian	Number (%)	35 (2.4%)	61 (3.3%)	58 (2.6%)	103 (3.6%)	124 (3.6%)
	CIR	6.0	9.1	7.7	11.6	13.6
	ASIR	5.3	7.9	8.1	11.7	11.4
	RR and 95% CI	0.20 (0.15-0.28)	0.28 (0.21-0.39)	0.30 (0.24-0.38)	0.45 (0.37-0.54)	0.47 (0.38-0.58)

Table 9.3.1.1(b): INCIDENCE NUMBER AND RATE (PER 100,000 POPULATION) AND RELATIVE RISK FOR COLON CANCER IN FEMALES BY ETHNICITY AND FIVE-YEAR PERIOD, 1968-2017

Period		1968-1972	1973-1977	1978-1982	1983-1987	1988-1992
All	Number (%)	278 (100.0%)	432 (100.0%)	655 (100.0%)	893 (100.0%)	1239 (100.0%)
	CIR	5.7	8.3	11.6	14.6	18.4
	ASIR	9.0	11.8	14.9	16.7	18.8
Chinese	Number (%)	254 (91.4%)	409 (94.7%)	599 (91.5%)	834 (93.4%)	1162 (93.8%)
	CIR	6.6	10.0	13.5	17.3	22.1
	ASIR	9.4	12.9	16.0	18.4	21.0
	RR	1.00	1.00	1.00	1.00	1.00
Malay	Number (%)	11 (4.0%)	12 (2.8%)	31 (4.7%)	31 (3.5%)	46 (3.7%)
	CIR	1.5	1.6	3.8	3.6	4.9
	ASIR	4.0	3.5	8.4	5.2	6.2
	RR and 95% CI	0.41 (0.26-0.65)	0.27 (0.15-0.51)	0.47 (0.34-0.65)	0.32 (0.22-0.48)	0.34 (0.23-0.52)
Indian	Number (%)	10 (3.6%)	4 (0.9%)	21 (3.2%)	17 (1.9%)	18 (1.5%)
	CIR	3.6	1.4	6.6	4.5	4.1
	ASIR	14.8	4.2	17.4	9.7	5.5
	RR and 95% CI	1.23 (0.73-2.09)	0.28 (0.14-0.58)	0.88 (0.55-1.42)	0.44 (0.24-0.79)	0.31 (0.23-0.42)
Period		**1993-1997**	**1998-2002**	**2003-2007**	**2008-2012**	**2013-2017**
All	Number (%)	1427 (100.0%)	1850 (100.0%)	2251 (100.0%)	2676 (100.0%)	3300 (100.0%)
	CIR	19.0	22.5	25.7	28.2	33.2
	ASIR	18.2	19.1	19.2	18.4	18.4
Chinese	Number (%)	1300 (91.1%)	1691 (91.4%)	2047 (90.9%)	2354 (88.0%)	2858 (86.6%)
	CIR	22.3	26.7	30.8	33.2	38.5
	ASIR	19.7	21.0	20.9	19.5	19.3
	RR	1.00	1.00	1.00	1.00	1.00
Malay	Number (%)	75 (5.3%)	100 (5.4%)	139 (6.2%)	206 (7.7%)	289 (8.8%)
	CIR	7.2	8.8	11.6	16.3	22.1
	ASIR	9.2	10.4	12.5	14.3	16.2
	RR and 95% CI	0.49 (0.38-0.64)	0.50 (0.45-0.56)	0.58 (0.46-0.73)	0.73 (0.67-0.79)	0.84 (0.75-0.94)
Indian	Number (%)	35 (2.5%)	43 (2.3%)	50 (2.2%)	72 (2.7%)	102 (3.1%)
	CIR	6.7	6.9	7.1	8.7	11.8
	ASIR	9.0	9.1	7.1	8.5	9.1
	RR and 95% CI	0.47 (0.32-0.68)	0.40 (0.30-0.52)	0.37 (0.27-0.52)	0.43 (0.36-0.51)	0.48 (0.44-0.53)

Figure 9.3.1.2: AGE-SPECIFIC INCIDENCE RATE (PER 100,000 POPULATION) FOR COLON CANCER BY AGE GROUP, 1968-1972, 1988-1992, 2013-2017

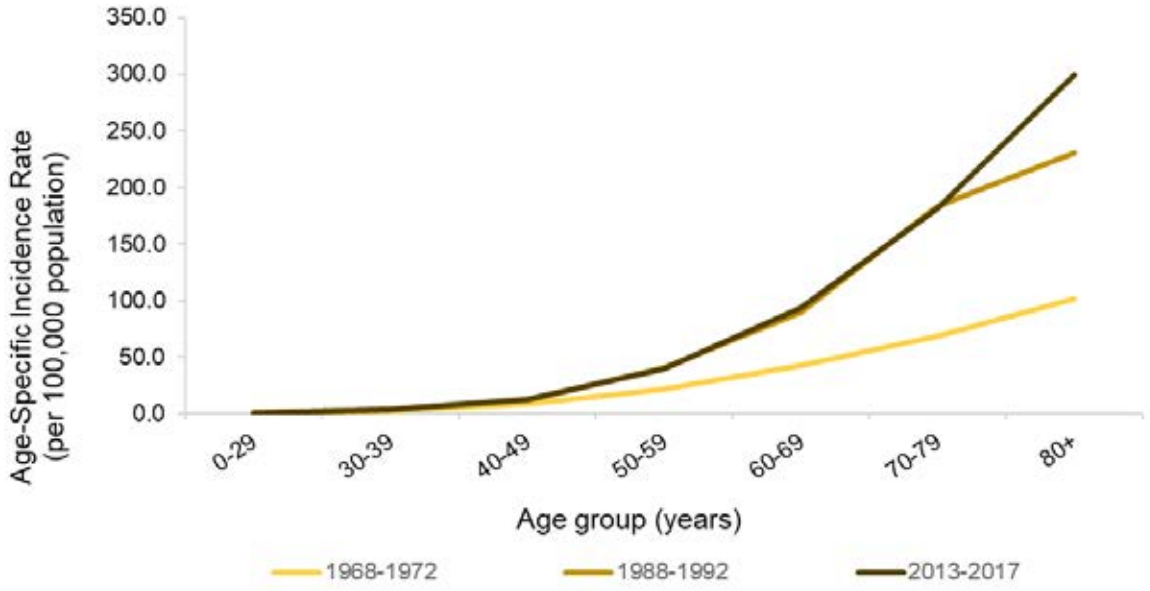


Figure 9.3.1.3: AGE-STANDARDISED MORTALITY RATE (PER 100,000 POPULATION) FOR COLON CANCER BY GENDER AND FIVE-YEAR PERIOD, 1968-2017

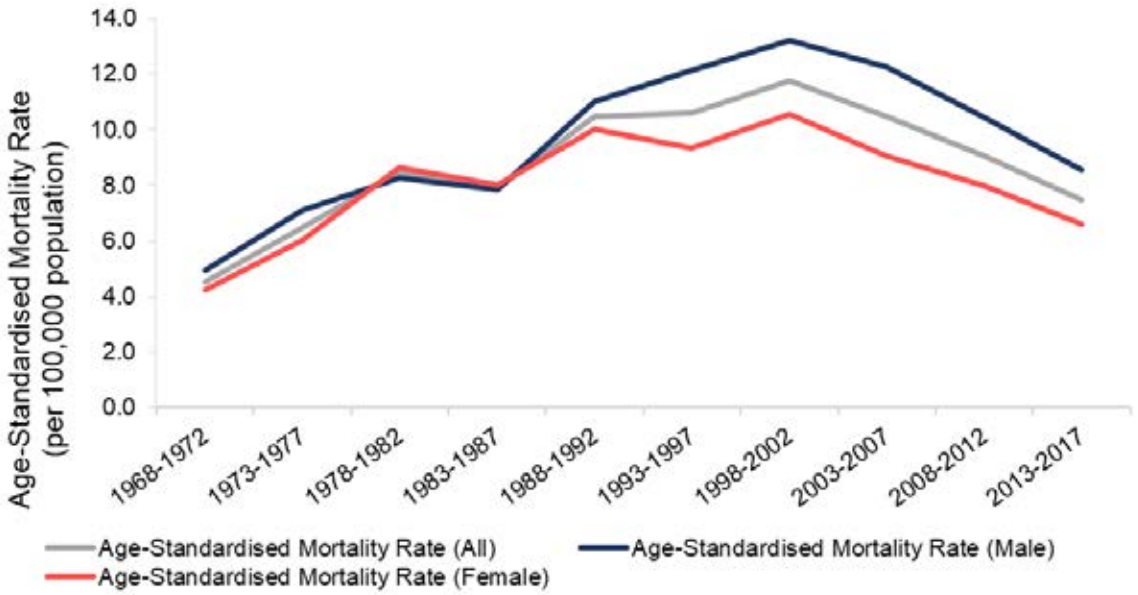


Table 9.3.1.2(a): MORTALITY NUMBER AND RATE (PER 100,000 POPULATION) FOR COLON CANCER IN MALES BY ETHNICITY AND FIVE-YEAR PERIOD, 1968-2017

Period		1968-1972	1973-1977	1978-1982	1983-1987	1988-1992
All	Number (%)	138 (100.0%)	226 (100.0%)	321 (100.0%)	366 (100.0%)	622 (100.0%)
	CMR	2.7	4.2	5.5	5.8	9.0
	ASMR	5.0	7.1	8.3	7.8	11.0
Chinese	Number (%)	125 (90.6%)	204 (90.3%)	290 (90.3%)	329 (89.9%)	557 (89.5%)
	CMR	3.2	4.9	6.4	6.8	10.5
	ASMR	5.6	8.2	9.6	9.1	12.8
Malay	Number (%)	4 (2.9%)	9 (4.0%)	15 (4.7%)	26 (7.1%)	41 (6.6%)
	CMR	0.5	1.2	1.8	2.9	4.2
	ASMR	1.8	2.1	2.8	4.6	6.4
Indian	Number (%)	7 (5.1%)	6 (2.7%)	12 (3.7%)	11 (3.0%)	18 (2.9%)
	CMR	1.6	1.5	2.9	2.4	3.5
	ASMR	1.6	3.4	3.8	2.9	3.6
Period		**1993-1997**	**1998-2002**	**2003-2007**	**2008-2012**	**2013-2017**
All	Number (%)	801 (100.0%)	1045 (100.0%)	1154 (100.0%)	1260 (100.0%)	1320 (100.0%)
	CMR	10.6	12.8	13.4	13.6	13.8
	ASMR	12.1	13.2	12.3	10.4	8.5
Chinese	Number (%)	709 (88.5%)	954 (91.3%)	1027 (89.0%)	1116 (88.6%)	1131 (85.7%)
	CMR	12.2	15.3	15.8	16.3	16.0
	ASMR	14.0	15.6	13.6	11.5	9.0
Malay	Number (%)	58 (7.2%)	50 (4.8%)	80 (6.9%)	96 (7.6%)	133 (10.1%)
	CMR	5.4	4.4	6.7	7.7	10.3
	ASMR	7.2	6.1	8.2	7.5	8.9
Indian	Number (%)	17 (2.1%)	27 (2.6%)	34 (2.9%)	36 (2.9%)	42 (3.2%)
	CMR	2.9	4.0	4.5	4.1	4.6
	ASMR	2.4	3.3	5.0	4.1	3.8

Table 9.3.1.2(b): MORTALITY NUMBER AND RATE (PER 100,000 POPULATION) FOR COLON CANCER IN FEMALES BY ETHNICITY AND FIVE-YEAR PERIOD, 1968-2017

Period		1968-1972	1973-1977	1978-1982	1983-1987	1988-1992
All	Number (%)	130 (100.0%)	219 (100.0%)	372 (100.0%)	426 (100.0%)	670 (100.0%)
	CMR	2.6	4.2	6.6	7.0	10.0
	ASMR	4.2	6.0	8.6	8.0	10.0
Chinese	Number (%)	119 (91.5%)	203 (92.7%)	339 (91.1%)	394 (92.5%)	624 (93.1%)
	CMR	3.1	5.0	7.6	8.2	11.8
	ASMR	4.4	6.4	9.1	8.7	10.9
Malay	Number (%)	8 (6.2%)	6 (2.7%)	21 (5.6%)	19 (4.5%)	28 (4.2%)
	CMR	1.1	0.8	2.6	2.2	3.0
	ASMR	2.9	1.9	5.9	3.7	4.1
Indian	Number (%)	2 (1.5%)	6 (2.7%)	10 (2.7%)	8 (1.9%)	15 (2.2%)
	CMR	0.7	2.1	3.1	2.1	3.4
	ASMR	6.6	6.8	11.8	4.0	5.4
Period		**1993-1997**	**1998-2002**	**2003-2007**	**2008-2012**	**2013-2017**
All	Number (%)	758 (100.0%)	1032 (100.0%)	1108 (100.0%)	1232 (100.0%)	1295 (100.0%)
	CMR	10.1	12.6	12.7	13.0	13.0
	ASMR	9.3	10.6	9.1	8.0	6.6
Chinese	Number (%)	692 (91.3%)	943 (91.4%)	1003 (90.5%)	1106 (89.8%)	1130 (87.3%)
	CMR	11.9	14.9	15.1	15.6	15.2
	ASMR	10.0	11.5	9.7	8.5	6.9
Malay	Number (%)	42 (5.5%)	58 (5.6%)	72 (6.5%)	88 (7.1%)	113 (8.7%)
	CMR	4.0	5.1	6.0	7.0	8.6
	ASMR	4.9	6.4	6.4	6.5	6.2
Indian	Number (%)	15 (2.0%)	21 (2.0%)	26 (2.3%)	33 (2.7%)	38 (2.9%)
	CMR	2.9	3.4	3.7	4.0	4.4
	ASMR	3.8	4.6	4.3	3.8	3.5

Figure 9.3.1.4(a): TRENDS IN AGE-STANDARDISED INCIDENCE RATE (PER 100,000 POPULATION), AGE-STANDARDISED MORTALITY RATE (PER 100,000 POPULATION), AND FIVE-YEAR AGE-STANDARDISED RELATIVE SURVIVAL RATE (%) FOR COLON CANCER IN MALES BY FIVE-YEAR PERIOD, 1968-2017

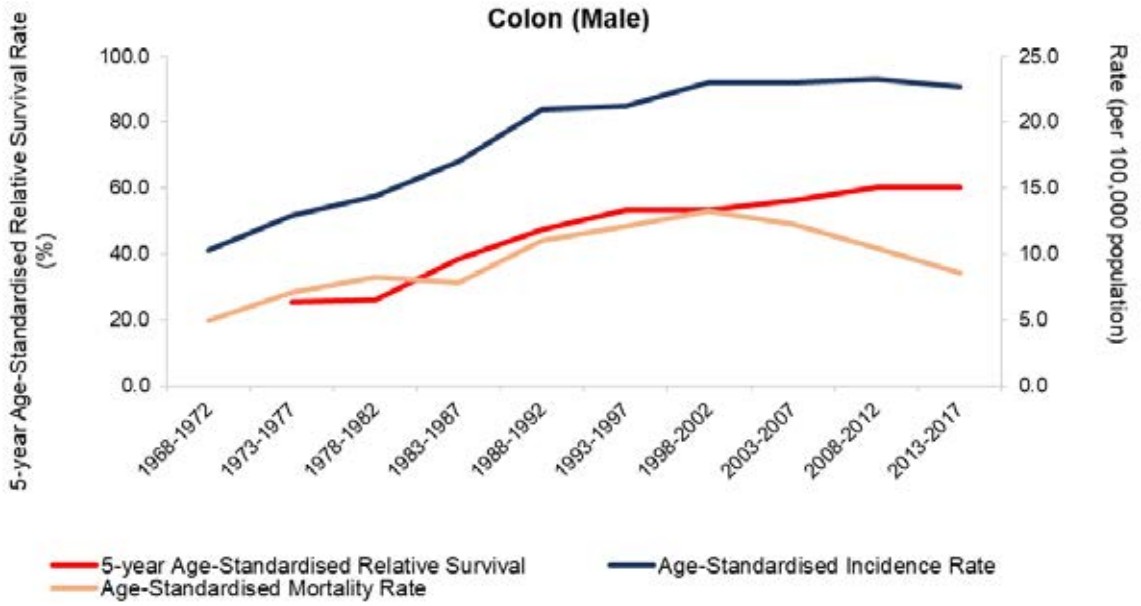


Figure 9.3.1.4(b): TRENDS IN AGE-STANDARDISED INCIDENCE RATE (PER 100,000 POPULATION), AGE-STANDARDISED MORTALITY RATE (PER 100,000 POPULATION), AND FIVE-YEAR AGE-STANDARDISED RELATIVE SURVIVAL RATE (%) FOR COLON CANCER IN FEMALES BY FIVE-YEAR PERIOD, 1968-2017

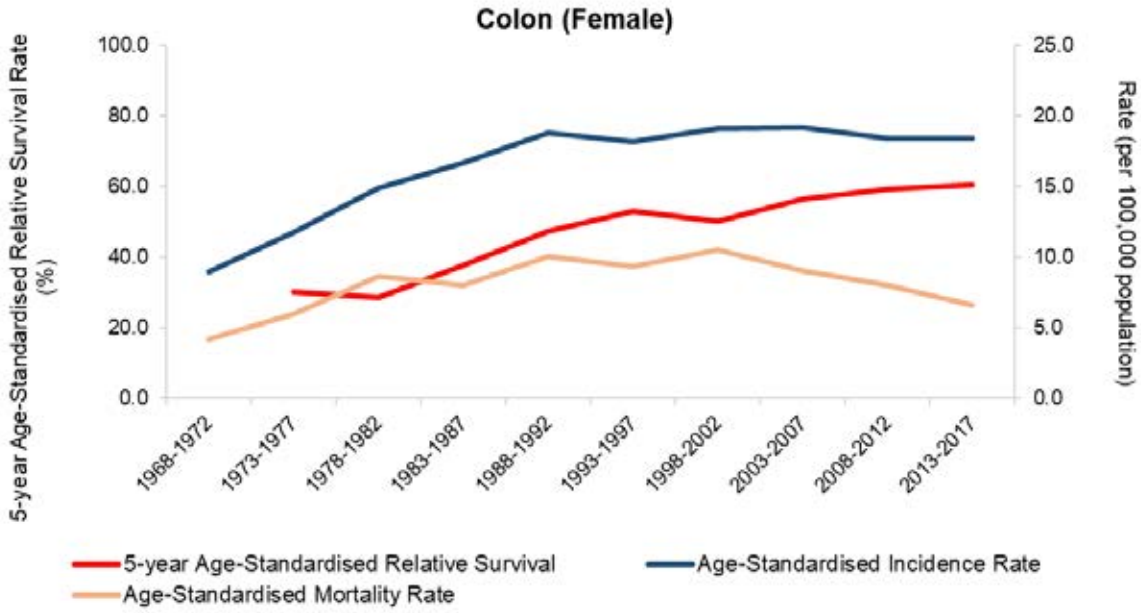


Table 9.3.1.3: STAGE DISTRIBUTION OF COLON CANCER, 2008-2017

Year	Stage I		Stage II		Stage III		Stage IV	
	Number	%	Number	%	Number	%	Number	%
2008	110	11.3	291	30.0	341	35.2	228	23.5
2009	139	14.4	275	28.4	330	34.1	224	23.1
2010	148	15.1	291	29.6	299	30.4	245	24.9
2011	119	11.3	329	31.4	320	30.5	281	26.8
2012	153	14.4	301	28.4	326	30.7	281	26.5
2013	145	13.1	327	29.6	327	29.6	304	27.6
2014	180	15.0	332	27.6	391	32.5	299	24.9
2015	211	16.4	324	25.2	404	31.4	349	27.1
2016	208	17.0	347	28.4	359	29.4	308	25.2
2017	204	15.6	370	28.3	405	31.0	327	25.0

Figure 9.3.1.5: AGE-STANDARDISED INCIDENCE RATE (PER 100,000 POPULATION) FOR COLON CANCER IN SELECTED COUNTRIES, 2008-2012

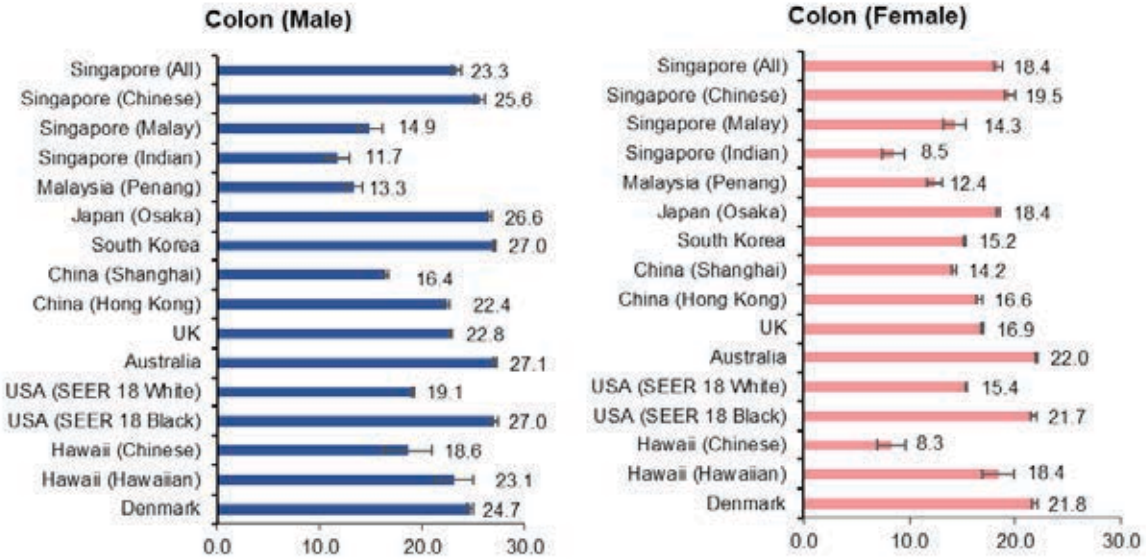
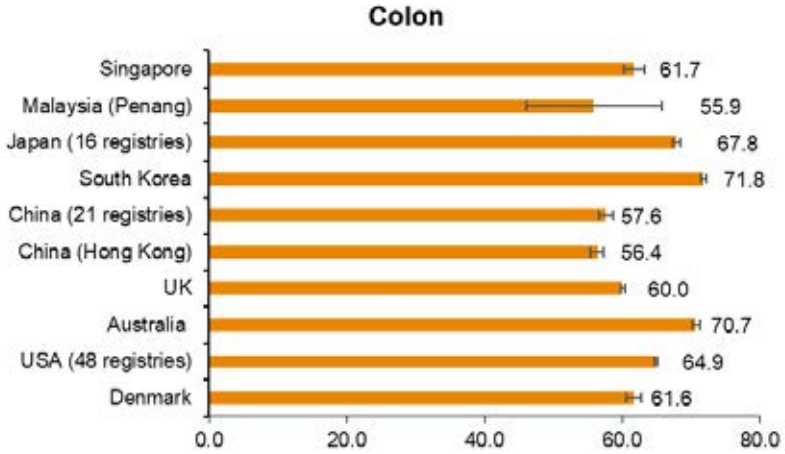


Figure 9.3.1.6: FIVE-YEAR AGE-STANDARDISED NET SURVIVAL (%) FOR COLON CANCER IN SELECTED COUNTRIES, 2010-2014



9.3.2 RECTUM (ICD-10: C19-C20)

The ASIR of rectal cancer had a similar pattern to that of colon cancer with suggestion of a slight recent downward trend from 2003-2007 onwards (Figure 9.3.2.1). The ASIR of rectal cancer was higher among males, with a male-to-female ratio of 1.4:1 in 1968-1972 and 1.8:1 in 2013-2017. The Chinese were at the highest risk of developing rectal cancer compared to the Malays and Indians for most of the period under study (Tables 9.3.2.1(a) and 9.3.2.1(b)). In 2013-2017, the age-adjusted relative risk was 0.87 (95% CI: 0.76-0.99) for Malay males and 0.55 (95% CI: 0.48-0.63) for Indian males. Among females, in 2013-2017, Chinese females and Malay females were at equal risk, but had higher risk than Indian females (age-adjusted relative risk: 0.74, 95%CI: 0.64-0.86). The ASIR of rectal cancer for Malay females increased over the years. In 2013-2017, Malay females (9.0 per 100,000 population) overtook Chinese females (8.9 per 100,000 population) as the ethnic group with the highest ASIR of rectal cancer among females, and Indian females had the lowest ASIR (6.6 per 100,000 population). The risk of developing rectal cancer increased sharply with age, with those aged 80 years and above having the highest age-specific incidence rate (Figure 9.3.2.2). In 2013-2017, 13.1% of rectal cancer occurred among those aged 80 years and above.

There was a general downward trend in the ASMR of rectal cancer from 1988-1992 onwards (Figure 9.3.2.3), though females saw an increase in the ASMR for the latest five-year period (2013-2017). The five-year ASRS of rectal cancer increased from 22.3% in 1973-1977 to 59.7% in 2013-2017 among males (Figure 9.3.2.4(a)) and from 20.6% to 60.2% among females during the same period (Figure 9.3.2.4(b)). Early detection and improvements in treatment modalities were likely contributors to the downward trend in mortality rate and enhanced survival rate [87]. Early detection significantly reduces mortality since rectal cancers detected at early stages have better prognosis. While the five-year ASRS for Stage I-III rectal cancer were above 62.0%, it dropped to about 10% for Stage IV cases in 2013-2017 (Appendix E1-E2). Around 40.0% of the total cases of rectal cancer were diagnosed at the earlier stages (Stage I and II) (Table 9.3.2.3). There was little change in the proportion of Stage III and IV rectal cancers over the last decade. The percentage of Stage I rectal cancer diagnosed during the past decade increased slightly - from 17.4% in 2008 to 21.1% in 2017, with a corresponding decline in Stage II cases.

The ASIR of rectal cancer among males in Singapore (2008-2012) was lower than those in Asian countries/regions such as Japan, South Korea and China (Hong Kong), but higher than that in USA (Figure 9.3.2.5). As for the ASIR in females, less geographic differences were observed among the selected countries/regions. The

age-standardised five-year net survival (2010-2014) of rectal cancer in Singapore was slightly lower than those in Japan, South Korea, UK, Australia, USA, and Denmark (Figure 9.3.2.6).

Figure 9.3.2.1: AGE-STANDARDISED INCIDENCE RATE (PER 100,000 POPULATION) FOR RECTAL CANCER BY GENDER AND FIVE-YEAR PERIOD, 1968-2017

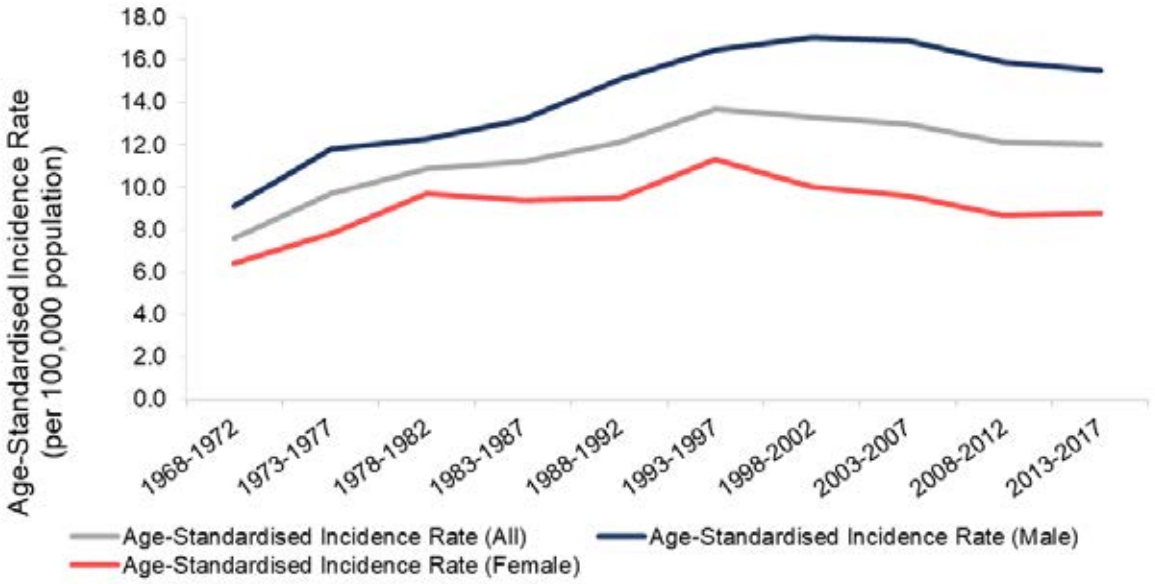


Table 9.3.2.1(a): INCIDENCE NUMBER AND RATE (PER 100,000 POPULATION) AND RELATIVE RISK FOR RECTAL CANCER IN MALES BY ETHNICITY AND FIVE-YEAR PERIOD, 1968-2017

Period		1968-1972	1973-1977	1978-1982	1983-1987	1988-1992
All	Number (%)	266 (100.0%)	398 (100.0%)	482 (100.0%)	620 (100.0%)	857 (100.0%)
	CIR	5.2	7.4	8.3	9.9	12.4
	ASIR	9.1	11.8	12.3	13.2	15.1
Chinese	Number (%)	231 (86.8%)	349 (87.7%)	433 (89.8%)	545 (87.9%)	766 (89.4%)
	CIR	5.9	8.4	9.6	11.2	14.4
	ASIR	10.1	13.1	14.3	15.2	17.6
	RR	1.00	1.00	1.00	1.00	1.00
Malay	Number (%)	14 (5.3%)	24 (6.0%)	26 (5.4%)	36 (5.8%)	49 (5.7%)
	CIR	1.8	3.1	3.1	4.0	5.0
	ASIR	3.9	6.2	4.8	6.7	7.3
	RR and 95% CI	0.43 (0.30-0.63)	0.47 (0.33-0.67)	0.38 (0.28-0.52)	0.42 (0.24-0.72)	0.42 (0.33-0.52)
Indian	Number (%)	18 (6.8%)	20 (5.0%)	18 (3.7%)	36 (5.8%)	31 (3.6%)
	CIR	4.2	4.9	4.4	7.9	6.0
	ASIR	4.8	6.3	5.3	7.9	5.5
	RR and 95% CI	0.60 (0.35-1.03)	0.49 (0.37-0.65)	0.34 (0.16-0.71)	0.52 (0.39-0.68)	0.31 (0.24-0.39)
Period		**1993-1997**	**1998-2002**	**2003-2007**	**2008-2012**	**2013-2017**
All	Number (%)	1118 (100.0%)	1391 (100.0%)	1656 (100.0%)	1956 (100.0%)	2343 (100.0%)
	CIR	14.8	17.0	19.2	21.1	24.4
	ASIR	16.5	17.1	16.9	15.9	15.5
Chinese	Number (%)	996 (89.1%)	1222 (87.9%)	1450 (87.6%)	1682 (86.0%)	1974 (84.3%)
	CIR	17.1	19.5	22.3	24.6	27.9
	ASIR	19.1	19.3	18.5	17.0	16.3
	RR	1.00	1.00	1.00	1.00	1.00
Malay	Number (%)	81 (7.2%)	106 (7.6%)	114 (6.9%)	164 (8.4%)	219 (9.3%)
	CIR	7.6	9.3	9.5	13.1	16.9
	ASIR	10.9	11.9	10.8	13.3	13.7
	RR and 95% CI	0.55 (0.46-0.67)	0.63 (0.53-0.75)	0.59 (0.52-0.67)	0.76 (0.67-0.87)	0.87 (0.76-0.99)
Indian	Number (%)	33 (3.0%)	56 (4.0%)	71 (4.3%)	74 (3.8%)	98 (4.2%)
	CIR	5.6	8.3	9.5	8.3	10.8
	ASIR	4.4	8.3	9.5	8.0	9.1
	RR and 95% CI	0.26 (0.19-0.36)	0.38 (0.27-0.53)	0.51 (0.43-0.60)	0.49 (0.36-0.66)	0.55 (0.48-0.63)

Table 9.3.2.1(b): INCIDENCE NUMBER AND RATE (PER 100,000 POPULATION) AND RELATIVE RISK FOR RECTAL CANCER IN FEMALES BY ETHNICITY AND FIVE-YEAR PERIOD, 1968-2017

Period		1968-1972	1973-1977	1978-1982	1983-1987	1988-1992
All	Number (%)	200 (100.0%)	283 (100.0%)	429 (100.0%)	500 (100.0%)	609 (100.0%)
	CIR	4.1	5.4	7.6	8.2	9.1
	ASIR	6.4	7.8	9.7	9.4	9.5
Chinese	Number (%)	183 (91.5%)	252 (89.0%)	388 (90.4%)	462 (92.4%)	539 (88.5%)
	CIR	4.8	6.2	8.7	9.6	10.2
	ASIR	6.8	8.0	10.2	10.2	9.9
	RR	1.00	1.00	1.00	1.00	1.00
Malay	Number (%)	7 (3.5%)	16 (5.7%)	23 (5.4%)	28 (5.6%)	47 (7.7%)
	CIR	1.0	2.1	2.9	3.2	5.0
	ASIR	2.0	4.7	4.4	5.4	7.3
	RR and 95% CI	0.35 (0.20-0.61)	0.62 (0.44-0.87)	0.54 (0.41-0.70)	0.54 (0.42-0.68)	0.76 (0.51-1.13)
Indian	Number (%)	7 (3.5%)	8 (2.8%)	15 (3.5%)	10 (2.0%)	15 (2.5%)
	CIR	2.5	2.8	4.7	2.7	3.4
	ASIR	5.1	5.0	10.5	5.9	6.1
	RR and 95% CI	1.14 (0.48-2.71)	0.97 (0.60-1.58)	0.98 (0.73-1.31)	0.48 (0.29-0.78)	0.55 (0.26-1.14)
Period		**1993-1997**	**1998-2002**	**2003-2007**	**2008-2012**	**2013-2017**
All	Number (%)	873 (100.0%)	945 (100.0%)	1099 (100.0%)	1244 (100.0%)	1535 (100.0%)
	CIR	11.6	11.5	12.6	13.1	15.5
	ASIR	11.3	10.0	9.6	8.7	8.8
Chinese	Number (%)	790 (90.5%)	837 (88.6%)	992 (90.3%)	1080 (86.8%)	1260 (82.1%)
	CIR	13.6	13.2	14.9	15.2	17.0
	ASIR	12.3	10.7	10.4	9.1	8.9
	RR	1.00	1.00	1.00	1.00	1.00
Malay	Number (%)	56 (6.4%)	73 (7.7%)	77 (7.0%)	98 (7.9%)	160 (10.4%)
	CIR	5.4	6.4	6.4	7.8	12.2
	ASIR	6.8	8.1	7.2	6.8	9.0
	RR and 95% CI	0.58 (0.47-0.72)	0.72 (0.59-0.89)	0.63 (0.49-0.81)	0.74 (0.59-0.92)	1.02 (0.86-1.20)
Indian	Number (%)	23 (2.6%)	29 (3.1%)	25 (2.3%)	44 (3.5%)	72 (4.7%)
	CIR	4.4	4.7	3.5	5.3	8.3
	ASIR	6.0	4.9	4.0	5.2	6.6
	RR and 95% CI	0.48 (0.40-0.59)	0.52 (0.39-0.70)	0.36 (0.27-0.50)	0.56 (0.43-0.73)	0.74 (0.64-0.86)

Figure 9.3.2.2: AGE-SPECIFIC INCIDENCE RATE (PER 100,000 POPULATION) FOR RECTAL CANCER BY AGE GROUP, 1968-1972, 1988-1992, 2013-2017

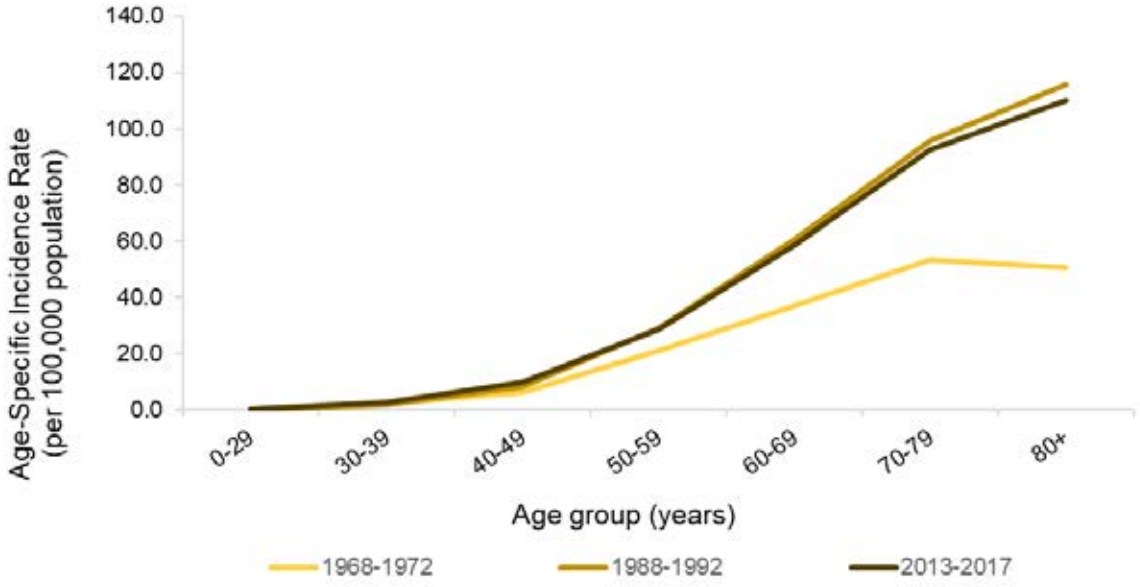


Figure 9.3.2.3: AGE-STANDARDISED MORTALITY RATE (PER 100,000 POPULATION) FOR RECTAL CANCER BY GENDER AND FIVE-YEAR PERIOD, 1968-2017

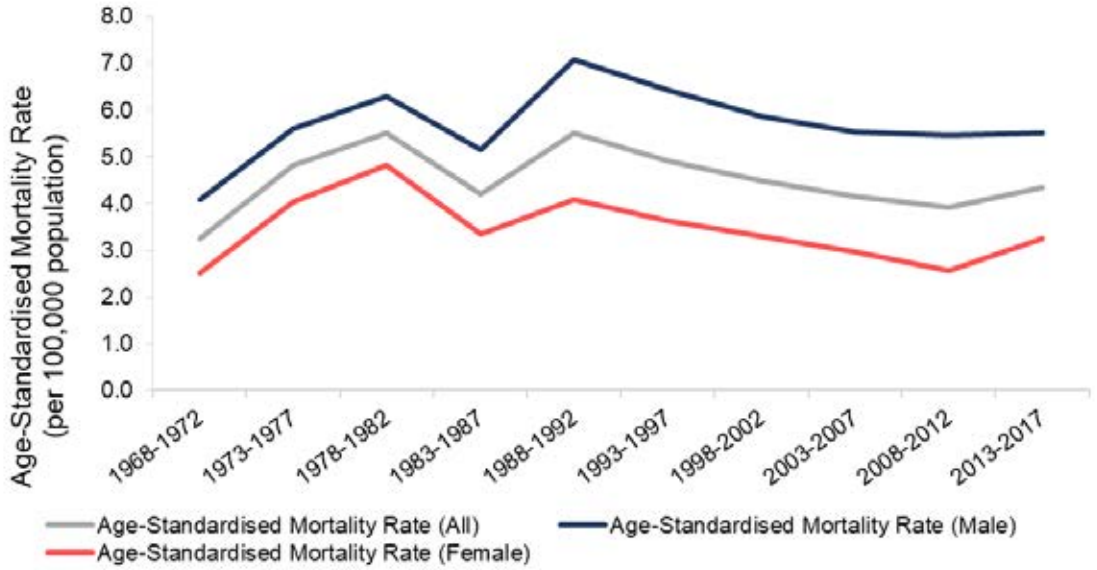


Table 9.3.2.2(a): MORTALITY NUMBER AND RATE (PER 100,000 POPULATION) FOR RECTAL CANCER IN MALES BY ETHNICITY AND FIVE-YEAR PERIOD, 1968-2017

Period		1968-1972	1973-1977	1978-1982	1983-1987	1988-1992
All	Number (%)	115 (100.0%)	187 (100.0%)	245 (100.0%)	240 (100.0%)	395 (100.0%)
	CMR	2.2	3.5	4.2	3.8	5.7
	ASMR	4.1	5.6	6.3	5.2	7.1
Chinese	Number (%)	99 (86.1%)	166 (88.8%)	224 (91.4%)	202 (84.2%)	350 (88.6%)
	CMR	2.5	4.0	5.0	4.1	6.6
	ASMR	4.5	6.4	7.5	5.6	8.2
Malay	Number (%)	9 (7.8%)	14 (7.5%)	13 (5.3%)	20 (8.3%)	27 (6.8%)
	CMR	1.2	1.8	1.6	2.2	2.8
	ASMR	2.6	2.9	2.4	4.0	4.1
Indian	Number (%)	7 (6.1%)	5 (2.7%)	6 (2.4%)	15 (6.3%)	14 (3.5%)
	CMR	1.6	1.2	1.5	3.3	2.7
	ASMR	2.4	1.4	1.6	3.4	2.4
Period		**1993-1997**	**1998-2002**	**2003-2007**	**2008-2012**	**2013-2017**
All	Number (%)	430 (100.0%)	464 (100.0%)	527 (100.0%)	651 (100.0%)	835 (100.0%)
	CMR	5.7	5.7	6.1	7.0	8.7
	ASMR	6.4	5.9	5.5	5.5	5.5
Chinese	Number (%)	380 (88.4%)	408 (87.9%)	472 (89.6%)	550 (84.5%)	719 (86.1%)
	CMR	6.5	6.5	7.3	8.1	10.2
	ASMR	7.4	6.7	6.2	5.7	5.8
Malay	Number (%)	32 (7.4%)	37 (8.0%)	44 (8.3%)	67 (10.3%)	77 (9.2%)
	CMR	3.0	3.2	3.7	5.3	5.9
	ASMR	4.5	4.0	4.6	5.4	5.0
Indian	Number (%)	14 (3.3%)	10 (2.2%)	10 (1.9%)	25 (3.8%)	25 (3.0%)
	CMR	2.4	1.5	1.3	2.8	2.7
	ASMR	1.8	1.2	1.5	3.0	2.5

Table 9.3.2.2(b): MORTALITY NUMBER AND RATE (PER 100,000 POPULATION) FOR RECTAL CANCER IN FEMALES BY ETHNICITY AND FIVE-YEAR PERIOD, 1968-2017

Period		1968-1972	1973-1977	1978-1982	1983-1987	1988-1992
All	Number (%)	77 (100.0%)	145 (100.0%)	215 (100.0%)	181 (100.0%)	273 (100.0%)
	CMR	1.6	2.8	3.8	3.0	4.1
	ASMR	2.5	4.0	4.8	3.3	4.1
Chinese	Number (%)	72 (93.5%)	129 (89.0%)	194 (90.2%)	168 (92.8%)	242 (88.6%)
	CMR	1.9	3.1	4.4	3.5	4.6
	ASMR	2.7	4.1	5.0	3.6	4.2
Malay	Number (%)	1 (1.3%)	8 (5.5%)	12 (5.6%)	8 (4.4%)	21 (7.7%)
	CMR	0.1	1.1	1.5	0.9	2.2
	ASMR	0.3	2.4	2.5	1.7	3.1
Indian	Number (%)	2 (2.6%)	2 (1.4%)	6 (2.8%)	3 (1.7%)	7 (2.6%)
	CMR	0.7	0.7	1.9	0.8	1.6
	ASMR	1.1	0.9	4.3	2.0	3.1
Period		**1993-1997**	**1998-2002**	**2003-2007**	**2008-2012**	**2013-2017**
All	Number (%)	294 (100.0%)	324 (100.0%)	358 (100.0%)	402 (100.0%)	632 (100.0%)
	CMR	3.9	3.9	4.1	4.2	6.4
	ASMR	3.6	3.3	3.0	2.6	3.2
Chinese	Number (%)	255 (86.7%)	281 (86.7%)	320 (89.4%)	351 (87.3%)	523 (82.8%)
	CMR	4.4	4.4	4.8	4.9	7.0
	ASMR	3.7	3.4	3.1	2.7	3.2
Malay	Number (%)	32 (10.9%)	31 (9.6%)	28 (7.8%)	34 (8.5%)	77 (12.2%)
	CMR	3.1	2.7	2.3	2.7	5.9
	ASMR	4.1	3.3	2.7	2.3	4.0
Indian	Number (%)	6 (2.0%)	9 (2.8%)	8 (2.2%)	10 (2.5%)	22 (3.5%)
	CMR	1.1	1.5	1.1	1.2	2.5
	ASMR	1.8	1.7	1.4	1.3	2.1

Figure 9.3.2.4(a): TRENDS IN AGE-STANDARDISED INCIDENCE RATE (PER 100,000 POPULATION), AGE-STANDARDISED MORTALITY RATE (PER 100,000 POPULATION), AND FIVE-YEAR AGE-STANDARDISED RELATIVE SURVIVAL RATE (%) FOR RECTAL CANCER IN MALES BY FIVE-YEAR PERIOD, 1968-2017

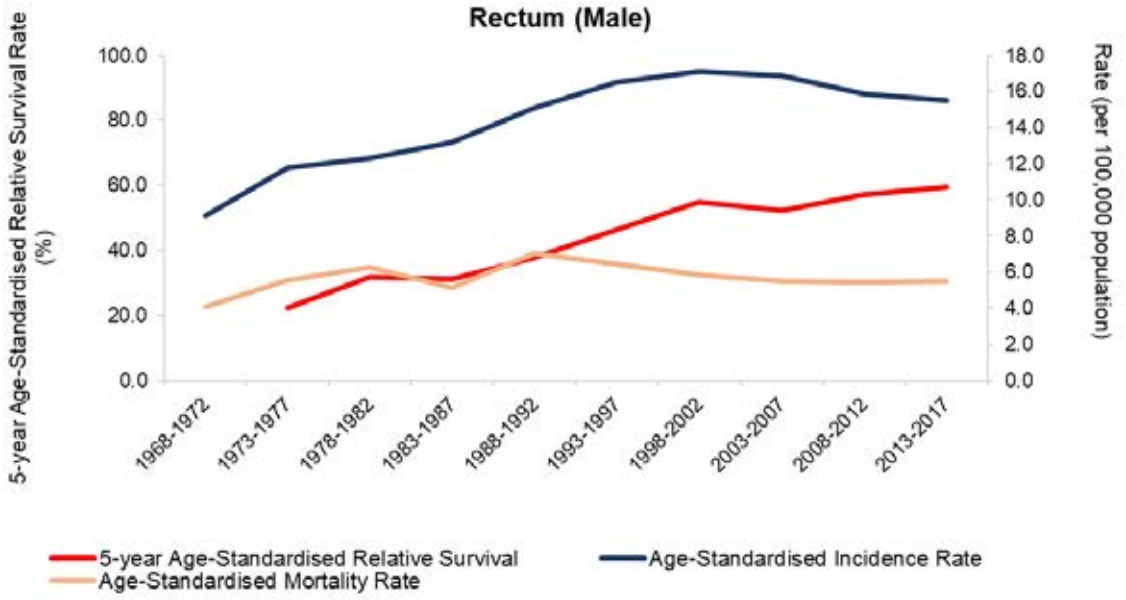


Figure 9.3.2.4(b): TRENDS IN AGE-STANDARDISED INCIDENCE RATE (PER 100,000 POPULATION), AGE-STANDARDISED MORTALITY RATE (PER 100,000 POPULATION), AND FIVE-YEAR AGE-STANDARDISED RELATIVE SURVIVAL RATE (%) FOR RECTAL CANCER IN FEMALES BY FIVE-YEAR PERIOD, 1968-2017

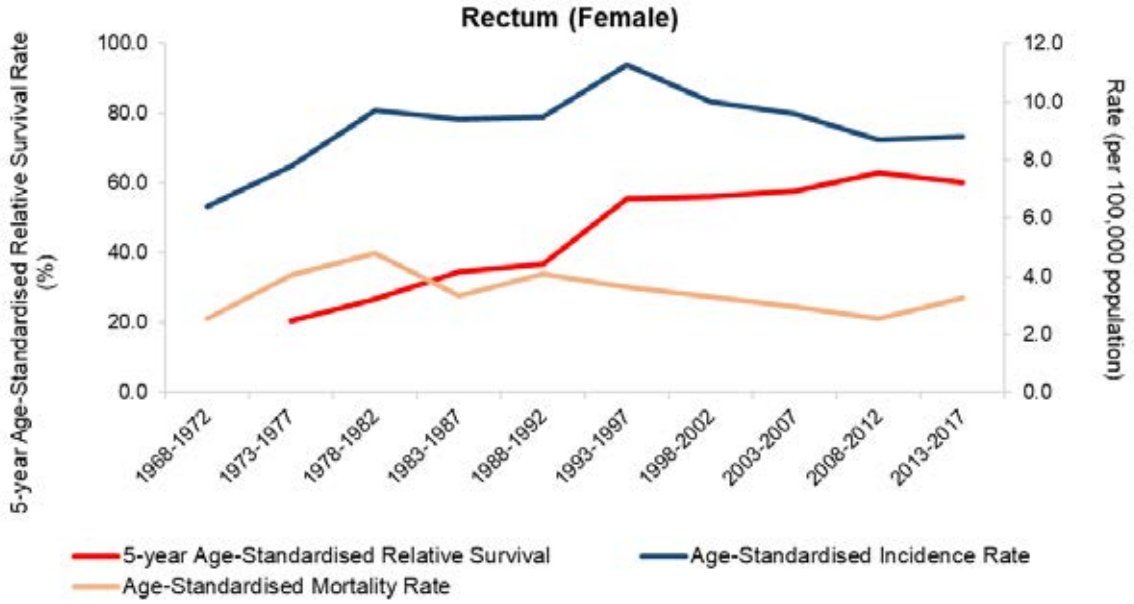


Table 9.3.2.3: STAGE DISTRIBUTION OF RECTAL CANCER, 2008-2017

Year	Stage I		Stage II		Stage III		Stage IV	
	Number	%	Number	%	Number	%	Number	%
2008	99	17.4	133	23.4	193	33.9	144	25.3
2009	87	16.6	121	23.0	206	39.2	111	21.1
2010	116	19.3	130	21.6	221	36.8	134	22.3
2011	104	19.3	110	20.4	198	36.7	127	23.6
2012	134	21.1	118	18.6	237	37.4	145	22.9
2013	113	19.0	111	18.7	220	37.0	150	25.3
2014	119	18.0	150	22.7	242	36.6	151	22.8
2015	181	24.1	140	18.6	275	36.6	156	20.7
2016	173	22.2	124	15.9	304	39.0	179	22.9
2017	157	21.1	122	16.4	289	38.8	177	23.8

Figure 9.3.2.5: AGE-STANDARDISED INCIDENCE RATE (PER 100,000 POPULATION) FOR RECTAL CANCER IN SELECTED COUNTRIES, 2008-2012

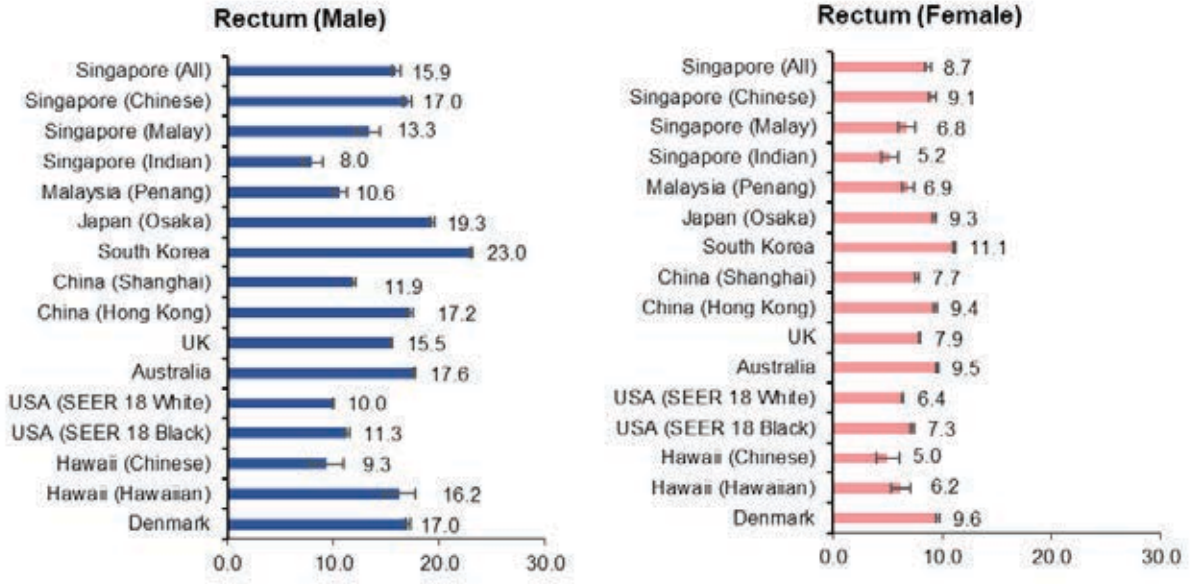
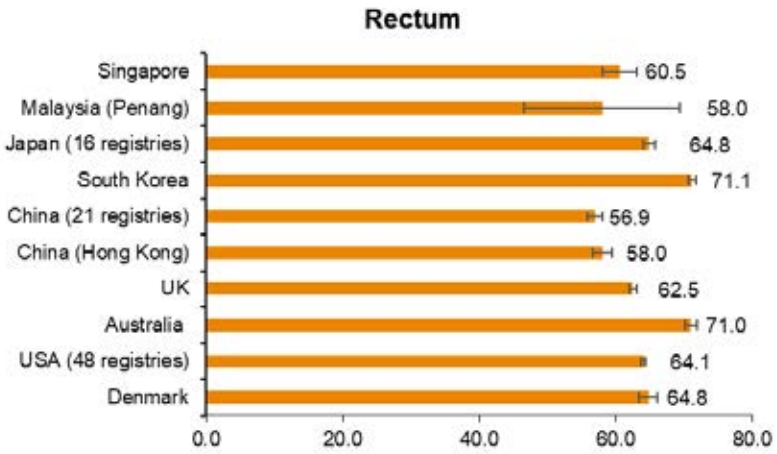


Figure 9.3.2.6: FIVE-YEAR AGE-STANDARDISED NET SURVIVAL (%) FOR RECTAL CANCER IN SELECTED COUNTRIES, 2010-2014



9.4 LIVER & INTRAHEPATIC BILE DUCTS (ICD-10: C22)

In Singapore, liver cancer remained as one of the most commonly diagnosed cancers. Among males, the ranking of liver cancer hovered between the third or fourth place for the past fifty years (Table 5.1.2(a)), whereas among females, it was the sixth most common leading incident cancer in 1968-1972, but by 1988-1992, it had fallen out of the ten most frequent leading incident cancers (Table 5.1.2(b)). In 2013-2017, there were 2,705 cases diagnosed among males (accounting for 7.8% of all cancers diagnosed among males) and 992 cases among females (accounting for 2.7% of all cancers diagnosed among females). Relative to incidence, liver cancer accounted for comparatively more cancer deaths because of its generally poor prognosis. In 2013-2017, it was the third leading cause of cancer deaths among males (1,954 deaths, accounting for 12.9% of all cancer deaths among males) and the fourth among females (842 deaths, accounting for 6.7% of all cancer deaths among females) (Tables 6.2.2(a) and 6.2.2(b))

Over the past fifty years, the ASIR of liver cancer declined and then plateaued from 1988-1992 onwards for both genders (Figure 9.4.1). The drop in incidence can partly be attributed to the better control and management of Hepatitis B [90] [91] [92]. Since 1987, Singapore has implemented the universal Hepatitis B virus (HBV) vaccination for all newborns as a part of the National Childhood Immunisation Programme; a catch-up vaccination programme was also implemented between 2001 and 2004 for those born before 1987. The ASIR of liver cancer was consistently higher among males, though a slight narrowing of the gender gap over the years was observed – the male-to-female ratio for the ASIR decreased from 3.6:1 in 1968-1972 to 3.3:1 in 2013-2017. The gender disparity was probably due to differences in lifestyle risk factors including higher rates of alcohol consumption, tobacco smoking, obesity and diabetes mellitus among males [93] [94] [95], as well as biological differences between genders [96]. The Chinese had the highest risk of developing liver cancer compared to the Malays and Indians for both genders (Tables 9.4.1(a) and 9.4.1(b)). In 2013-2017, the age-adjusted relative risk was 0.88 (95% CI: 0.74-1.04) for Malay males and 0.63 (95% CI: 0.53-0.74) for Indian males, and the relative risk was 0.98 (95% CI: 0.80-1.21) for Malay females and 0.57 (95% CI: 0.43-0.76) for Indian females. The risk of developing liver cancer rose sharply with age and peaked among those in the oldest age band in 2013-2017 (Figure 9.4.2). In 2013-2017, 18.9% of liver cancers occurred among those aged 80 years and above.

The ASMR of liver cancer declined from 1983-1987 onwards, a trend observed especially among males (Figure 9.4.3). Generally, the prognosis of liver cancer tended to be poor since most cases were diagnosed at advanced stages [97]. In Singapore, some gradual improvements were observed in this area in the last two decades; the five-year ASRS increased from 3.6% in 1993-1997 to 26.1% in 2013-2017 for males

and from 2.9% to 22.6% for females (Figures 9.4.4(a) and 9.4.4(b)). The percentage of liver cancer diagnosed at Stage I and II increased from 31.3% in 2008 to 45.0% in 2017 (Table 9.4.3), a positive trend since treatment options tend to be limited and less efficacious for cases diagnosed in later stages.

The ASIR of liver cancer (2008-2012) in Singapore was one of the lowest among the Asian countries including Japan (Osaka), South Korea, and China (Shanghai and Hong Kong), but higher than those in UK, Australia, USA and Denmark (Figure 9.4.5). The age-standardised five-year net survival (2010-2014) of liver cancer in Singapore was one of the highest among the selected countries, trailing behind only Japan and South Korea (Figure 9.4.6).

Figure 9.4.1: AGE-STANDARDISED INCIDENCE RATE (PER 100,000 POPULATION) FOR LIVER CANCER BY GENDER AND FIVE-YEAR PERIOD, 1968-2017

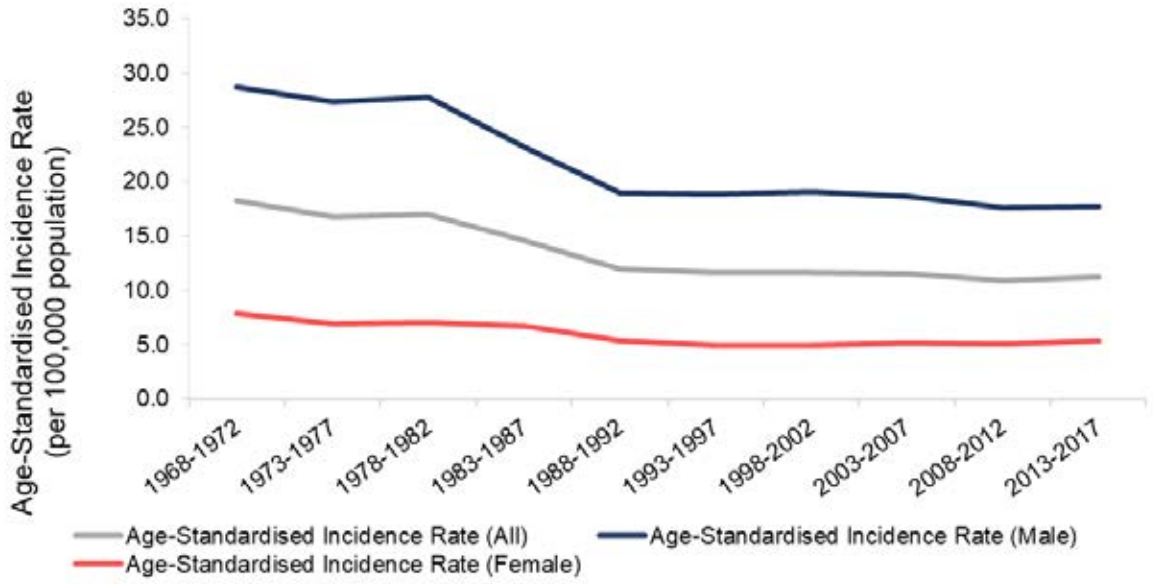


Table 9.4.1(a): INCIDENCE NUMBER AND RATE (PER 100,000 POPULATION) AND RELATIVE RISK FOR LIVER CANCER IN MALES BY ETHNICITY AND FIVE-YEAR PERIOD, 1968-2017

Period		1968-1972	1973-1977	1978-1982	1983-1987	1988-1992
All	Number (%)	898 (100.0%)	965 (100.0%)	1126 (100.0%)	1095 (100.0%)	1089 (100.0%)
	CIR	17.5	17.9	19.4	17.4	15.8
	ASIR	28.7	27.4	27.8	23.2	19.0
Chinese	Number (%)	792 (88.2%)	840 (87.0%)	988 (87.7%)	974 (88.9%)	960 (88.2%)
	CIR	20.2	20.2	21.9	20.0	18.0
	ASIR	32.8	31.1	31.6	27.0	22.0
	RR	1.00	1.00	1.00	1.00	1.00
Malay	Number (%)	58 (6.5%)	75 (7.8%)	78 (6.9%)	78 (7.1%)	82 (7.5%)
	CIR	7.6	9.6	9.3	8.7	8.4
	ASIR	15.0	16.6	15.7	12.6	11.4
	RR and 95% CI	0.49 (0.39-0.62)	0.58 (0.46-0.72)	0.49 (0.39-0.62)	0.50 (0.41-0.61)	0.55 (0.41-0.73)
Indian	Number (%)	42 (4.7%)	44 (4.6%)	54 (4.8%)	40 (3.7%)	39 (3.6%)
	CIR	9.9	10.9	13.2	8.7	7.5
	ASIR	10.3	13.8	14.1	9.4	6.2
	RR and 95% CI	0.37 (0.25-0.53)	0.41 (0.32-0.52)	0.44 (0.35-0.56)	0.32 (0.23-0.43)	0.30 (0.22-0.41)
Period		**1993-1997**	**1998-2002**	**2003-2007**	**2008-2012**	**2013-2017**
All	Number (%)	1302 (100.0%)	1554 (100.0%)	1787 (100.0%)	2134 (100.0%)	2705 (100.0%)
	CIR	17.2	19.0	20.7	23.1	28.2
	ASIR	18.9	19.1	18.7	17.6	17.7
Chinese	Number (%)	1121 (86.1%)	1372 (88.3%)	1559 (87.2%)	1834 (85.9%)	2286 (84.5%)
	CIR	19.2	21.9	24.0	26.8	32.3
	ASIR	21.2	21.7	20.5	18.7	18.6
	RR	1.00	1.00	1.00	1.00	1.00
Malay	Number (%)	122 (9.4%)	114 (7.3%)	142 (7.9%)	187 (8.8%)	248 (9.2%)
	CIR	11.4	10.0	11.8	14.9	19.1
	ASIR	15.6	12.5	13.5	15.0	15.4
	RR and 95% CI	0.73 (0.57-0.93)	0.59 (0.46-0.75)	0.69 (0.57-0.84)	0.81 (0.72-0.91)	0.88 (0.74-1.04)
Indian	Number (%)	49 (3.8%)	60 (3.9%)	69 (3.9%)	82 (3.8%)	124 (4.6%)
	CIR	8.4	8.9	9.2	9.2	13.6
	ASIR	7.6	8.1	9.2	9.3	11.6
	RR and 95% CI	0.34 (0.26-0.43)	0.35 (0.26-0.47)	0.46 (0.33-0.64)	0.50 (0.43-0.59)	0.63 (0.53-0.74)

Table 9.4.1(b): INCIDENCE NUMBER AND RATE (PER 100,000 POPULATION) AND RELATIVE RISK FOR LIVER CANCER IN FEMALES BY ETHNICITY AND FIVE-YEAR PERIOD, 1968-2017

Period		1968-1972	1973-1977	1978-1982	1983-1987	1988-1992
All	Number (%)	243 (100.0%)	255 (100.0%)	305 (100.0%)	354 (100.0%)	354 (100.0%)
	CIR	5.0	4.9	5.4	5.8	5.3
	ASIR	7.9	6.9	7.0	6.7	5.4
Chinese	Number (%)	214 (88.1%)	231 (90.6%)	273 (89.5%)	314 (88.7%)	321 (90.7%)
	CIR	5.6	5.6	6.1	6.5	6.1
	ASIR	8.0	7.2	7.2	7.0	5.8
	RR	1.00	1.00	1.00	1.00	1.00
Malay	Number (%)	19 (7.8%)	10 (3.9%)	23 (7.5%)	33 (9.3%)	25 (7.1%)
	CIR	2.6	1.3	2.9	3.8	2.7
	ASIR	6.7	2.8	5.5	6.2	3.9
	RR and 95% CI	0.88 (0.64-1.20)	0.40 (0.20-0.80)	0.81 (0.48-1.37)	0.95 (0.70-1.28)	0.70 (0.50-0.98)
Indian	Number (%)	6 (2.5%)	9 (3.5%)	4 (1.3%)	6 (1.7%)	6 (1.7%)
	CIR	2.1	3.1	1.3	1.6	1.4
	ASIR	6.3	5.1	2.2	4.8	2.7
	RR and 95% CI	0.91 (0.44-1.88)	1.10 (0.43-2.84)	0.41 (0.17-0.98)	0.44 (0.18-1.12)	0.40 (0.21-0.75)
Period		**1993-1997**	**1998-2002**	**2003-2007**	**2008-2012**	**2013-2017**
All	Number (%)	379 (100.0%)	471 (100.0%)	588 (100.0%)	736 (100.0%)	992 (100.0%)
	CIR	5.1	5.7	6.7	7.7	10.0
	ASIR	4.9	4.9	5.1	5.0	5.3
Chinese	Number (%)	342 (90.2%)	414 (87.9%)	515 (87.6%)	639 (86.8%)	846 (85.3%)
	CIR	5.9	6.5	7.7	9.0	11.4
	ASIR	5.2	5.1	5.2	5.2	5.4
	RR	1.00	1.00	1.00	1.00	1.00
Malay	Number (%)	27 (7.1%)	36 (7.6%)	48 (8.2%)	62 (8.4%)	95 (9.6%)
	CIR	2.6	3.2	4.0	4.9	7.3
	ASIR	3.3	3.6	4.3	4.4	5.6
	RR and 95% CI	0.68 (0.50-0.92)	0.77 (0.55-1.09)	0.80 (0.64-1.01)	0.87 (0.67-1.11)	0.98 (0.80-1.21)
Indian	Number (%)	7 (1.8%)	14 (3.0%)	20 (3.4%)	25 (3.4%)	34 (3.4%)
	CIR	1.3	2.3	2.8	3.0	3.9
	ASIR	1.7	3.4	3.3	2.9	3.0
	RR and 95% CI	0.37 (0.24-0.58)	0.57 (0.34-0.95)	0.62 (0.47-0.81)	0.59 (0.41-0.86)	0.57 (0.43-0.76)

Figure 9.4.2: AGE-SPECIFIC INCIDENCE RATE (PER 100,000 POPULATION) FOR LIVER CANCER BY AGE GROUP, 1968-1972, 1988-1992, 2013-2017

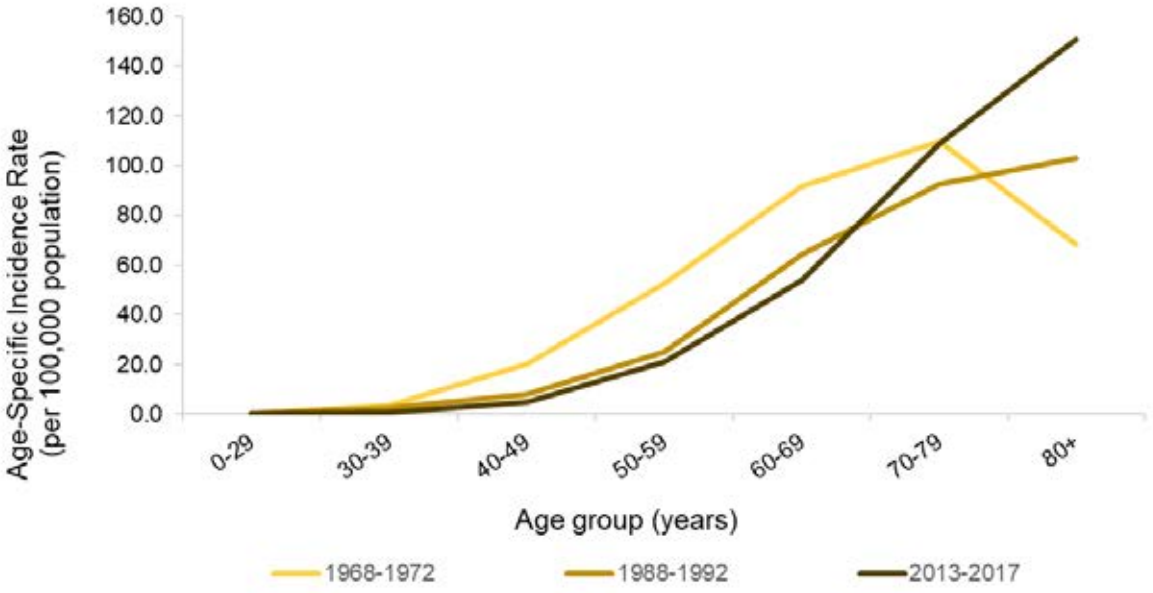


Figure 9.4.3: AGE-STANDARDISED MORTALITY RATE (PER 100,000 POPULATION) FOR LIVER CANCER BY GENDER AND FIVE-YEAR PERIOD, 1968-2017

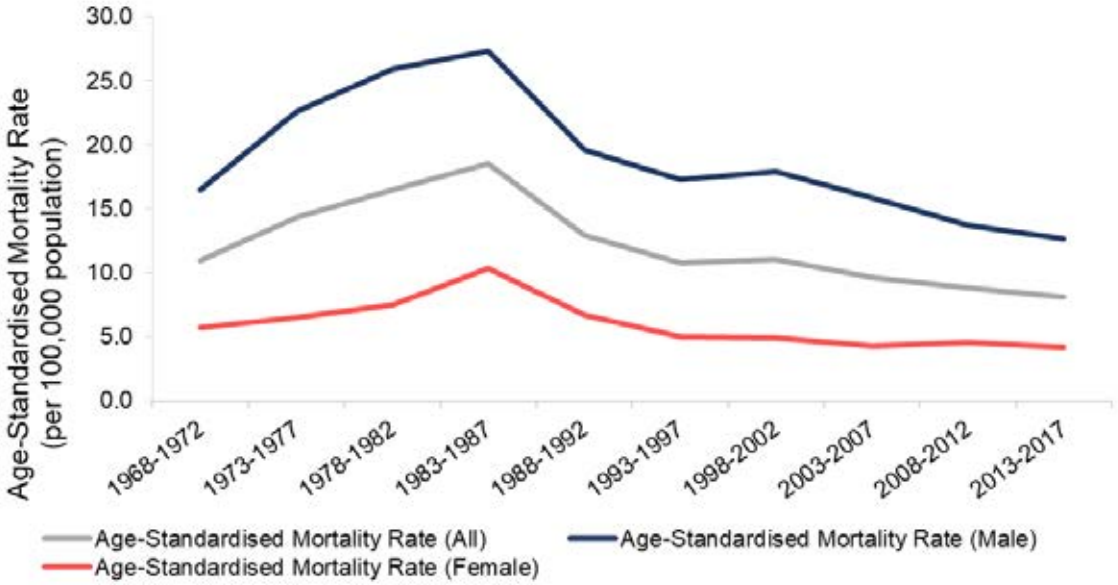


Table 9.4.2(a): MORTALITY NUMBER AND RATE (PER 100,000 POPULATION) FOR LIVER CANCER IN MALES BY ETHNICITY AND FIVE-YEAR PERIOD, 1968-2017

Period		1968-1972	1973-1977	1978-1982	1983-1987	1988-1992
All	Number (%)	501 (100.0%)	799 (100.0%)	1048 (100.0%)	1292 (100.0%)	1119 (100.0%)
	CMR	9.7	14.8	18.1	20.5	16.2
	ASMR	16.5	22.6	25.9	27.4	19.6
Chinese	Number (%)	456 (91.0%)	709 (88.7%)	943 (90.0%)	1171 (90.6%)	994 (88.8%)
	CMR	11.6	17.1	20.9	24.0	18.7
	ASMR	19.4	26.1	30.4	32.5	22.8
Malay	Number (%)	25 (5.0%)	52 (6.5%)	64 (6.1%)	74 (5.7%)	78 (7.0%)
	CMR	3.3	6.6	7.7	8.2	8.0
	ASMR	7.5	11.5	12.9	12.4	11.0
Indian	Number (%)	18 (3.6%)	31 (3.9%)	38 (3.6%)	43 (3.3%)	41 (3.7%)
	CMR	4.2	7.7	9.3	9.4	7.9
	ASMR	5.0	10.5	9.6	9.5	6.9
Period		**1993-1997**	**1998-2002**	**2003-2007**	**2008-2012**	**2013-2017**
All	Number (%)	1177 (100.0%)	1449 (100.0%)	1505 (100.0%)	1672 (100.0%)	1954 (100.0%)
	CMR	15.5	17.7	17.5	18.1	20.4
	ASMR	17.2	17.9	15.8	13.8	12.7
Chinese	Number (%)	1007 (85.6%)	1285 (88.7%)	1301 (86.4%)	1441 (86.2%)	1669 (85.4%)
	CMR	17.3	20.5	20.0	21.1	23.6
	ASMR	19.3	20.5	17.1	14.7	13.3
Malay	Number (%)	119 (10.1%)	96 (6.6%)	135 (9.0%)	146 (8.7%)	185 (9.5%)
	CMR	11.1	8.4	11.2	11.7	14.3
	ASMR	14.9	10.3	13.0	11.9	12.0
Indian	Number (%)	41 (3.5%)	50 (3.5%)	60 (4.0%)	64 (3.8%)	80 (4.1%)
	CMR	7.0	7.4	8.0	7.2	8.8
	ASMR	6.2	6.3	8.3	7.2	7.7

Table 9.4.2(b): MORTALITY NUMBER AND RATE (PER 100,000 POPULATION) FOR LIVER CANCER IN FEMALES BY ETHNICITY AND FIVE-YEAR PERIOD, 1968-2017

Period		1968-1972	1973-1977	1978-1982	1983-1987	1988-1992
All	Number (%)	176 (100.0%)	236 (100.0%)	332 (100.0%)	543 (100.0%)	436 (100.0%)
	CMR	3.6	4.5	5.9	8.9	6.5
	ASMR	5.7	6.5	7.5	10.3	6.7
Chinese	Number (%)	158 (89.8%)	212 (89.8%)	295 (88.9%)	485 (89.3%)	396 (90.8%)
	CMR	4.1	5.2	6.6	10.1	7.5
	ASMR	5.9	6.7	7.7	10.9	7.2
Malay	Number (%)	12 (6.8%)	14 (5.9%)	25 (7.5%)	39 (7.2%)	27 (6.2%)
	CMR	1.6	1.9	3.1	4.5	2.9
	ASMR	4.3	3.8	5.6	7.4	4.2
Indian	Number (%)	4 (2.3%)	5 (2.1%)	4 (1.2%)	17 (3.1%)	9 (2.1%)
	CMR	1.4	1.7	1.3	4.5	2.0
	ASMR	4.2	2.4	2.3	8.8	3.5
Period		**1993-1997**	**1998-2002**	**2003-2007**	**2008-2012**	**2013-2017**
All	Number (%)	391 (100.0%)	481 (100.0%)	519 (100.0%)	702 (100.0%)	842 (100.0%)
	CMR	5.2	5.9	5.9	7.4	8.5
	ASMR	5.0	4.9	4.3	4.5	4.2
Chinese	Number (%)	351 (89.8%)	420 (87.3%)	459 (88.4%)	607 (86.5%)	726 (86.2%)
	CMR	6.0	6.6	6.9	8.6	9.8
	ASMR	5.3	5.0	4.5	4.6	4.2
Malay	Number (%)	30 (7.7%)	41 (8.5%)	45 (8.7%)	61 (8.7%)	72 (8.6%)
	CMR	2.9	3.6	3.7	4.8	5.5
	ASMR	3.8	4.2	4.0	4.4	4.0
Indian	Number (%)	6 (1.5%)	14 (2.9%)	12 (2.3%)	25 (3.6%)	28 (3.3%)
	CMR	1.1	2.3	1.7	3.0	3.2
	ASMR	1.5	3.4	1.9	2.9	2.6

Figure 9.4.4(a): TRENDS IN AGE-STANDARDISED INCIDENCE RATE (PER 100,000 POPULATION), AGE-STANDARDISED MORTALITY RATE (PER 100,000 POPULATION), AND FIVE-YEAR AGE-STANDARDISED RELATIVE SURVIVAL RATE (%) FOR LIVER CANCER IN MALES BY FIVE-YEAR PERIOD, 1968-2017

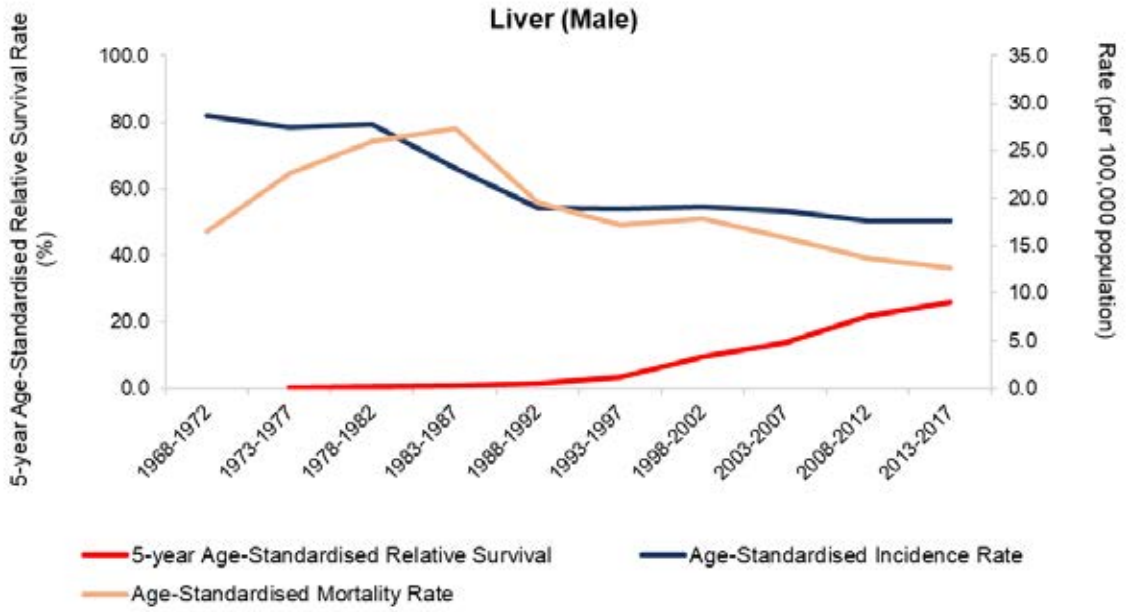


Figure 9.4.4(b): TRENDS IN AGE-STANDARDISED INCIDENCE RATE (PER 100,000 POPULATION), AGE-STANDARDISED MORTALITY RATE (PER 100,000 POPULATION), AND FIVE-YEAR AGE-STANDARDISED RELATIVE SURVIVAL RATE (%) FOR LIVER CANCER IN FEMALES BY FIVE-YEAR PERIOD, 1968-2017

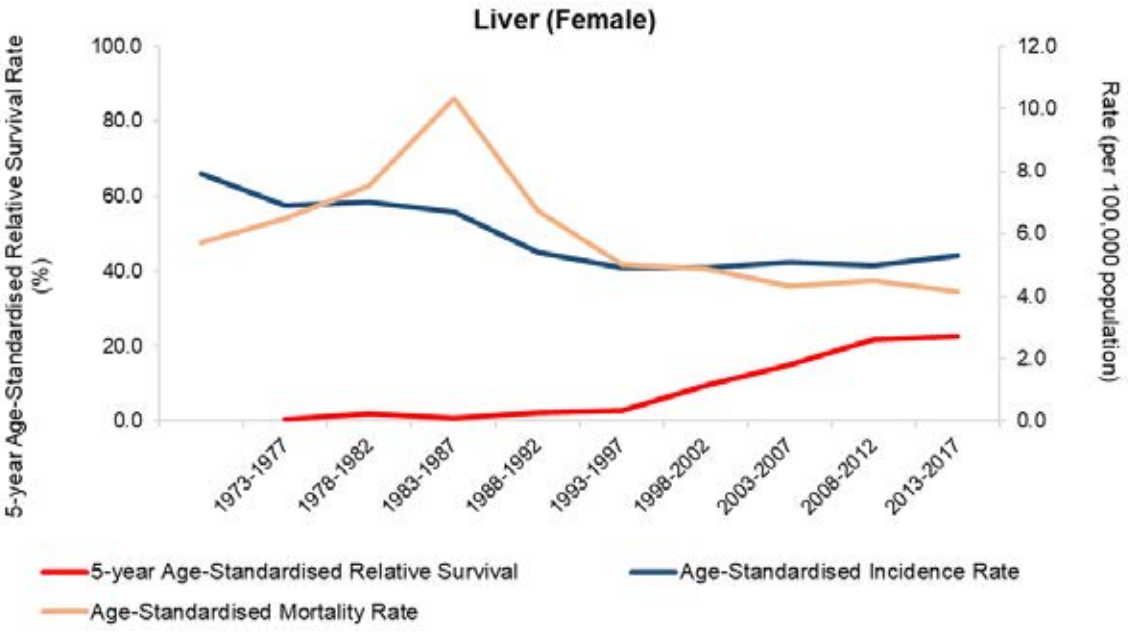


Table 9.4.3: STAGE DISTRIBUTION OF LIVER CANCER, 2008-2017

Year	Stage I		Stage II		Stage III		Stage IV	
	Number	%	Number	%	Number	%	Number	%
2008	42	17.1	35	14.2	76	30.9	93	37.8
2009	69	24.1	42	14.7	100	35.0	75	26.2
2010	116	25.4	89	19.5	139	30.4	113	24.7
2011	82	18.1	93	20.5	140	30.8	139	30.6
2012	127	26.3	99	20.5	119	24.7	137	28.4
2013	157	25.8	109	17.9	157	25.8	185	30.4
2014	151	23.8	132	20.8	164	25.9	187	29.5
2015	175	26.7	114	17.4	195	29.7	172	26.2
2016	177	25.7	109	15.8	196	28.4	208	30.1
2017	176	27.5	112	17.5	164	25.7	187	29.3

Figure 9.4.5: AGE-STANDARDISED INCIDENCE RATE (PER 100,000 POPULATION) FOR LIVER CANCER IN SELECTED COUNTRIES, 2008-2012

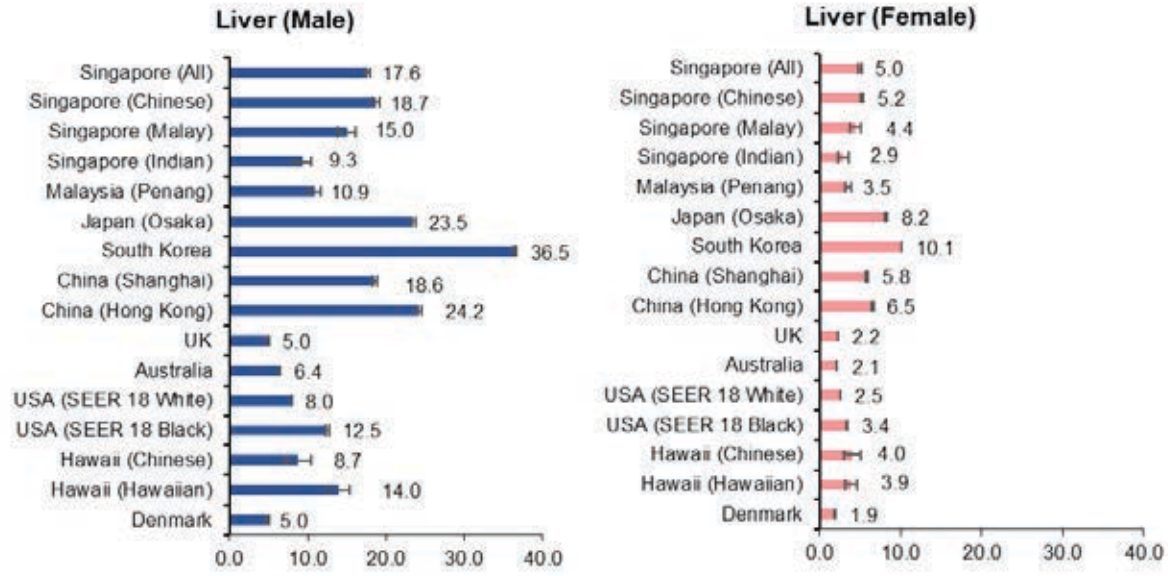
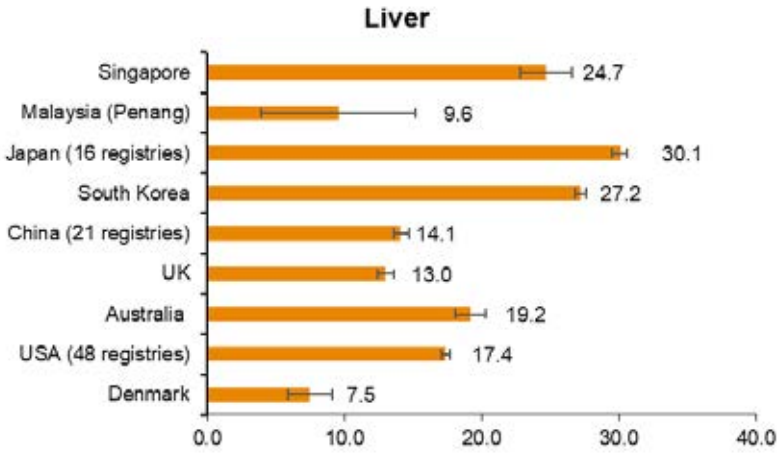


Figure 9.4.6: FIVE-YEAR AGE-STANDARDISED NET SURVIVAL (%) FOR LIVER CANCER IN SELECTED COUNTRIES, 2010-2014



9.5 LUNG (INCLUDING TRACHEA AND BRONCHUS) (ICD-10: C33-C34)

In Singapore, lung cancer was consistently ranked as one of the leading cancers in the past fifty years. Among males, it was the top ranking cancer diagnosed during 1968-2007 and fell to second place from 2008-2012 onwards (Table 5.1.2(a)). Among females, it was the fourth most common cancer during 1968-1977, before moving up to third place thereafter (Table 5.1.2(b)). In 2013-2017, there were 7,780 new cases diagnosed (around four cases per day), accounting for 14.5% of all cancers among males and 7.6% among females. Lung cancer accounted for a higher percentage of cancer deaths than its percentage among all incident cancers; this was due to its relatively high fatality rate. In 2013-2017, it was the top cause of cancer death among males and the second leading cause of cancer death among females, with 6,064 deaths (more than three cases per day), accounting for 26.6% of cancer deaths among males and 16.1% among females (Tables 6.2.2(a) and 6.2.2(b)).

The ASIR of lung cancer rose steadily between 1968-1977 and started to decline from 1978-1982 onwards, a trend that was particularly pronounced in males (Figure 9.5.1). The initial rise in incidence was primarily due to increased prevalence of cigarette smoking, and the downward trend from 1978-1982 onwards was attributable to the drop in smoking prevalence under Singapore's strict tobacco-control regulations since 1970 [98] [99]. In line with the gender differences in smoking prevalence rates, 21.1% among males and 3.4% among females in 2017, males were at higher risk of developing lung cancer than females [67]. Since 1978-1982, the gender gap in terms of ASIR for lung cancer had narrowed due to a marked decline of the ASIR among males, and the male-to-female ratio decreased from 2.9:1 in 1968-1972 to 2.1:1 in 2013-2017. Among males, while the ASIR for Chinese males began declining since 1978-1982, a similar trend was not observed among Malay and Indian males (Table 9.5.1(a)). In 2013-2017, Malay males overtook Chinese males to be the ethnic group having the highest ASIR. However, the ASIR was consistently the highest among Chinese females in the past fifty years, and lowest among Indian females, with Malay females somewhere in between (Table 9.5.1(b)). The risk of developing lung cancer increased sharply with age and peaked among those in the oldest age band in 2013-2017 (Figure 9.5.2). In 2013-2017, 21.1% of lung cancer occurred among those aged 80 years and above.

In line with the temporal trend of the ASIR of lung cancer, the ASMR also gradually declined from 1978-1982 onwards for males and from 1983-1987 onwards for females (Figure 9.5.3). The ethnic disparity in the mortality rate of lung cancer was similar to that observed for the incidence rate (Tables 9.5.2(a) and 9.5.2(b)). In 2013-2017, Malay males overtook Chinese males to be the ethnic group having both the highest ASIR and ASMR of lung cancer, perhaps not surprising as Malay males also had the

highest smoking prevalence rate [95]. The mortality rate of lung cancer closely mirrored the incidence rate for both genders (Figures 9.5.4(a) and 9.5.4(b)), pointing to the high case fatality rate of lung cancer. The overall survival rate for lung cancer patients was poor, especially for males. This was partly due to the fact that the majority of the cases were diagnosed at advanced stage - about two-thirds were diagnosed at Stage IV in the past decade (Table 9.5.3). The five-year ASRS was much lower for cases diagnosed at Stage IV in 2013-2017 (less than 10.0%) compared with cases diagnosed at earlier stages in the same period (above 35.0% for cases diagnosed at Stages I-II) (Appendix E1-2). Although some improvements in the five-year ASRS was observed among females (from 5.3% in 1973-1977 to 24.0% in 2013-2017), the improvement was less pronounced among males (from 3.0% in 1973-1977 to 13.8% in 2013-2017).

The ASIR of lung cancer in Singapore (2008-2012) was one of the lowest among the selected countries/regions for both genders (Figure 9.5.5). The age-standardised five-year net survival (2010-2014) of lung cancer in Singapore was lower than those in Japan, South Korea, China, Australia and USA, but higher compared to those in Malaysia (Penang) and UK (Figure 9.5.6).

Figure 9.5.1: AGE-STANDARDISED INCIDENCE RATE (PER 100,000 POPULATION) FOR LUNG CANCER BY GENDER AND FIVE-YEAR PERIOD, 1968-2017

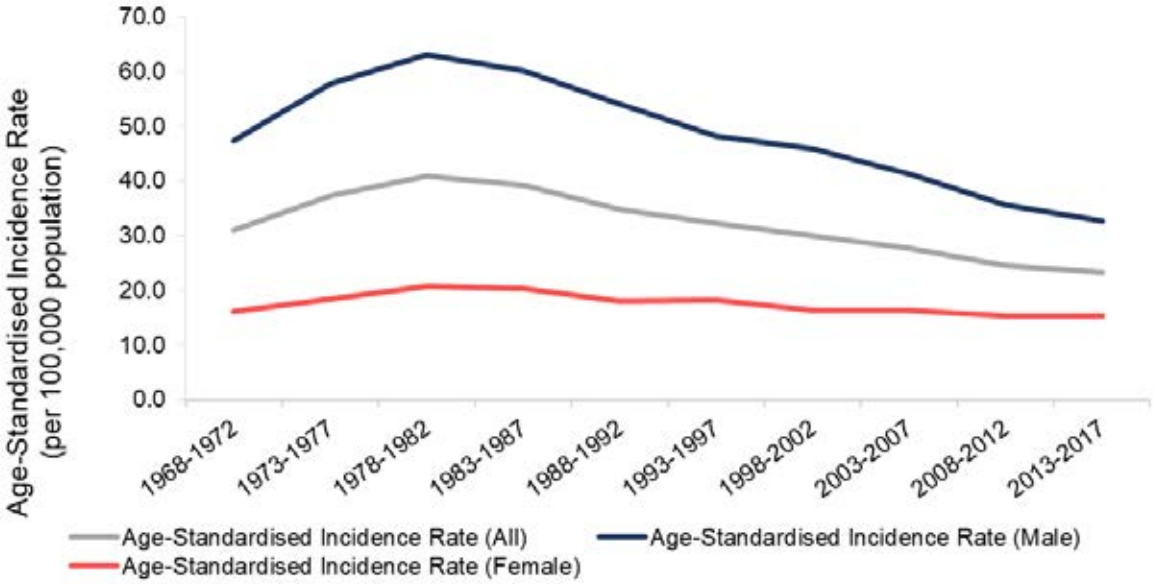


Table 9.5.1(a): INCIDENCE NUMBER AND RATE (PER 100,000 POPULATION) AND RELATIVE RISK FOR LUNG CANCER IN MALES BY ETHNICITY AND FIVE-YEAR PERIOD, 1968-2017

Period		1968-1972	1973-1977	1978-1982	1983-1987	1988-1992
All	Number (%)	1361 (100.0%)	1920 (100.0%)	2440 (100.0%)	2770 (100.0%)	2971 (100.0%)
	CIR	26.5	35.5	42.1	44.0	43.1
	ASIR	47.3	57.9	63.0	60.1	54.1
Chinese	Number (%)	1273 (93.5%)	1728 (90.0%)	2226 (91.2%)	2475 (89.4%)	2617 (88.1%)
	CIR	32.5	41.6	49.4	50.8	49.1
	ASIR	55.7	66.6	73.9	70.1	62.8
	RR	1.00	1.00	1.00	1.00	1.00
Malay	Number (%)	47 (3.5%)	111 (5.8%)	122 (5.0%)	191 (6.9%)	241 (8.1%)
	CIR	6.2	14.2	14.6	21.3	24.6
	ASIR	14.9	26.0	25.9	32.4	37.0
	RR and 95% CI	0.27 (0.20-0.36)	0.44 (0.35-0.56)	0.36 (0.30-0.43)	0.49 (0.42-0.57)	0.59 (0.51-0.68)
Indian	Number (%)	34 (2.5%)	65 (3.4%)	74 (3.0%)	92 (3.3%)	83 (2.8%)
	CIR	8.0	16.0	18.1	20.1	16.0
	ASIR	10.2	19.7	21.7	21.4	14.4
	RR and 95% CI	0.21 (0.15-0.31)	0.31 (0.22-0.45)	0.28 (0.20-0.38)	0.29 (0.25-0.34)	0.23 (0.18-0.29)
Period		**1993-1997**	**1998-2002**	**2003-2007**	**2008-2012**	**2013-2017**
All	Number (%)	3168 (100.0%)	3598 (100.0%)	3862 (100.0%)	4291 (100.0%)	4992 (100.0%)
	CIR	41.8	44.0	44.8	46.4	52.1
	ASIR	48.1	45.8	41.3	35.7	32.6
Chinese	Number (%)	2818 (89.0%)	3150 (87.5%)	3346 (86.6%)	3648 (85.0%)	4157 (83.3%)
	CIR	48.3	50.4	51.5	53.4	58.7
	ASIR	56.5	52.3	44.9	37.5	33.2
	RR	1.00	1.00	1.00	1.00	1.00
Malay	Number (%)	241 (7.6%)	318 (8.8%)	357 (9.2%)	439 (10.2%)	555 (11.1%)
	CIR	22.5	27.8	29.7	35.1	42.8
	ASIR	30.6	36.1	34.2	35.5	37.2
	RR and 95% CI	0.56 (0.49-0.65)	0.70 (0.64-0.77)	0.80 (0.70-0.93)	0.97 (0.86-1.10)	1.13 (0.99-1.28)
Indian	Number (%)	74 (2.3%)	94 (2.6%)	125 (3.2%)	151 (3.5%)	194 (3.9%)
	CIR	12.6	14.0	16.7	17.0	21.3
	ASIR	10.8	12.6	17.6	17.8	19.0
	RR and 95% CI	0.19 (0.15-0.23)	0.22 (0.14-0.34)	0.37 (0.29-0.48)	0.46 (0.38-0.55)	0.55 (0.46-0.66)

Table 9.5.1(b): INCIDENCE NUMBER AND RATE (PER 100,000 POPULATION) AND RELATIVE RISK FOR LUNG CANCER IN FEMALES BY ETHNICITY AND FIVE-YEAR PERIOD, 1968-2017

Period		1968-1972	1973-1977	1978-1982	1983-1987	1988-1992
All	Number (%)	489 (100.0%)	663 (100.0%)	893 (100.0%)	1072 (100.0%)	1174 (100.0%)
	CIR	10.0	12.8	15.9	17.5	17.4
	ASIR	16.2	18.5	20.8	20.4	18.0
Chinese	Number (%)	461 (94.3%)	622 (93.8%)	849 (95.1%)	992 (92.5%)	1096 (93.4%)
	CIR	12.0	15.2	19.1	20.6	20.8
	ASIR	17.3	19.9	22.8	22.0	19.8
	RR	1.00	1.00	1.00	1.00	1.00
Malay	Number (%)	20 (4.1%)	22 (3.3%)	29 (3.2%)	61 (5.7%)	60 (5.1%)
	CIR	2.7	2.9	3.6	7.1	6.4
	ASIR	7.6	6.7	7.8	12.0	9.5
	RR and 95% CI	0.44 (0.28-0.70)	0.36 (0.26-0.49)	0.33 (0.22-0.50)	0.58 (0.45-0.74)	0.50 (0.40-0.62)
Indian	Number (%)	5 (1.0%)	9 (1.4%)	8 (0.9%)	10 (0.9%)	12 (1.0%)
	CIR	1.8	3.1	2.5	2.7	2.7
	ASIR	8.1	7.5	6.1	5.7	4.3
	RR and 95% CI	0.38 (0.20-0.72)	0.47 (0.21-1.02)	0.27 (0.16-0.45)	0.24 (0.13-0.45)	0.24 (0.14-0.40)
Period		**1993-1997**	**1998-2002**	**2003-2007**	**2008-2012**	**2013-2017**
All	Number (%)	1444 (100.0%)	1603 (100.0%)	1905 (100.0%)	2262 (100.0%)	2788 (100.0%)
	CIR	19.3	19.5	21.8	23.8	28.1
	ASIR	18.3	16.4	16.3	15.4	15.4
Chinese	Number (%)	1336 (92.5%)	1442 (90.0%)	1719 (90.2%)	2005 (88.6%)	2444 (87.7%)
	CIR	22.9	22.8	25.9	28.3	32.9
	ASIR	20.2	17.6	17.7	16.5	16.5
	RR	1.00	1.00	1.00	1.00	1.00
Malay	Number (%)	86 (6.0%)	115 (7.2%)	143 (7.5%)	179 (7.9%)	231 (8.3%)
	CIR	8.2	10.2	11.9	14.2	17.6
	ASIR	10.3	12.0	12.2	12.3	12.4
	RR and 95% CI	0.57 (0.45-0.71)	0.71 (0.62-0.81)	0.71 (0.57-0.88)	0.75 (0.64-0.89)	0.78 (0.69-0.90)
Indian	Number (%)	17 (1.2%)	34 (2.1%)	29 (1.5%)	49 (2.2%)	67 (2.4%)
	CIR	3.3	5.5	4.1	5.9	7.8
	ASIR	5.5	7.1	4.4	5.7	6.4
	RR and 95% CI	0.23 (0.16-0.34)	0.39 (0.27-0.58)	0.26 (0.18-0.38)	0.35 (0.27-0.45)	0.37 (0.27-0.51)

Figure 9.5.2: AGE-SPECIFIC INCIDENCE RATE (PER 100,000 POPULATION) FOR LUNG CANCER BY AGE GROUP, 1968-1972, 1988-1992, 2013-2017

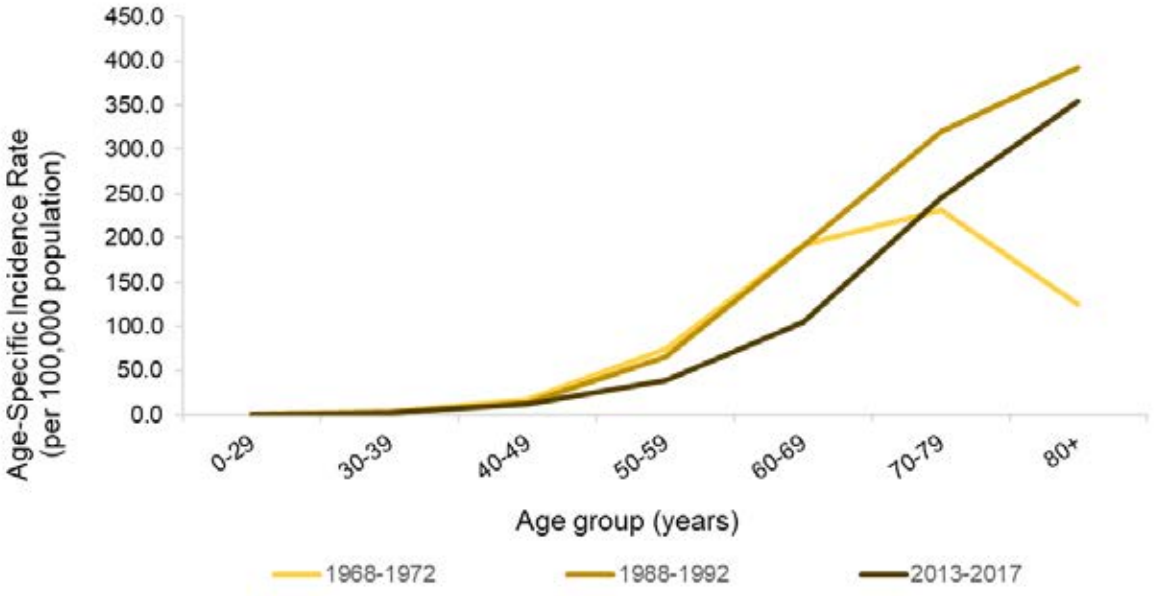


Figure 9.5.3: AGE-STANDARDISED MORTALITY RATE (PER 100,000 POPULATION) FOR LUNG CANCER BY GENDER AND FIVE-YEAR PERIOD, 1968-2017

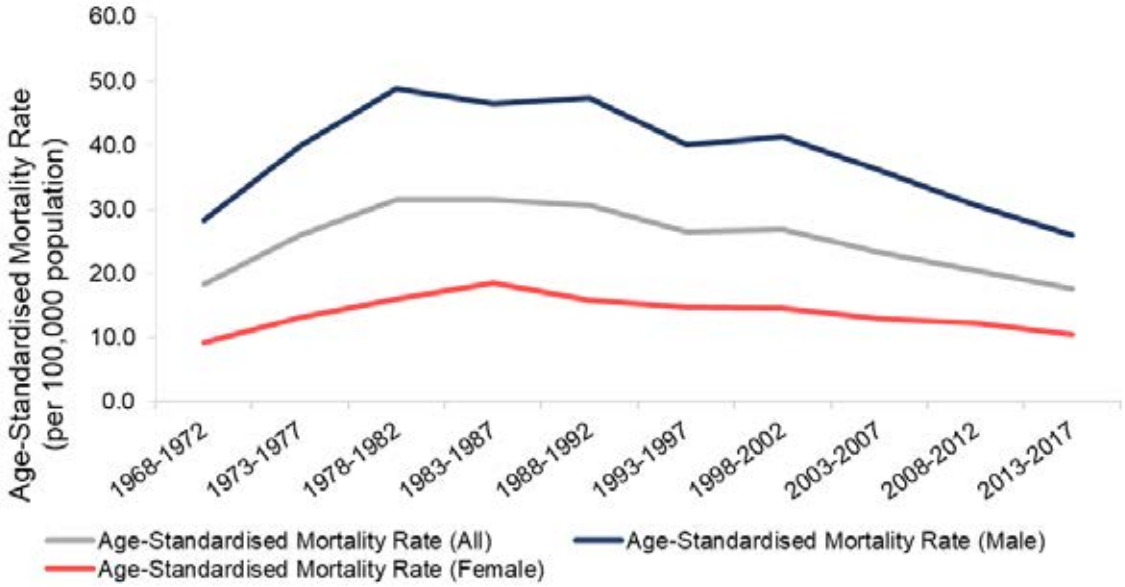


Table 9.5.2(a): MORTALITY NUMBER AND RATE (PER 100,000 POPULATION) FOR LUNG CANCER IN MALES BY ETHNICITY AND FIVE-YEAR PERIOD, 1968-2017

Period		1968-1972	1973-1977	1978-1982	1983-1987	1988-1992
All	Number (%)	807 (100.0%)	1336 (100.0%)	1881 (100.0%)	2155 (100.0%)	2607 (100.0%)
	CMR	15.6	24.7	32.4	34.3	37.8
	ASMR	28.3	40.0	48.8	46.5	47.4
Chinese	Number (%)	761 (94.3%)	1206 (90.3%)	1734 (92.2%)	1951 (90.5%)	2297 (88.1%)
	CMR	19.4	29.0	38.5	40.1	43.1
	ASMR	33.9	46.2	57.8	54.8	55.0
Malay	Number (%)	22 (2.7%)	76 (5.7%)	86 (4.6%)	139 (6.5%)	220 (8.4%)
	CMR	2.9	9.7	10.3	15.5	22.5
	ASMR	6.4	16.6	17.3	24.5	33.3
Indian	Number (%)	20 (2.5%)	44 (3.3%)	44 (2.3%)	56 (2.6%)	63 (2.4%)
	CMR	4.7	10.9	10.8	12.2	12.1
	ASMR	7.0	13.4	14.0	12.8	11.4
Period		**1993-1997**	**1998-2002**	**2003-2007**	**2008-2012**	**2013-2017**
All	Number (%)	2623 (100.0%)	3247 (100.0%)	3375 (100.0%)	3682 (100.0%)	4046 (100.0%)
	CMR	34.6	39.7	39.2	39.8	42.2
	ASMR	40.0	41.4	36.1	30.7	26.1
Chinese	Number (%)	2360 (90.0%)	2865 (88.2%)	2927 (86.7%)	3161 (85.9%)	3384 (83.6%)
	CMR	40.5	45.8	45.1	46.3	47.8
	ASMR	47.4	47.7	39.3	32.6	26.6
Malay	Number (%)	174 (6.6%)	247 (7.6%)	308 (9.1%)	355 (9.6%)	471 (11.6%)
	CMR	16.3	21.6	25.6	28.3	36.3
	ASMR	22.4	27.3	29.6	28.9	31.1
Indian	Number (%)	55 (2.1%)	66 (2.0%)	110 (3.3%)	130 (3.5%)	148 (3.7%)
	CMR	9.4	9.8	14.7	14.7	16.2
	ASMR	7.8	8.8	14.3	15.6	14.3

Table 9.5.2(b): MORTALITY NUMBER AND RATE (PER 100,000 POPULATION) FOR LUNG CANCER IN FEMALES BY ETHNICITY AND FIVE-YEAR PERIOD, 1968-2017

Period		1968-1972	1973-1977	1978-1982	1983-1987	1988-1992
All	Number (%)	282 (100.0%)	474 (100.0%)	687 (100.0%)	980 (100.0%)	1045 (100.0%)
	CMR	5.7	9.1	12.2	16.0	15.5
	ASMR	9.3	13.2	16.0	18.6	15.9
Chinese	Number (%)	268 (95.0%)	444 (93.7%)	654 (95.2%)	901 (91.9%)	983 (94.1%)
	CMR	7.0	10.8	14.7	18.7	18.7
	ASMR	10.0	14.2	17.5	19.9	17.5
Malay	Number (%)	9 (3.2%)	19 (4.0%)	19 (2.8%)	55 (5.6%)	48 (4.6%)
	CMR	1.2	2.5	2.4	6.4	5.1
	ASMR	3.0	6.1	5.0	10.5	7.5
Indian	Number (%)	3 (1.1%)	7 (1.5%)	9 (1.3%)	17 (1.7%)	10 (1.0%)
	CMR	1.1	2.4	2.8	4.5	2.3
	ASMR	3.3	7.0	7.1	7.0	3.9
Period		**1993-1997**	**1998-2002**	**2003-2007**	**2008-2012**	**2013-2017**
All	Number (%)	1186 (100.0%)	1426 (100.0%)	1556 (100.0%)	1844 (100.0%)	2018 (100.0%)
	CMR	15.8	17.4	17.8	19.4	20.3
	ASMR	14.9	14.6	13.0	12.2	10.4
Chinese	Number (%)	1118 (94.3%)	1292 (90.6%)	1408 (90.5%)	1658 (89.9%)	1746 (86.5%)
	CMR	19.2	20.4	21.2	23.4	23.5
	ASMR	16.6	15.7	14.0	13.1	10.8
Malay	Number (%)	55 (4.6%)	93 (6.5%)	117 (7.5%)	138 (7.5%)	186 (9.2%)
	CMR	5.3	8.2	9.7	10.9	14.2
	ASMR	6.7	9.8	10.1	9.7	10.0
Indian	Number (%)	11 (0.9%)	31 (2.2%)	27 (1.7%)	35 (1.9%)	59 (2.9%)
	CMR	2.1	5.0	3.8	4.2	6.8
	ASMR	4.6	6.7	4.1	4.3	5.4

Figure 9.5.4(a): TRENDS IN AGE-STANDARDISED INCIDENCE RATE (PER 100,000 POPULATION), AGE-STANDARDISED MORTALITY RATE (PER 100,000 POPULATION), AND FIVE-YEAR AGE-STANDARDISED RELATIVE SURVIVAL RATE (%) FOR LUNG CANCER IN MALES BY FIVE-YEAR PERIOD, 1968-2017

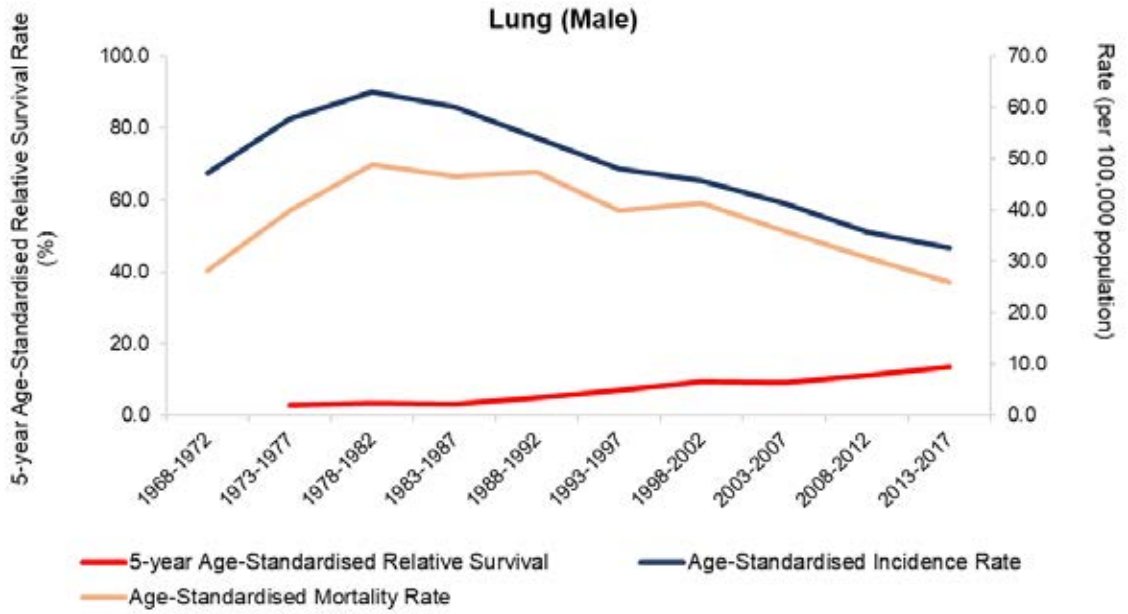


Figure 9.5.4(b): TRENDS IN AGE-STANDARDISED INCIDENCE RATE (PER 100,000 POPULATION), AGE-STANDARDISED MORTALITY RATE (PER 100,000 POPULATION), AND FIVE-YEAR AGE-STANDARDISED RELATIVE SURVIVAL RATE (%) FOR LUNG CANCER IN FEMALES BY FIVE-YEAR PERIOD, 1968-2017

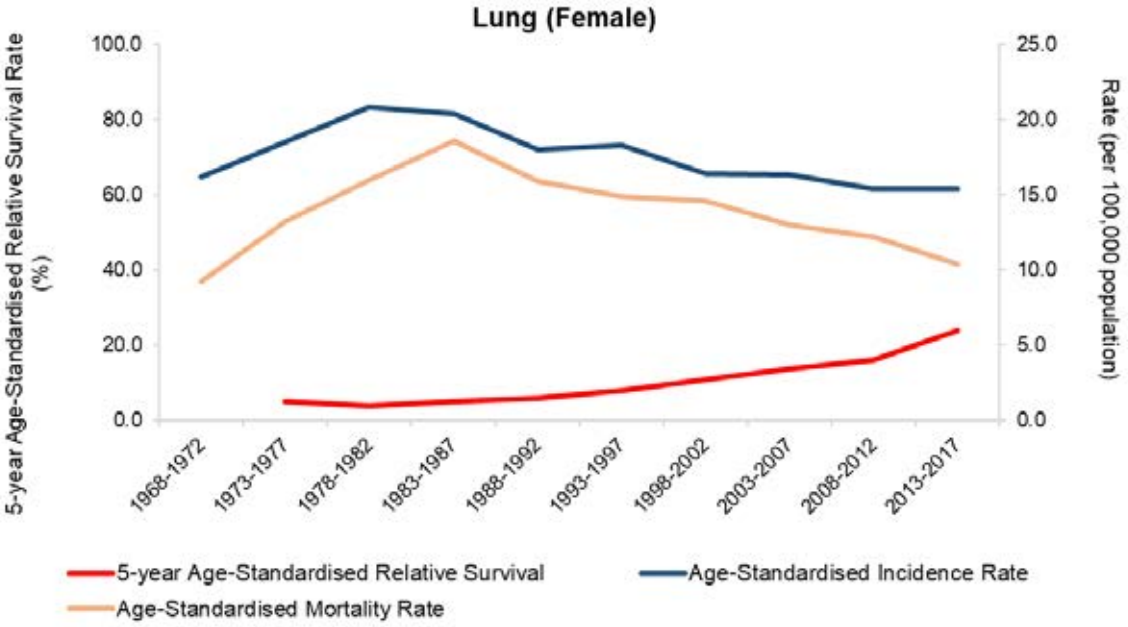


Table 9.5.3: STAGE DISTRIBUTION OF LUNG CANCER, 2008-2017

Year	Stage I		Stage II		Stage III		Stage IV	
	Number	%	Number	%	Number	%	Number	%
2008	123	11.5	37	3.5	269	25.2	637	59.8
2009	123	10.8	37	3.3	290	25.5	686	60.4
2010	117	10.1	48	4.1	237	20.4	759	65.4
2011	108	9.3	51	4.4	202	17.4	803	69.0
2012	146	11.0	75	5.7	237	17.9	867	65.4
2013	151	10.9	68	4.9	233	16.8	938	67.5
2014	146	10.5	73	5.3	218	15.7	949	68.5
2015	195	13.6	80	5.6	227	15.9	927	64.9
2016	218	15.2	63	4.4	216	15.0	941	65.4
2017	238	16.5	69	4.8	198	13.7	938	65.0

Figure 9.5.5: AGE-STANDARDISED INCIDENCE RATE (PER 100,000 POPULATION) FOR LUNG CANCER IN SELECTED COUNTRIES, 2008-2012

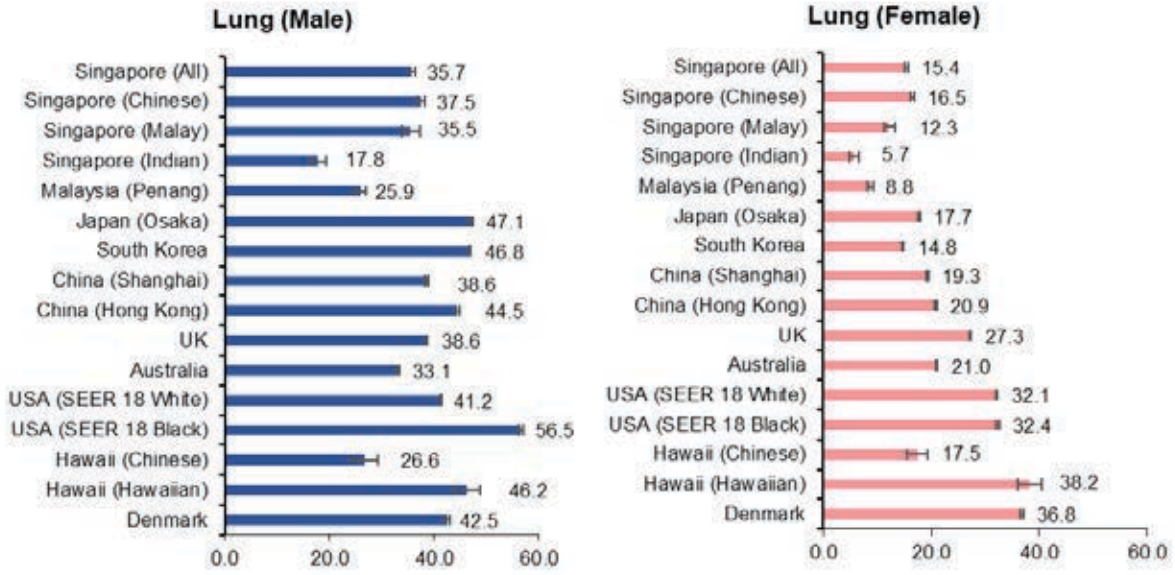
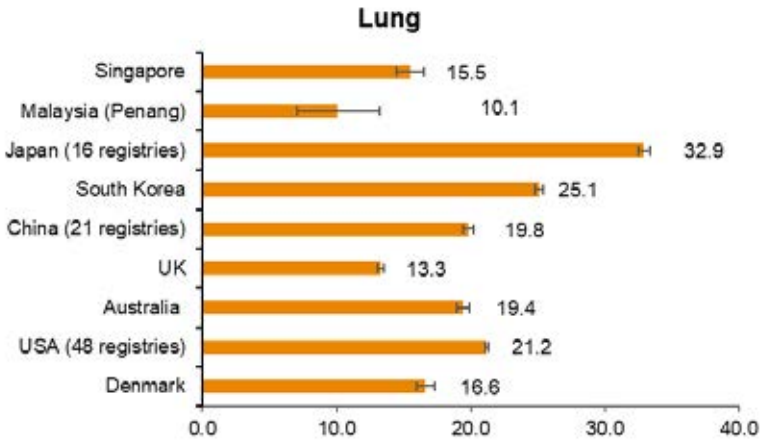


Figure 9.5.6: FIVE-YEAR AGE-STANDARDISED NET SURVIVAL (%) FOR LUNG CANCER IN SELECTED COUNTRIES, 2010-2014



9.6 NON-MELANOMA SKIN CANCER (ICD-10: C44)

In Singapore, non-melanoma skin cancer was one of the most commonly diagnosed cancers in the past fifty years. Among males, its ranking climbed from being the ninth most common cancer in 1968-1972 to the sixth in 2013-2017 (Table 5.1.2(a)). Among females, its ranking fluctuated between the seventh and the ninth from 1973-1977 onwards (Table 5.1.2(b)). In 2013-2017, there were 1,866 new cases diagnosed among males (accounting for 5.4% of all cancer diagnosed among males) and 1,507 new cases among females (accounting for 4.1% of all cancer diagnosed among females). It was one of the least deadly cancers - there were 52 deaths from non-melanoma skin cancer in 2013-2017 (accounting for 0.2% of total cancer deaths during this period), about ten cases per year (Tables 9.6.2(a) and 9.6.2(b)).

A general rising trend in the ASIR of non-melanoma skin cancer for both genders was observed over the past fifty years (Figure 9.6.1). Notably, the upward trend persisted among males, whereas the ASIR among females appeared to plateau from 1993-1997 onwards. The rising incidence might be linked to the increased exposure to ultraviolet (UV) radiation, the primary environmental risk factor for non-melanoma skin cancer [100] [101] [102]. The ASIR was consistently higher among males and the gender gap widened over the years - the male-to-female ratio among incident cases increased from 1.2:1 in 1968-1972 to 1.5:1 in 2013-2017. The reason for the higher incidence among males is unknown, though a study in another Asian country found gender differences in the knowledge, attitudes, and practices (KAP) regarding skin cancer [103], which might lead to different UV exposure between genders. The upward trend in ASIR was observed in the Chinese, but not in the Malays and Indians (Tables 9.6.1(a) and 9.6.1(b)). The Chinese had significantly higher risk of developing non-melanoma skin cancer compared to the Malays and Indians for both genders. In 2013-2017, the age-adjusted relative risk was 0.37 (95%CI: 0.28-0.48) for Malay males and 0.21 (95%CI: 0.16-0.27) for Indian males; the relative risk was 0.45 (95%CI: 0.36-0.55) for Malay females and 0.32 (95%CI: 0.21-0.49) for Indian females. The ethnic disparity is mainly attributable to the differences in skin type – fair-skinned populations are more susceptible to non-melanoma skin cancer [104]. The risk of developing non-melanoma skin cancer rose sharply with age and peaked among those in the oldest age band (Figure 9.6.2). In 2013-2017, 29.9% of non-melanoma skin cancer occurred among those aged 80 years and above.

In spite of the upward trend in the ASIR of non-melanoma skin cancer, the ASMR remained consistently low over the past fifty years and a downward trend was observed in the recent decades (Figure 9.6.3). It is generally considered as a cancer with an excellent prognosis, especially for those diagnosed at early stages. The five-year ASRS of non-melanoma skin cancer remained high during the period under study – above 83.0% for males and above 89.0% for females (Figures 9.6.4(a) and 9.6.4(b)).

The majority of non-melanoma skin cancer were diagnosed at earlier stages – 76.8% and 21.2% of the cases were diagnosed at Stages I and II respectively in 2017 (Table 9.6.3).

The ASIR of non-melanoma skin cancer (2008-2012) in Singapore for both genders was comparable to that in UK, and higher than those in other Asian countries, but much lower than that in Denmark (Figure 9.6.5). Being located immediately north of the Equator, the UV index score in Singapore is one of the highest in the world throughout the year, ranging from 10 to 13 [105], which highlights the importance of public education to increase the awareness of the disease and encourage preventive measures.

Figure 9.6.1: AGE-STANDARDISED INCIDENCE RATE (PER 100,000 POPULATION) FOR NON-MELANOMA SKIN CANCER BY GENDER AND FIVE-YEAR PERIOD, 1968-2017

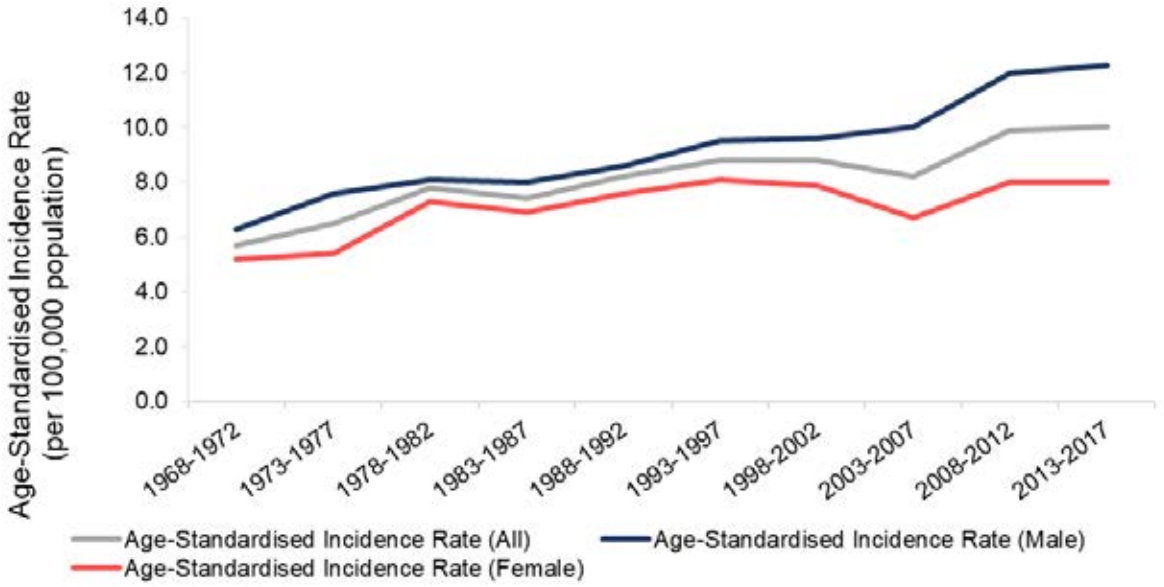


Table 9.6.1(a): INCIDENCE NUMBER AND RATE (PER 100,000 POPULATION) AND RELATIVE RISK FOR NON-MELANOMA SKIN CANCER IN MALES BY ETHNICITY AND FIVE-YEAR PERIOD, 1968-2017

Period		1968-1972	1973-1977	1978-1982	1983-1987	1988-1992
All	Number (%)	167 (100.0%)	247 (100.0%)	319 (100.0%)	371 (100.0%)	501 (100.0%)
	CIR	3.3	4.6	5.5	5.9	7.3
	ASIR	6.3	7.6	8.1	8.0	8.6
Chinese	Number (%)	135 (80.8%)	205 (83.0%)	276 (86.5%)	317 (85.4%)	424 (84.6%)
	CIR	3.4	4.9	6.1	6.5	8.0
	ASIR	6.5	8.1	8.9	8.7	9.5
	RR	1.00	1.00	1.00	1.00	1.00
Malay	Number (%)	15 (9.0%)	12 (4.9%)	19 (6.0%)	25 (6.7%)	29 (5.8%)
	CIR	2.0	1.5	2.3	2.8	3.0
	ASIR	4.6	2.7	3.4	4.5	4.1
	RR and 95% CI	0.77 (0.51-1.16)	0.39 (0.25-0.62)	0.45 (0.28-0.72)	0.52 (0.37-0.74)	0.46 (0.33-0.64)
Indian	Number (%)	7 (4.2%)	15 (6.1%)	7 (2.2%)	9 (2.4%)	17 (3.4%)
	CIR	1.6	3.7	1.7	2.0	3.3
	ASIR	3.3	4.6	2.0	1.9	3.7
	RR and 95% CI	0.41 (0.21-0.83)	0.61 (0.37-1.01)	0.23 (0.10-0.50)	0.24 (0.15-0.39)	0.33 (0.21-0.52)
Period		**1993-1997**	**1998-2002**	**2003-2007**	**2008-2012**	**2013-2017**
All	Number (%)	667 (100.0%)	789 (100.0%)	954 (100.0%)	1469 (100.0%)	1866 (100.0%)
	CIR	8.8	9.6	11.1	15.9	19.5
	ASIR	9.5	9.6	10.0	12.0	12.3
Chinese	Number (%)	569 (85.3%)	671 (85.0%)	774 (81.1%)	1151 (78.4%)	1508 (80.8%)
	CIR	9.8	10.7	11.9	16.8	21.3
	ASIR	10.6	10.5	10.3	11.9	12.1
	RR	1.00	1.00	1.00	1.00	1.00
Malay	Number (%)	35 (5.2%)	40 (5.1%)	36 (3.8%)	59 (4.0%)	66 (3.5%)
	CIR	3.3	3.5	3.0	4.7	5.1
	ASIR	4.2	4.6	3.6	4.4	4.7
	RR and 95% CI	0.43 (0.29-0.63)	0.43 (0.32-0.56)	0.35 (0.26-0.45)	0.40 (0.29-0.56)	0.37 (0.28-0.48)
Indian	Number (%)	23 (3.4%)	16 (2.0%)	26 (2.7%)	20 (1.4%)	28 (1.5%)
	CIR	3.9	2.4	3.5	2.3	3.1
	ASIR	3.3	2.0	4.0	2.3	2.5
	RR and 95% CI	0.33 (0.24-0.44)	0.19 (0.11-0.35)	0.33 (0.18-0.62)	0.18 (0.11-0.30)	0.21 (0.16-0.27)

Table 9.6.1(b): INCIDENCE NUMBER AND RATE (PER 100,000 POPULATION) AND RELATIVE RISK FOR NON-MELANOMA SKIN CANCER IN FEMALES BY ETHNICITY AND FIVE-YEAR PERIOD, 1968-2017

Period		1968-1972	1973-1977	1978-1982	1983-1987	1988-1992
All	Number (%)	153 (100.0%)	198 (100.0%)	328 (100.0%)	374 (100.0%)	526 (100.0%)
	CIR	3.1	3.8	5.8	6.1	7.8
	ASIR	5.2	5.4	7.3	6.9	7.6
Chinese	Number (%)	135 (88.2%)	181 (91.4%)	301 (91.8%)	351 (93.9%)	479 (91.1%)
	CIR	3.5	4.4	6.8	7.3	9.1
	ASIR	5.1	5.7	7.7	7.5	8.1
	RR	1.00	1.00	1.00	1.00	1.00
Malay	Number (%)	7 (4.6%)	4 (2.0%)	12 (3.7%)	12 (3.2%)	24 (4.6%)
	CIR	1.0	0.5	1.5	1.4	2.5
	ASIR	3.2	1.3	3.1	2.2	3.6
	RR and 95% CI	0.55 (0.32-0.95)	0.23 (0.09-0.59)	0.40 (0.26-0.61)	0.32 (0.19-0.54)	0.47 (0.35-0.64)
Indian	Number (%)	2 (1.3%)	6 (3.0%)	8 (2.4%)	5 (1.3%)	12 (2.3%)
	CIR	0.7	2.1	2.5	1.3	2.7
	ASIR	4.9	4.0	4.8	2.5	4.5
	RR and 95% CI	0.55 (0.16-1.91)	1.07 (0.58-1.98)	0.76 (0.43-1.37)	0.34 (0.18-0.67)	0.55 (0.29-1.03)
Period		**1993-1997**	**1998-2002**	**2003-2007**	**2008-2012**	**2013-2017**
All	Number (%)	666 (100.0%)	790 (100.0%)	800 (100.0%)	1217 (100.0%)	1507 (100.0%)
	CIR	8.9	9.6	9.2	12.8	15.2
	ASIR	8.1	7.9	6.7	8.0	8.0
Chinese	Number (%)	592 (88.9%)	716 (90.6%)	711 (88.9%)	1066 (87.6%)	1333 (88.5%)
	CIR	10.2	11.3	10.7	15.0	18.0
	ASIR	8.4	8.5	7.1	8.3	8.4
	RR	1.00	1.00	1.00	1.00	1.00
Malay	Number (%)	35 (5.3%)	34 (4.3%)	39 (4.9%)	51 (4.2%)	66 (4.4%)
	CIR	3.4	3.0	3.2	4.0	5.0
	ASIR	4.4	3.7	3.3	3.7	3.7
	RR and 95% CI	0.56 (0.42-0.74)	0.44 (0.31-0.63)	0.50 (0.34-0.73)	0.43 (0.35-0.54)	0.45 (0.36-0.55)
Indian	Number (%)	17 (2.6%)	15 (1.9%)	14 (1.8%)	23 (1.9%)	29 (1.9%)
	CIR	3.3	2.4	2.0	2.8	3.4
	ASIR	5.1	2.7	2.0	2.7	2.5
	RR and 95% CI	0.56 (0.43-0.74)	0.37 (0.22-0.60)	0.32 (0.18-0.58)	0.33 (0.24-0.47)	0.32 (0.21-0.49)

Figure 9.6.2: AGE-SPECIFIC INCIDENCE RATE (PER 100,000 POPULATION) FOR NON-MELANOMA SKIN CANCER BY AGE GROUP, 1968-1972, 1988-1992, 2013-2017

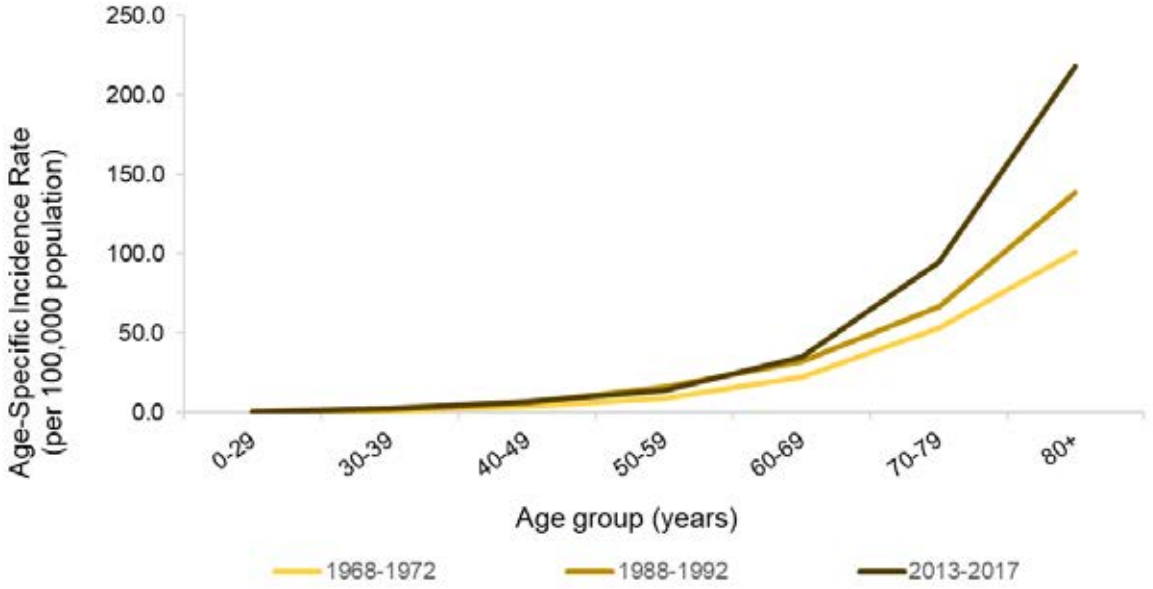


Figure 9.6.3: AGE-STANDARDISED MORTALITY RATE (PER 100,000 POPULATION) FOR NON-MELANOMA SKIN CANCER BY GENDER AND FIVE-YEAR PERIOD, 1968-2017

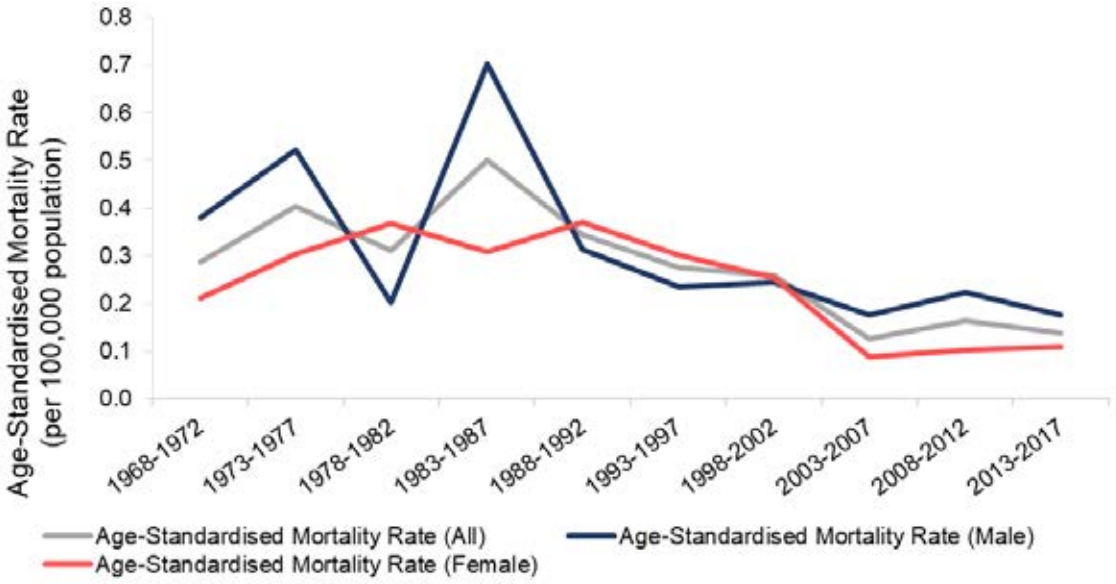


Table 9.6.2(a): MORTALITY NUMBER AND RATE (PER 100,000 POPULATION) FOR NON-MELANOMA SKIN CANCER IN MALES BY ETHNICITY AND FIVE-YEAR PERIOD, 1968-2017

Period		1968-1972	1973-1977	1978-1982	1983-1987	1988-1992
All	Number (%)	12 (100.0%)	15 (100.0%)	8 (100.0%)	32 (100.0%)	18 (100.0%)
	CMR	0.2	0.3	0.1	0.5	0.3
	ASMR	0.4	0.5	0.2	0.7	0.3
Chinese	Number (%)	8 (66.7%)	14 (93.3%)	8 (100.0%)	31 (96.9%)	16 (88.9%)
	CMR	0.2	0.3	0.2	0.6	0.3
	ASMR	0.3	0.6	0.3	0.9	0.3
Malay	Number (%)	1 (8.3%)	0 (0.0%)	0 (0.0%)	1 (3.1%)	2 (11.1%)
	CMR	0.1	0.0	0.0	0.1	0.2
	ASMR	0.4	0.0	0.0	0.2	0.3
Indian	Number (%)	3 (25.0%)	1 (6.7%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
	CMR	0.7	0.2	0.0	0.0	0.0
	ASMR	0.9	0.3	0.0	0.0	0.0
Period		**1993-1997**	**1998-2002**	**2003-2007**	**2008-2012**	**2013-2017**
All	Number (%)	16 (100.0%)	19 (100.0%)	16 (100.0%)	27 (100.0%)	27 (100.0%)
	CMR	0.2	0.2	0.2	0.3	0.3
	ASMR	0.2	0.2	0.2	0.2	0.2
Chinese	Number (%)	13 (81.3%)	18 (94.7%)	15 (93.8%)	23 (85.2%)	26 (96.3%)
	CMR	0.2	0.3	0.2	0.3	0.4
	ASMR	0.2	0.3	0.2	0.2	0.2
Malay	Number (%)	2 (12.5%)	0 (0.0%)	0 (0.0%)	2 (7.4%)	0 (0.0%)
	CMR	0.2	0.0	0.0	0.2	0.0
	ASMR	0.5	0.0	0.0	0.2	0.0
Indian	Number (%)	1 (6.3%)	0 (0.0%)	1 (6.3%)	1 (3.7%)	0 (0.0%)
	CMR	0.2	0.0	0.1	0.1	0.0
	ASMR	0.1	0.0	0.1	0.1	0.0

Table 9.6.2(b): MORTALITY NUMBER AND RATE (PER 100,000 POPULATION) FOR NON-MELANOMA SKIN CANCER IN FEMALES BY ETHNICITY AND FIVE-YEAR PERIOD, 1968-2017

Period		1968-1972	1973-1977	1978-1982	1983-1987	1988-1992
All	Number (%)	7 (100.0%)	11 (100.0%)	16 (100.0%)	18 (100.0%)	24 (100.0%)
	CMR	0.1	0.2	0.3	0.3	0.4
	ASMR	0.2	0.3	0.4	0.3	0.4
Chinese	Number (%)	4 (57.1%)	11 (100.0%)	16 (100.0%)	18 (100.0%)	19 (79.2%)
	CMR	0.1	0.3	0.4	0.4	0.4
	ASMR	0.1	0.3	0.4	0.4	0.3
Malay	Number (%)	2 (28.6%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	4 (16.7%)
	CMR	0.3	0.0	0.0	0.0	0.4
	ASMR	0.4	0.0	0.0	0.0	0.6
Indian	Number (%)	1 (14.3%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (4.2%)
	CMR	0.4	0.0	0.0	0.0	0.2
	ASMR	1.8	0.0	0.0	0.0	0.5
Period		**1993-1997**	**1998-2002**	**2003-2007**	**2008-2012**	**2013-2017**
All	Number (%)	26 (100.0%)	27 (100.0%)	11 (100.0%)	17 (100.0%)	25 (100.0%)
	CMR	0.3	0.3	0.1	0.2	0.3
	ASMR	0.3	0.3	0.1	0.1	0.1
Chinese	Number (%)	22 (84.6%)	22 (81.5%)	9 (81.8%)	17 (100.0%)	22 (88.0%)
	CMR	0.4	0.3	0.1	0.2	0.3
	ASMR	0.3	0.2	0.1	0.1	0.1
Malay	Number (%)	2 (7.7%)	2 (7.4%)	1 (9.1%)	0 (0.0%)	2 (8.0%)
	CMR	0.2	0.2	0.1	0.0	0.2
	ASMR	0.3	0.2	0.1	0.0	0.1
Indian	Number (%)	0 (0.0%)	1 (3.7%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
	CMR	0.0	0.2	0.0	0.0	0.0
	ASMR	0.0	0.2	0.0	0.0	0.0

Figure 9.6.4(a): TRENDS IN AGE-STANDARDISED INCIDENCE RATE (PER 100,000 POPULATION), AGE-STANDARDISED MORTALITY RATE (PER 100,000 POPULATION), AND FIVE-YEAR AGE-STANDARDISED RELATIVE SURVIVAL RATE (%) FOR NON-MELANOMA SKIN CANCER IN MALES BY FIVE-YEAR PERIOD, 1968-2017

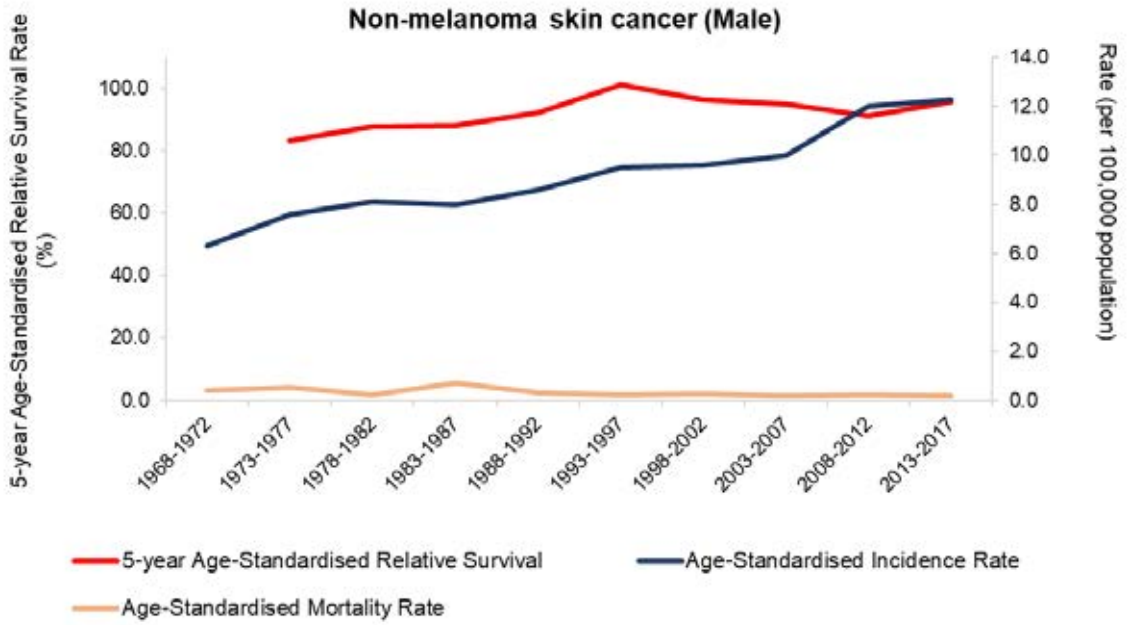


Figure 9.6.4(b): TRENDS IN AGE-STANDARDISED INCIDENCE RATE (PER 100,000 POPULATION), AGE-STANDARDISED MORTALITY RATE (PER 100,000 POPULATION), AND FIVE-YEAR AGE-STANDARDISED RELATIVE SURVIVAL RATE (%) FOR NON-MELANOMA SKIN CANCER IN FEMALES BY FIVE-YEAR PERIOD, 1968-2017

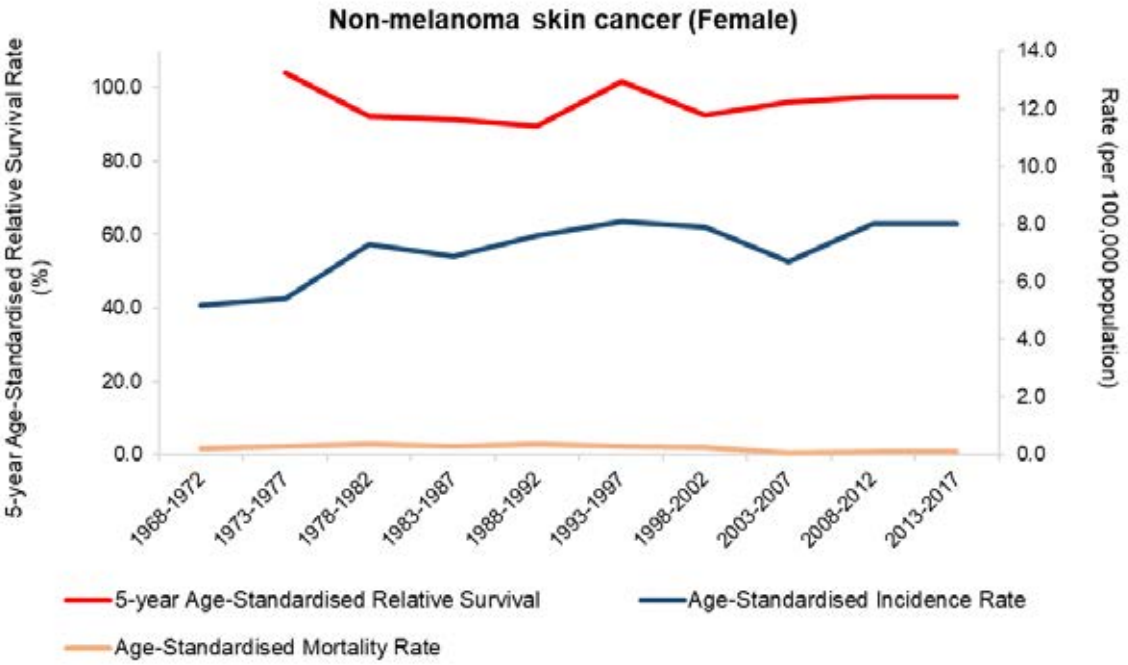
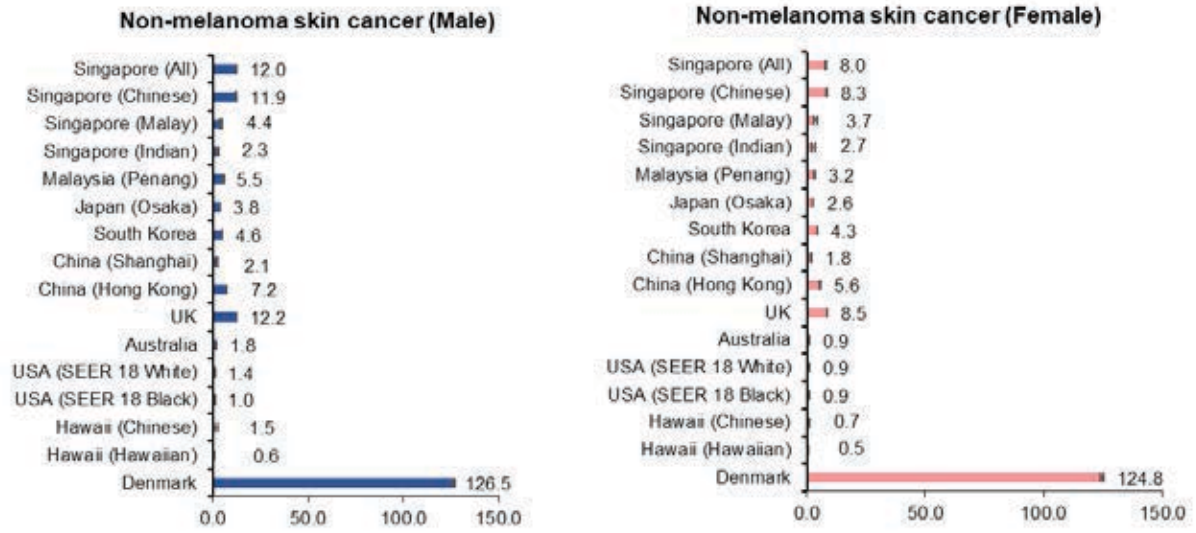


Table 9.6.3: STAGE DISTRIBUTION OF NON-MELANOMA SKIN CANCER, 2008-2017

Year	Stage I		Stage II		Stage III		Stage IV	
	Number	%	Number	%	Number	%	Number	%
2008	96	73.8	27	20.8	7	5.4	0	0.0
2009	239	78.9	55	18.2	7	2.3	2	0.7
2010	341	80.2	74	17.4	5	1.2	5	1.2
2011	314	78.3	69	17.2	5	1.2	13	3.2
2012	367	81.6	70	15.6	4	0.9	9	2.0
2013	376	77.5	99	20.4	4	0.8	6	1.2
2014	393	76.0	106	20.5	5	1.0	13	2.5
2015	402	79.8	86	17.1	2	0.4	14	2.8
2016	415	80.7	84	16.3	5	1.0	10	1.9
2017	384	76.8	106	21.2	6	1.2	4	0.8

Figure 9.6.5: AGE-STANDARDISED INCIDENCE RATE (PER 100,000 POPULATION) FOR NON-MELANOMA SKIN CANCER [3] IN SELECTED COUNTRIES, 2008-2012



[3] According to 'Cancer Incidence in Five Continents (Volume XI)', the incidence of non-melanoma skin cancers is difficult to assess. The completeness of their registration varies widely depending on access to outpatient and general practitioners' records. Most non-melanoma skin cancers are basal cell carcinomas (BCCs) or squamous cell carcinomas (SCCs). Although some registries record the first occurrence of all cases, others register BCC only, and many do not collect data on either SCC or BCC [64].

9.7 FEMALE BREAST (ICD-10: C50)

In Singapore, invasive breast cancer was consistently ranked as the leading cancer among females in the past fifty years (Table 5.1.2(b)). In 2013-2017, there were 10,824 new cases of invasive breast cancer diagnosed (nearly six cases per day) and 2,180 deaths (slightly more than one death per day) (Table 6.2.2(b)). The ASIR of invasive breast cancer far exceeded those of other cancers, and was more than twice that of the ASIR for the second most common cancer among females (colorectal cancer). It was the leading cause of cancer death among females in 2013-2017, accounting for 17.4% of cancer deaths among females.

Over the past fifty years, the ASIR of invasive breast cancer climbed steadily, with more than a threefold increase from 20.1 per 100,000 population in 1968-1972 to 69.8 per 100,000 population in 2013-2017 (Figure 9.7.1). The rise in the incidence was likely attributable to factors such as changes in the reproductive pattern in Singapore including delayed childbearing and having fewer children, reduced prevalence and duration of breastfeeding, as well as changes in other risk factors such as use of hormone replacement therapy, use of oral contraceptives, and increase in obesity prevalence [106] [107] [108]. Notably, the rate of increase in ASIR slowed down slightly from 1998-2002 onwards, which might be partly due to a 2002 publication linking hormone replacement therapy to increased breast cancer risk [109]. The ASIR of in-situ breast cancer rose rapidly since the early 2000s, largely contributed by the availability of the population-based breast cancer screening programme [110] [111]. The ASIR of in-situ breast cancer was about one fifth the rate of invasive breast cancer. The upward trend in the ASIR of invasive breast cancer was consistent across all three ethnic groups (Table 9.7.1). The Chinese had the highest risk of developing invasive breast cancer compared to the Malays and Indians. In 2013-2017, the age-adjusted relative risk was 0.93 (95% CI: 0.89-0.97) for Malays and 0.91 (95% CI: 0.81-1.04) for Indians. The underlying reasons for these ethnic differences are unclear and might reflect differences in the exposure and response to certain risk factors such as number of childbirths, age at first childbirth, breastfeeding and obesity [112]. In 2013-2017, the risk of developing invasive breast cancer increased sharply from 30 years of age onwards and peaked among females aged 60-79 years, before gradually declining after the age of 80 years (Figure 9.7.2). In 2013-2017, 42.3% of invasive breast cancers were diagnosed among females aged 60 years and above. In comparison, the increase in the incidence with age for in-situ breast cancer was not as pronounced, with rates being fairly similar for those aged 40-69 years.

While the ASIR of invasive breast cancer increased steadily, the ASMR started to stabilise from 1988-1992 onwards (Figure 9.7.3). Notably, the ethnic disparity in the ASMR was different from that in the ASIR observed in the recent years. From 1983-1987 onwards, the ASMR among the Malays was consistently higher than that for the

Chinese and Indians (Table 9.7.2), although the ASIR of invasive breast cancer was lower among the Malays compared to the Chinese during the same period (Table 9.7.1). Several reasons might explain this, including stage at diagnosis, comorbidities, tumour characteristics and response to treatments [113]. An assessment of health screening behaviour using data from the 2010 National Health Survey found lower uptake of breast cancer screening among Malay females compared to Chinese females [114]. A local study published in 2012 suggested that a higher percentage of Malay females (16.0%) was diagnosed with distant metastases compared with Chinese (9.0%) and Indian (4.0%) females [113]. The five-year ASRS improved substantially from 49.9% in 1973-1977 to 80.6% in 2013-2017 (Figure 9.7.4). The decline in mortality and the improvement in survival rate were most likely attributable to the introduction of population-based breast cancer screening and the systemic use of adjuvant therapies [115] [116]. Early detection significantly reduces mortality since breast cancer detected at earlier stages have better prognosis. In 2013-2017, the five-year ASRS for the women diagnosed at Stage I, II and III were 100.1%, 89.5% and 73.3% respectively, compared with 27.0% for patients diagnosed with distant metastases (Stage IV) (Appendix E2). More than 70% of the invasive breast cancer cases were diagnosed at Stages I and II (Table 9.7.3).

The ASIR of invasive breast cancer in Singapore (2008-2012) was much lower than those in western countries including UK, Australia, USA, and Denmark (Figure 9.7.5). However, it was the highest among the Asian countries including Malaysia (Penang), Japan (Osaka), South Korea and China (Shanghai and Hong Kong). The age-standardised five-year net survival (2010-2014) of invasive breast cancer in Singapore was comparable to those in China (mainland China and Hong Kong), but lower than those in Japan, South Korea, UK, Australia, USA, and Denmark (Figure 9.7.6).

Figure 9.7.1: AGE-STANDARDISED INCIDENCE RATE (PER 100,000 POPULATION) FOR BREAST CANCER BY FIVE-YEAR PERIOD, 1968-2017

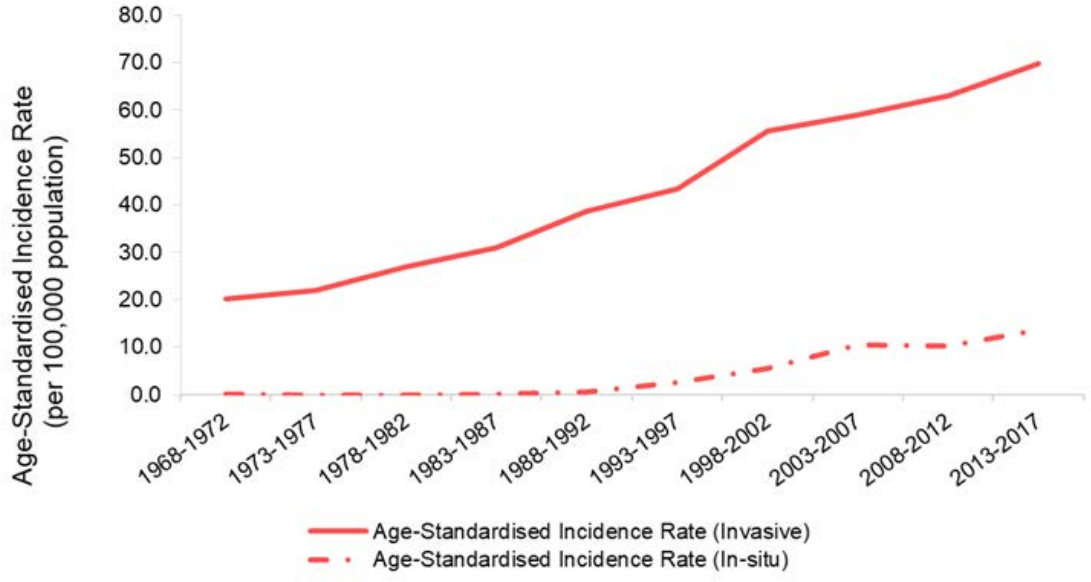


Table 9.7.1: INCIDENCE NUMBER AND RATE (PER 100,000 POPULATION) AND RELATIVE RISK FOR INVASIVE BREAST CANCER BY ETHNICITY AND FIVE-YEAR PERIOD, 1968-2017

Period		1968-1972	1973-1977	1978-1982	1983-1987	1988-1992
All	Number (%)	672 (100.0%)	861 (100.0%)	1237 (100.0%)	1737 (100.0%)	2631 (100.0%)
	CIR	13.7	16.6	22.0	28.4	39.1
	ASIR	20.1	22.1	26.9	31.1	38.6
Chinese	Number (%)	554 (82.4%)	738 (85.7%)	1048 (84.7%)	1461 (84.1%)	2208 (83.9%)
	CIR	14.4	18.0	23.6	30.4	41.9
	ASIR	19.5	22.6	27.4	31.8	39.4
	RR	1.00	1.00	1.00	1.00	1.00
Malay	Number (%)	64 (9.5%)	69 (8.0%)	111 (9.0%)	154 (8.9%)	260 (9.9%)
	CIR	8.7	9.1	13.8	17.8	27.6
	ASIR	16.9	14.9	20.9	22.6	33.4
	RR and 95% CI	0.89 (0.76-1.04)	0.70 (0.54-0.92)	0.77 (0.68-0.87)	0.76 (0.64-0.90)	0.88 (0.76-1.01)
Indian	Number (%)	25 (3.7%)	41 (4.8%)	53 (4.3%)	88 (5.1%)	118 (4.5%)
	CIR	8.9	14.1	16.6	23.4	26.7
	ASIR	25.6	26.5	29.8	32.4	34.5
	RR and 95% CI	1.01 (0.80-1.28)	1.14 (0.93-1.40)	0.91 (0.69-1.21)	0.96 (0.76-1.20)	0.78 (0.65-0.94)
Period		**1993-1997**	**1998-2002**	**2003-2007**	**2008-2012**	**2013-2017**
All	Number (%)	3598 (100.0%)	5577 (100.0%)	6856 (100.0%)	8560 (100.0%)	10824 (100.0%)
	CIR	48.0	67.9	78.4	90.1	109.0
	ASIR	43.5	55.6	58.9	63.0	69.8
Chinese	Number (%)	2994 (83.2%)	4675 (83.8%)	5633 (82.2%)	6893 (80.5%)	8668 (80.1%)
	CIR	51.4	73.8	84.7	97.2	116.8
	ASIR	44.4	57.8	60.3	64.2	70.8
	RR	1.00	1.00	1.00	1.00	1.00
Malay	Number (%)	356 (9.9%)	524 (9.4%)	729 (10.6%)	910 (10.6%)	1137 (10.5%)
	CIR	34.1	46.3	60.7	72.1	86.8
	ASIR	37.2	44.5	54.5	58.0	65.6
	RR and 95% CI	0.87 (0.79-0.96)	0.81 (0.70-0.93)	0.91 (0.84-0.98)	0.92 (0.87-0.97)	0.93 (0.89-0.97)
Indian	Number (%)	187 (5.2%)	290 (5.2%)	376 (5.5%)	542 (6.3%)	718 (6.6%)
	CIR	35.8	46.8	53.2	65.5	83.1
	ASIR	39.6	48.7	50.4	58.4	65.8
	RR and 95% CI	0.83 (0.68-1.00)	0.76 (0.63-0.92)	0.80 (0.73-0.87)	0.89 (0.75-1.05)	0.91 (0.81-1.04)

Figure 9.7.2: AGE-SPECIFIC INCIDENCE RATE (PER 100,000 POPULATION) FOR BREAST CANCER BY AGE GROUP, 1968-1972, 1988-1992, 2013-2017

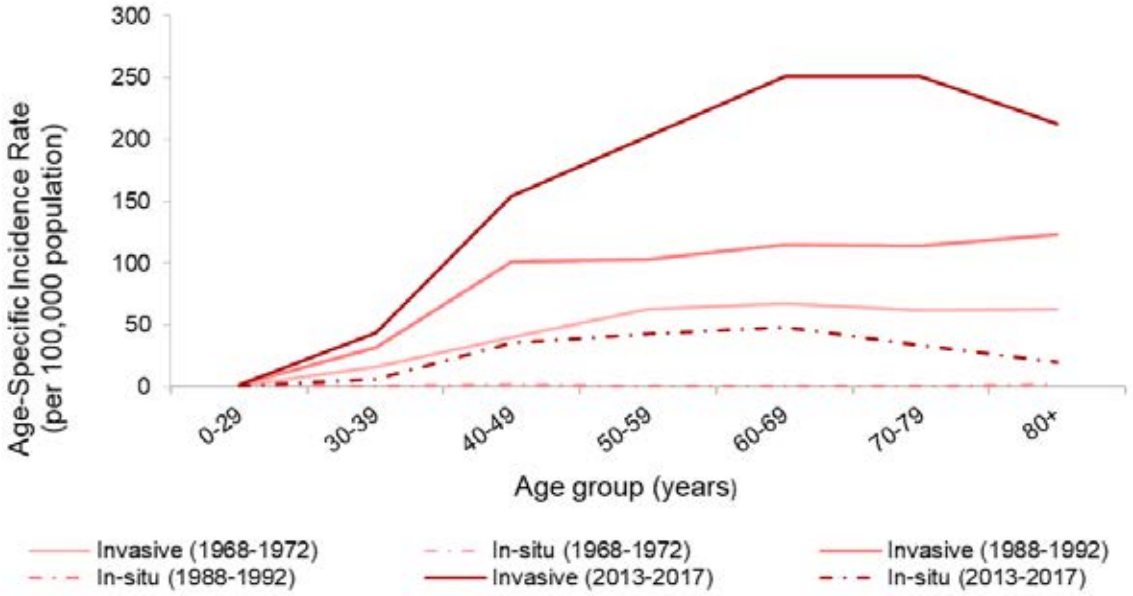


Figure 9.7.3: AGE-STANDARDISED MORTALITY RATE (PER 100,000 POPULATION) FOR INVASIVE BREAST CANCER BY FIVE-YEAR PERIOD, 1968-2017

Table 9.7.2: MORTALITY NUMBER AND RATE (PER 100,000 POPULATION) FOR INVASIVE BREAST CANCER BY ETHNICITY AND FIVE-YEAR PERIOD, 1968-2017

Period		1968-1972	1973-1977	1978-1982	1983-1987	1988-1992
All	Number (%)	193 (100.0%)	320 (100.0%)	517 (100.0%)	481 (100.0%)	849 (100.0%)
	CMR	3.9	6.1	9.2	7.9	12.6
	ASMR	5.8	8.5	11.6	8.7	13.0
Chinese	Number (%)	146 (75.6%)	258 (80.6%)	425 (82.2%)	397 (82.5%)	682 (80.3%)
	CMR	3.8	6.3	9.6	8.3	12.9
	ASMR	5.2	8.1	11.3	8.7	12.6
Malay	Number (%)	30 (15.5%)	39 (12.2%)	51 (9.9%)	62 (12.9%)	106 (12.5%)
	CMR	4.1	5.2	6.3	7.2	11.2
	ASMR	7.9	8.8	10.3	9.6	14.6
Indian	Number (%)	9 (4.7%)	15 (4.7%)	30 (5.8%)	13 (2.7%)	39 (4.6%)
	CMR	3.2	5.2	9.4	3.5	8.8
	ASMR	7.1	11.4	18.1	5.4	12.4
Period		**1993-1997**	**1998-2002**	**2003-2007**	**2008-2012**	**2013-2017**
All	Number (%)	1010 (100.0%)	1346 (100.0%)	1566 (100.0%)	1979 (100.0%)	2180 (100.0%)
	CMR	13.5	16.4	17.9	20.8	21.9
	ASMR	12.5	13.9	13.6	14.2	13.0
Chinese	Number (%)	810 (80.2%)	1062 (78.9%)	1215 (77.6%)	1506 (76.1%)	1638 (75.1%)
	CMR	13.9	16.8	18.3	21.2	22.1
	ASMR	12.3	13.5	12.9	13.3	12.0
Malay	Number (%)	137 (13.6%)	184 (13.7%)	223 (14.2%)	301 (15.2%)	339 (15.6%)
	CMR	13.1	16.2	18.6	23.8	25.9
	ASMR	14.8	16.8	17.7	20.4	19.1
Indian	Number (%)	49 (4.9%)	77 (5.7%)	103 (6.6%)	141 (7.1%)	157 (7.2%)
	CMR	9.4	12.4	14.6	17.0	18.2
	ASMR	11.7	13.7	15.0	16.2	14.5

Figure 9.7.4: TRENDS IN AGE-STANDARDISED INCIDENCE RATE (PER 100,000 POPULATION), AGE-STANDARDISED MORTALITY RATE (PER 100,000 POPULATION), AND FIVE-YEAR AGE-STANDARDISED RELATIVE SURVIVAL RATE (%) FOR INVASIVE BREAST CANCER BY FIVE-YEAR PERIOD, 1968-2017

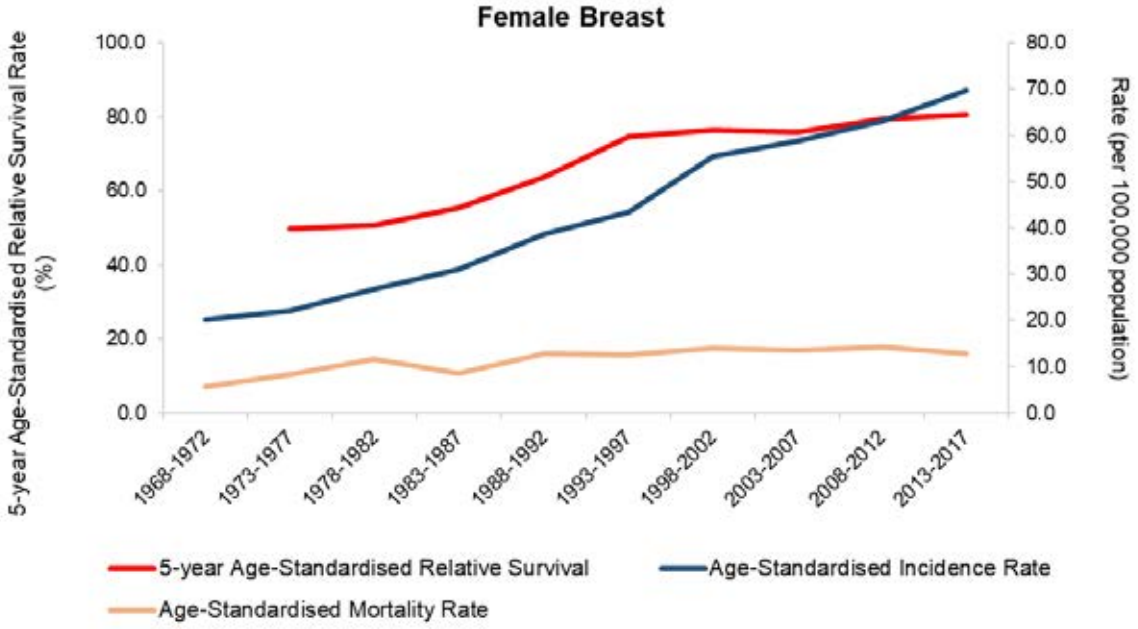


Table 9.7.3: STAGE DISTRIBUTION OF INVASIVE BREAST CANCER, 2008-2017

	Stage I		Stage II		Stage III		Stage IV	
Year	Number	%	Number	%	Number	%	Number	%
2008	508	34.3	557	37.6	273	18.4	145	9.8
2009	481	31.1	617	39.9	299	19.3	150	9.7
2010	570	34.1	623	37.3	315	18.9	163	9.8
2011	525	32.2	621	38.1	328	20.1	154	9.5
2012	567	33.2	664	38.9	310	18.1	168	9.8
2013	626	34.3	686	37.6	330	18.1	181	9.9
2014	630	33.0	719	37.7	342	17.9	218	11.4
2015	627	31.7	799	40.4	339	17.1	213	10.8
2016	763	35.0	869	39.9	344	15.8	204	9.4
2017	745	33.9	859	39.1	340	15.5	254	11.6

Figure 9.7.5: AGE-STANDARDISED INCIDENCE RATE (PER 100,000 POPULATION) FOR INVASIVE BREAST CANCER IN SELECTED COUNTRIES, 2008-2012

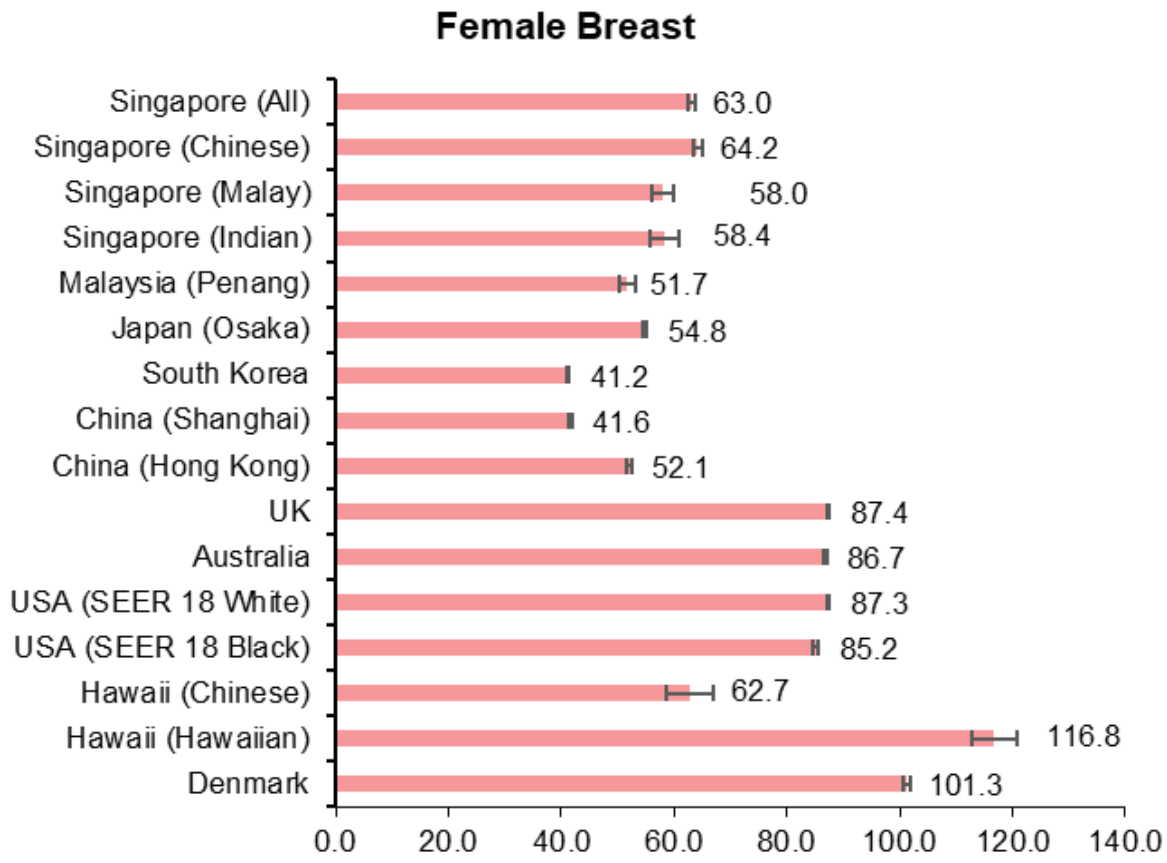
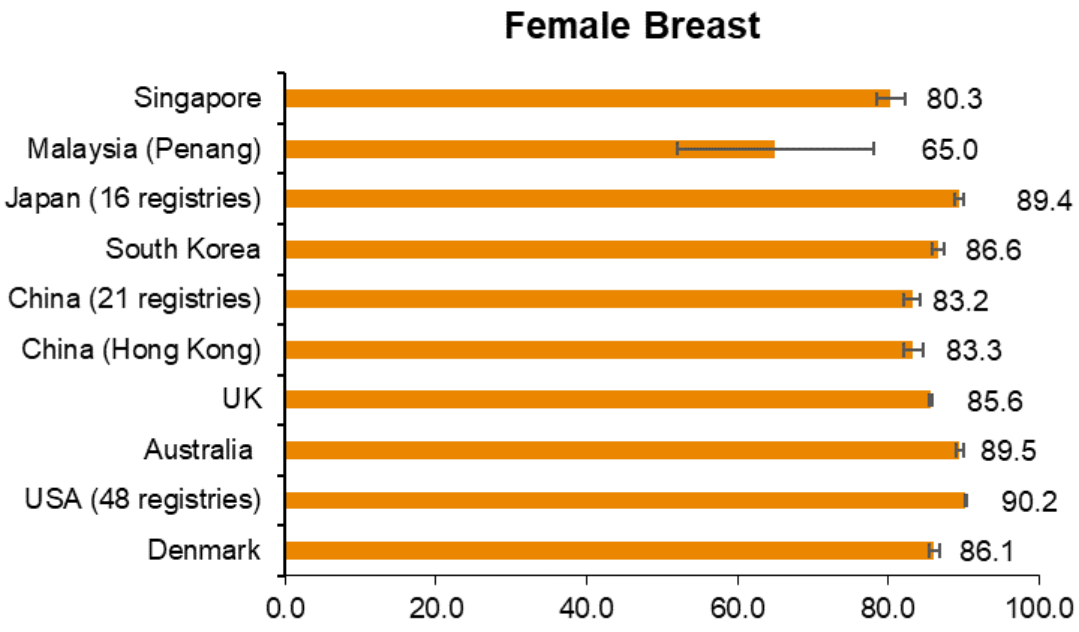


Figure 9.7.6: FIVE-YEAR AGE-STANDARDISED NET SURVIVAL (%) FOR INVASIVE BREAST CANCER IN SELECTED COUNTRIES, 2010-2014



9.8 CERVIX UTERI (ICD-10: C53)

In Singapore, the ranking of cervical cancer fell from being the second most common cancer among females in 1968-1972 to tenth place from 2008-2012 onwards (Table 5.1.2(b)). In 2013-2017, there were 1,077 new cases diagnosed, accounting for 2.9% of all cancers diagnosed among females. In 2013-2017, it was the ninth leading cause of cancer deaths among females with 359 deaths, which accounted for 2.9% of all cancer deaths among females (Table 6.2.2(b)).

In contrast to breast, ovarian, and uterine cancers, the ASIR of invasive cervical cancer consistently declined over the years and appeared to stabilise from 2008-2012 onwards (Figure 9.8.1). The decline was largely attributable to increased uptake of Papanicolaou (Pap) smear screening, improved genital hygiene and reduced parity [117] [118]. Human papillomavirus (HPV) vaccination, as another strategy for cervical cancer prevention, has been included under the National Childhood Immunisation Schedule [119] and the National Adult Immunisation Schedule [120] in Singapore. In 2019, MOH introduced free HPV vaccination to Secondary One female students. It will take many years to observe its impact on the incidence of cervical cancer since there is a latency period between HPV infection and development of malignancy [121]. The ASIR of in-situ cervical cancer rose rapidly since 1978-1982, largely due to the introduction of Pap smear screening, and reached a peak in 1988-1992 before gradually declining. In 2013-2017, the ASIR of in-situ cervical cancer was 1.7 times that of invasive cervical cancer. An overall downward trend in the ASIR of invasive cervical cancer was observed across all three ethnic groups, with the steepest decline observed among Indian females (Table 9.8.1). In 2013-2017, Malay females overtook Chinese females to be the ethnic group having the highest ASIR. In 2013-2017, the risk of developing invasive cervical cancer increased with age (Figure 9.8.2), peaking at 70-79 years, whereas the incidence rate of in-situ cervical cancer peaked at 30-39 years for the same period.

The ASMR of cervical cancer began decreasing steadily from 1978-1982 onwards, after an upward climb in the earlier years (Figure 9.8.3). From 2003-2007 onwards, Malay females had the highest ASMR, Indian females the lowest, and Chinese females between the two (Table 9.8.2). In 2013-2017, Malay females had both the highest ASIR and ASMR among the three ethnic groups. Relatively lower cervical cancer screening uptake among Malay females might be one of the contributing factors. An assessment of health screening behaviour using data from the 2010 National Health Survey found that Malay females were less likely to have Pap smear screening within the recommended time period, compared to Chinese females [114]. They also had a higher rate of loss to rescreen as compared to Indian and Chinese females [122]. Additionally, they had the highest rates of smoking, which is one of the risk factors associated with cervical cancer [95] [123]. The progressive decline in both

the ASIR and ASMR of cervical cancer was accompanied by the moderate improvement in survival rate over the past fifty years (Figure 9.8.4). The five-year ASRS improved from 47.6% in 1973-1977 to 60.4% in 2013-2017, although the rate plateaued from 1998-2002 onwards. The decline in the ASMR was likely attributable to the decreased ASIR, early detection by screening and introduction of efficacious modalities of treatment [124]. Early detection significantly reduces mortality since cervical cancer detected at earlier stages have better prognosis. In 2013-2017, the five-year ASRS for patients diagnosed at Stages I-III was 86.7%, 65.8% and 54.8% respectively, compared with 16.6% for patients diagnosed at Stage IV (Appendix E2). More than 55.0% of total cases were diagnosed at Stages I and II (Table 9.8.3).

The ASIR of cervical cancer in Singapore (2008-2012) was comparable to those in China (Shanghai and Hong Kong) and USA, lower than those in other Asian countries such as Malaysia (Penang), Japan (Osaka), and South Korea, and higher than that in Australia (Figure 9.8.5). Australia is one of the first countries to implement a population-based HPV vaccination programme, which led to a high HPV immunisation rate and is projected to reduce cervical cancer incidence [125]. The age-standardised five-year net survival (2010-2014) of cervical cancer in Singapore was comparable to those in UK and USA, but lower than those in Japan, South Korea and Denmark (Figure 9.8.6).

Figure 9.8.1: AGE-STANDARDISED INCIDENCE RATE (PER 100,000 POPULATION) FOR CERVICAL CANCER BY FIVE-YEAR PERIOD, 1968-2017

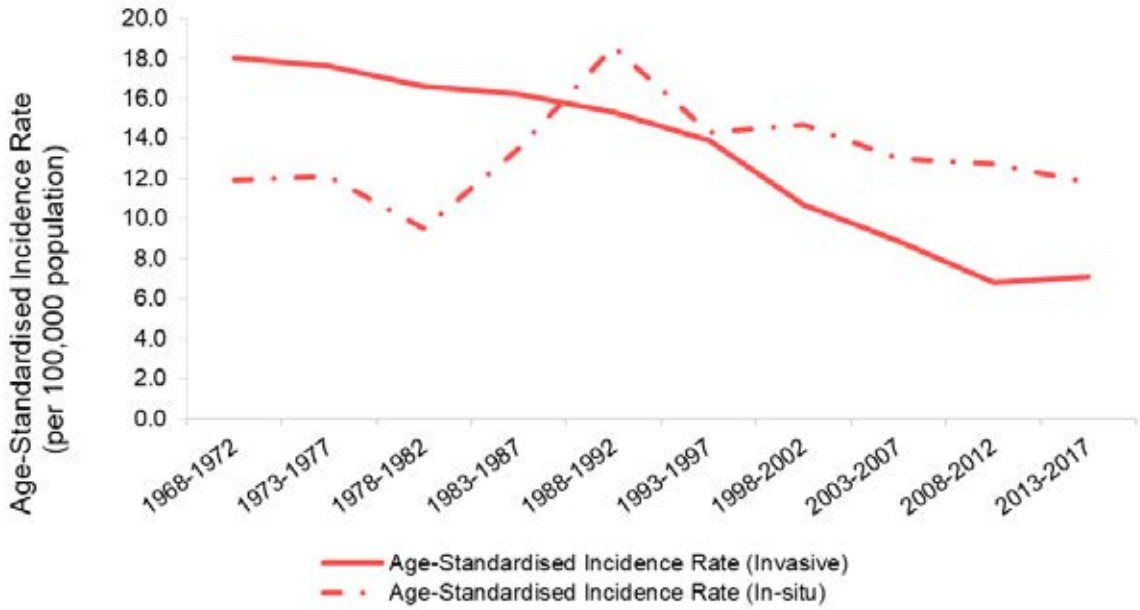


Table 9.8.1: INCIDENCE NUMBER AND RATE (PER 100,000 POPULATION) AND RELATIVE RISK FOR INVASIVE CERVICAL CANCER BY ETHNICITY AND FIVE-YEAR PERIOD, 1968-2017

Period		1968-1972	1973-1977	1978-1982	1983-1987	1988-1992
All	Number (%)	603 (100.0%)	675 (100.0%)	751 (100.0%)	897 (100.0%)	1002 (100.0%)
	CIR	12.3	13.0	13.4	14.7	14.9
	ASIR	18.0	17.6	16.6	16.2	15.3
Chinese	Number (%)	527 (87.4%)	587 (87.0%)	639 (85.1%)	802 (89.4%)	882 (88.0%)
	CIR	13.7	14.3	14.4	16.7	16.7
	ASIR	18.6	18.3	17.0	17.6	16.3
	RR	1.00	1.00	1.00	1.00	1.00
Malay	Number (%)	45 (7.5%)	43 (6.4%)	49 (6.5%)	56 (6.2%)	81 (8.1%)
	CIR	6.1	5.7	6.1	6.5	8.6
	ASIR	11.4	8.8	9.4	8.9	11.2
	RR and 95% CI	0.67 (0.44-1.03)	0.55 (0.42-0.72)	0.55 (0.38-0.78)	0.50 (0.40-0.61)	0.68 (0.55-0.85)
Indian	Number (%)	26 (4.3%)	37 (5.5%)	54 (7.2%)	36 (4.0%)	32 (3.2%)
	CIR	9.3	12.7	16.9	9.6	7.2
	ASIR	26.8	26.8	28.6	12.2	8.7
	RR and 95% CI	1.14 (0.84-1.54)	1.30 (0.98-1.73)	1.51 (1.22-1.86)	0.70 (0.49-1.01)	0.53 (0.43-0.67)
Period		**1993-1997**	**1998-2002**	**2003-2007**	**2008-2012**	**2013-2017**
All	Number (%)	1128 (100.0%)	1038 (100.0%)	1015 (100.0%)	926 (100.0%)	1077 (100.0%)
	CIR	15.0	12.6	11.6	9.7	10.8
	ASIR	13.9	10.7	8.9	6.8	7.1
Chinese	Number (%)	992 (87.9%)	913 (88.0%)	867 (85.4%)	775 (83.7%)	845 (78.5%)
	CIR	17.0	14.4	13.0	10.9	11.4
	ASIR	14.9	11.6	9.4	7.2	7.0
	RR	1.00	1.00	1.00	1.00	1.00
Malay	Number (%)	90 (8.0%)	79 (7.6%)	104 (10.2%)	100 (10.8%)	142 (13.2%)
	CIR	8.6	7.0	8.7	7.9	10.8
	ASIR	10.1	7.3	8.5	6.8	8.6
	RR and 95% CI	0.67 (0.59-0.77)	0.63 (0.52-0.78)	0.87 (0.75-1.00)	0.94 (0.78-1.13)	1.19 (0.99-1.42)
Indian	Number (%)	38 (3.4%)	38 (3.7%)	24 (2.4%)	22 (2.4%)	45 (4.2%)
	CIR	7.3	6.1	3.4	2.7	5.2
	ASIR	8.8	6.8	3.5	2.6	4.3
	RR and 95% CI	0.52 (0.34-0.79)	0.52 (0.37-0.73)	0.34 (0.24-0.48)	0.33 (0.21-0.52)	0.57 (0.38-0.84)

Figure 9.8.2: AGE-SPECIFIC INCIDENCE RATE (PER 100,000 POPULATION) FOR CERVICAL CANCER BY AGE GROUP, 1968-1972, 1988-1992, 2013-2017

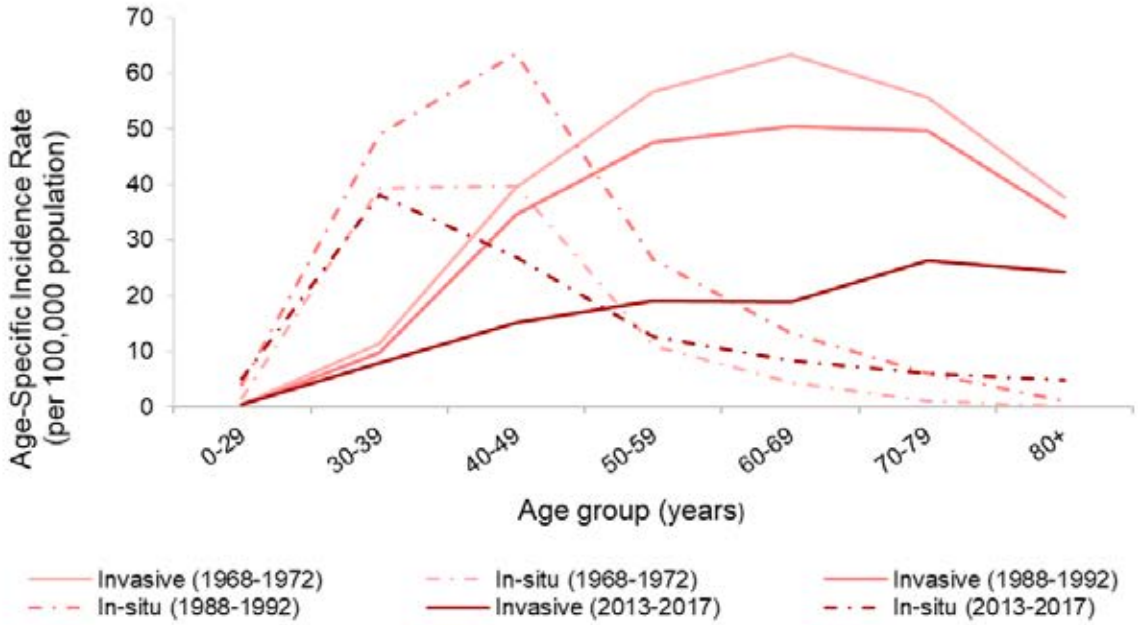


Figure 9.8.3: AGE-STANDARDISED MORTALITY RATE (PER 100,000 POPULATION) FOR INVASIVE CERVICAL CANCER BY FIVE-YEAR PERIOD, 1968-2017

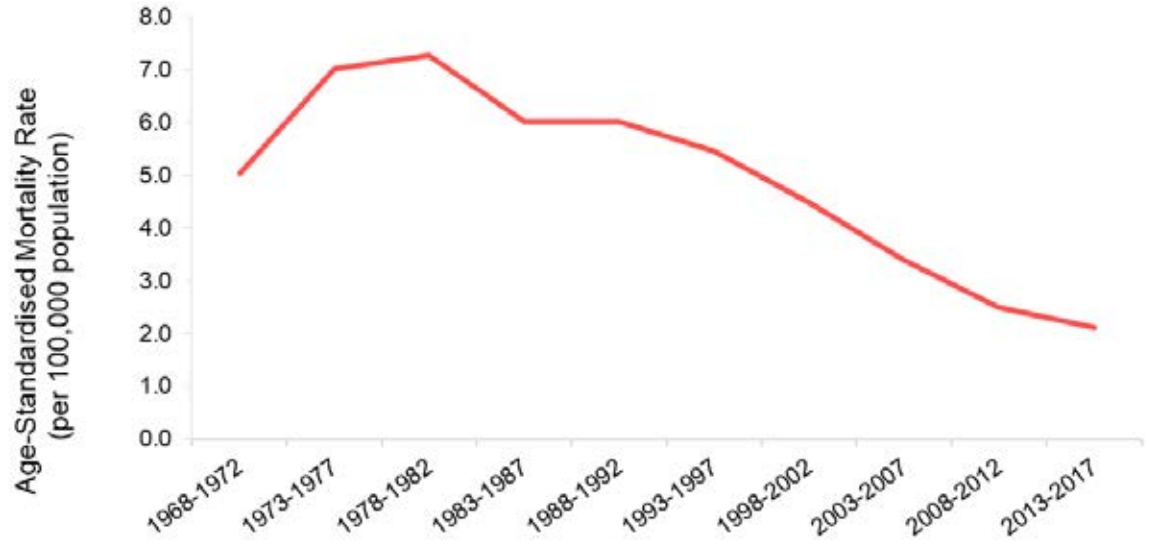


Table 9.8.2: MORTALITY NUMBER AND RATE (PER 100,000 POPULATION) FOR INVASIVE CERVICAL CANCER BY ETHNICITY AND FIVE-YEAR PERIOD, 1968-2017

Period		1968-1972	1973-1977	1978-1982	1983-1987	1988-1992
All	Number (%)	166 (100.0%)	261 (100.0%)	320 (100.0%)	315 (100.0%)	393 (100.0%)
	CMR	3.4	5.0	5.7	5.1	5.8
	ASMR	5.0	7.0	7.3	6.0	6.0
Chinese	Number (%)	138 (83.1%)	224 (85.8%)	263 (82.2%)	276 (87.6%)	342 (87.0%)
	CMR	3.6	5.5	5.9	5.7	6.5
	ASMR	4.9	7.1	7.2	6.3	6.3
Malay	Number (%)	18 (10.8%)	20 (7.7%)	34 (10.6%)	21 (6.7%)	34 (8.7%)
	CMR	2.5	2.6	4.2	2.4	3.6
	ASMR	5.6	4.4	6.9	3.5	4.9
Indian	Number (%)	9 (5.4%)	13 (5.0%)	23 (7.2%)	16 (5.1%)	15 (3.8%)
	CMR	3.2	4.5	7.2	4.2	3.4
	ASMR	9.5	10.4	15.3	6.4	4.4
Period		**1993-1997**	**1998-2002**	**2003-2007**	**2008-2012**	**2013-2017**
All	Number (%)	424 (100.0%)	419 (100.0%)	381 (100.0%)	360 (100.0%)	359 (100.0%)
	CMR	5.7	5.1	4.4	3.8	3.6
	ASMR	5.5	4.5	3.4	2.5	2.1
Chinese	Number (%)	360 (84.9%)	360 (85.9%)	315 (82.7%)	294 (81.7%)	275 (76.6%)
	CMR	6.2	5.7	4.7	4.1	3.7
	ASMR	5.6	4.6	3.4	2.5	2.0
Malay	Number (%)	43 (10.1%)	37 (8.8%)	44 (11.5%)	48 (13.3%)	67 (18.7%)
	CMR	4.1	3.3	3.7	3.8	5.1
	ASMR	5.4	4.0	3.8	3.2	4.0
Indian	Number (%)	19 (4.5%)	20 (4.8%)	16 (4.2%)	13 (3.6%)	12 (3.3%)
	CMR	3.6	3.2	2.3	1.6	1.4
	ASMR	4.8	3.8	2.4	1.6	1.2

Figure 9.8.4: TRENDS IN AGE-STANDARDISED INCIDENCE RATE (PER 100,000 POPULATION), AGE-STANDARDISED MORTALITY RATE (PER 100,000 POPULATION), AND FIVE-YEAR AGE-STANDARDISED RELATIVE SURVIVAL RATE (%) FOR INVASIVE CERVICAL CANCER BY FIVE-YEAR PERIOD, 1968-2017

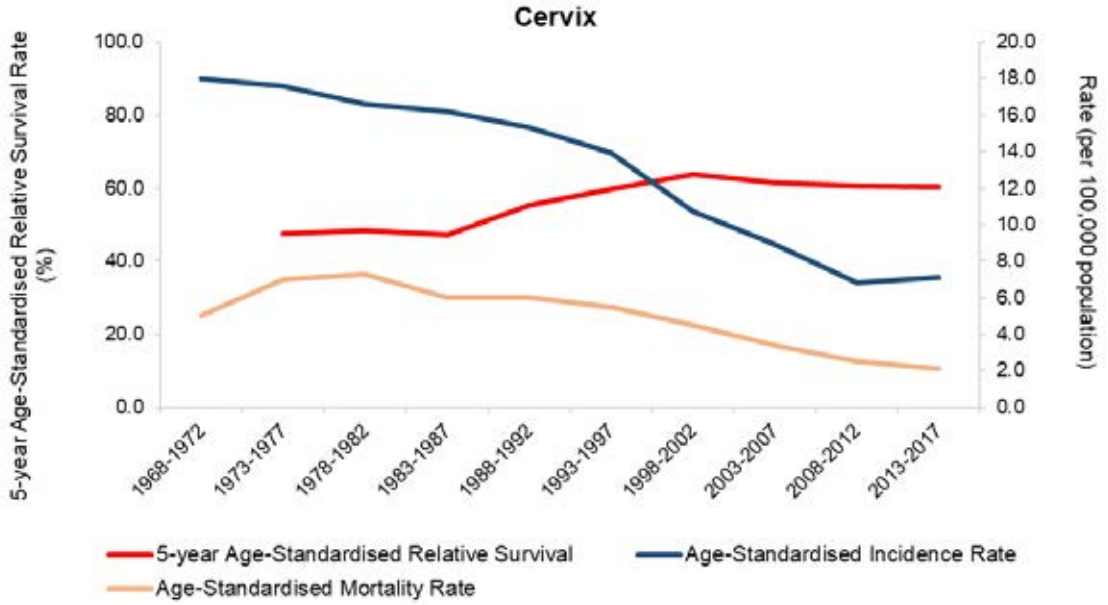


Table 9.8.3: STAGE DISTRIBUTION OF INVASIVE CERVICAL CANCER, 2008-2017

Year	Stage I		Stage II		Stage III		Stage IV	
	Number	%	Number	%	Number	%	Number	%
2008	89	53.6	41	24.7	20	12.0	16	9.6
2009	64	40.3	46	28.9	26	16.4	23	14.5
2010	80	45.2	49	27.7	21	11.9	27	15.3
2011	70	45.2	37	23.9	30	19.4	18	11.6
2012	68	38.2	43	24.2	29	16.3	38	21.3
2013	81	42.2	55	28.6	28	14.6	28	14.6
2014	78	39.6	46	23.4	36	18.3	37	18.8
2015	104	46.2	53	23.6	33	14.7	35	15.6
2016	71	36.8	36	18.7	44	22.8	42	21.8
2017	78	41.7	40	21.4	46	24.6	23	12.3

Figure 9.8.5: AGE-STANDARDISED INCIDENCE RATE (PER 100,000 POPULATION) FOR INVASIVE CERVICAL CANCER IN SELECTED COUNTRIES, 2008-2012

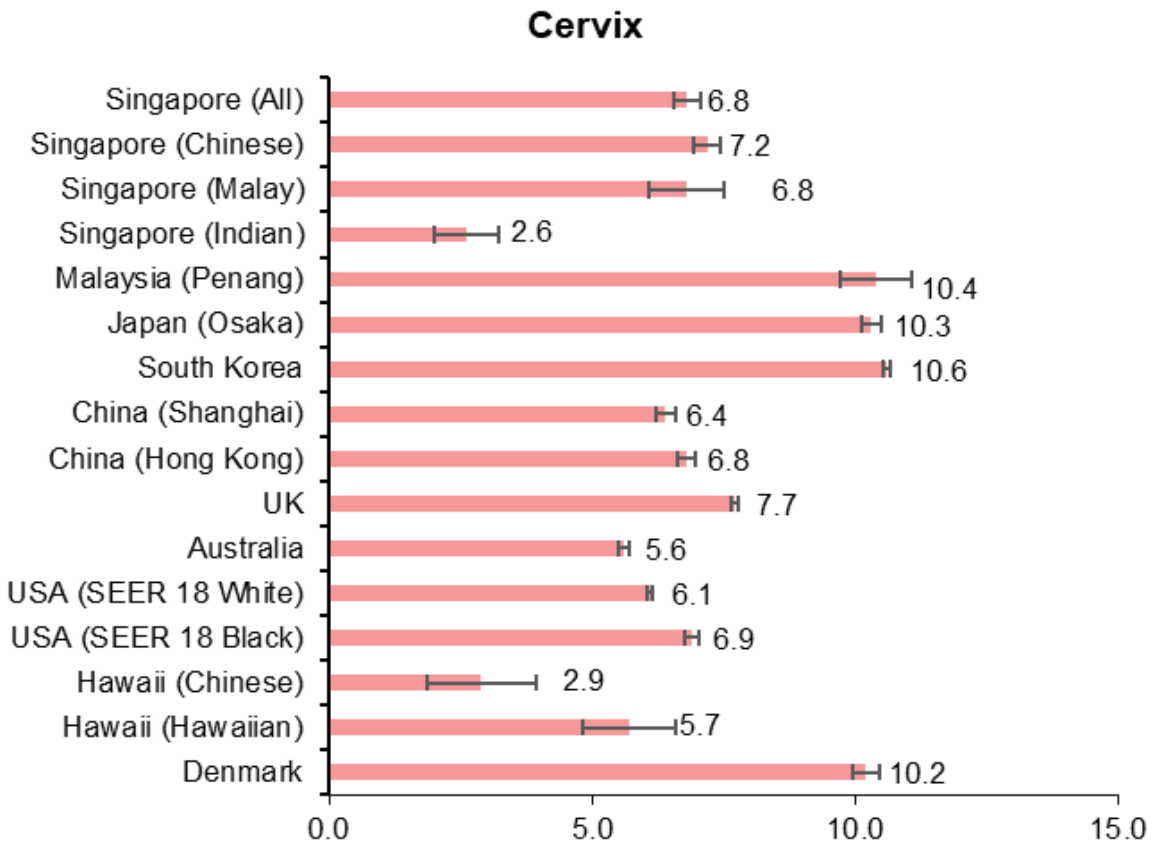
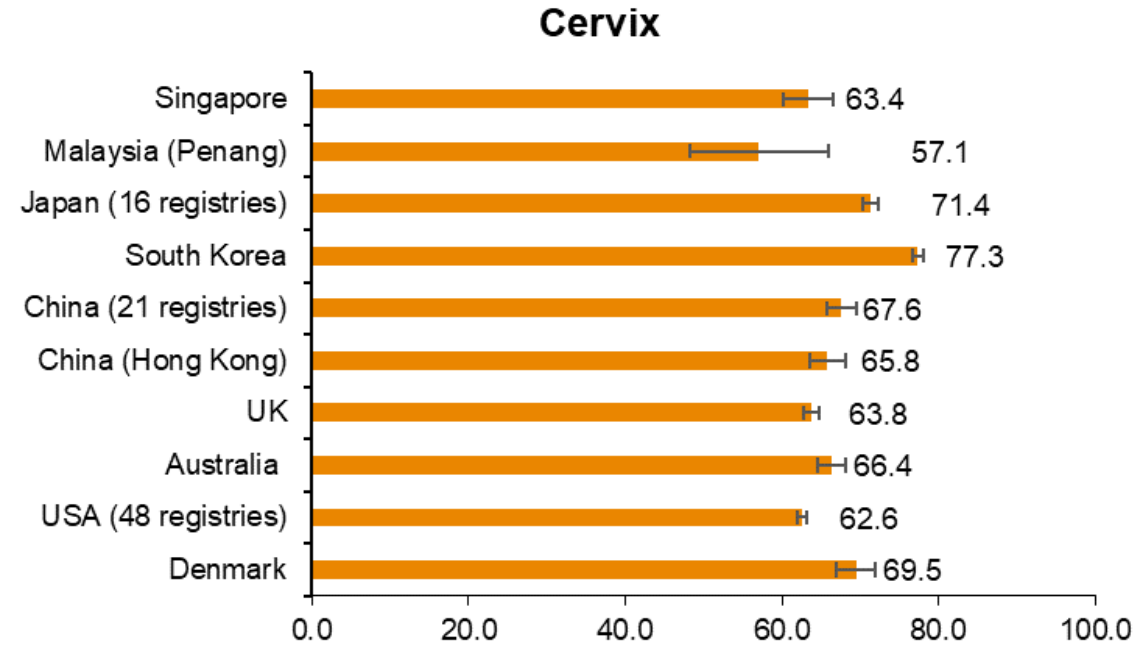


Figure 9.8.6: FIVE-YEAR AGE-STANDARDISED NET SURVIVAL (%) FOR INVASIVE CERVICAL CANCER IN SELECTED COUNTRIES, 2010-2014



9.9 CORPUS UTERI (ICD-10: C54)

In Singapore, uterine cancer first emerged among the ten most frequent cancers for females in 1993-1997 as the eighth most common cancer. It rose over the years to be the fourth most common cancer among females from 2003-2007 onwards (Table 5.1.2(b)), surpassing the other two gynaecologic cancers - ovarian and cervical cancers. In 2013-2017, there were 2,610 new cases diagnosed, accounting for 7.1% of all cancers among females. In 2013-2017, it was the tenth leading cause of cancer death among females (321 deaths, accounting for 2.6% of all cancer deaths among females), trailing behind ovarian and cervical cancers (Table 6.2.2(b)).

Similar to the temporal trends of breast and ovarian cancers, the ASIR of uterine cancer rose steadily, with a more than threefold increase from 4.9 per 100,000 population in 1968-1972 to 16.9 per 100,000 population 2013-2017 (Figure 9.9.1). Changes in risk factors for uterine cancer within the population, including delayed childbearing, having fewer children, use of hormone replacement therapy, increase in body mass index (BMI) and increase in diabetes mellitus prevalence, might be responsible for the increased incidence rate [126] [127] [128]. The upward trend in the ASIR was consistent across all three ethnic groups, which had similar risks of developing uterine cancer in 2013-2017 (Table 9.9.1). In 2013-2017, the risk of developing uterine cancer was observed to increase from 30 years of age onwards, peaking at 50-69 years, before gradually declining after the age of 70 years (Figure 9.9.2). Uterine cancer occurred predominantly among postmenopausal females and 73.2% of uterine cancers were diagnosed among females aged 50 years and above in 2013-2017.

Although the ASIR of uterine cancer increased over the past fifty years, the ASMR remained low between 0.5 to 1.4 per 100,000 population between 1968-2002 before increasing from 2003-2007 onwards to 1.9 per 100,000 population in 2013-2017 (Figure 9.9.3). In 2013-2017, the ASMR was lower among Chinese females compared with Malay and Indian females (Table 9.9.2). The five-year ASRS improved slightly from 48.3% in 1973-1977 to 68.7% in 2013-2017 (Figure 9.9.4). As uterine cancer is frequently symptomatic at an early stage (such as abnormal uterine bleeding), it is typically diagnosed when the disease is still confined to the corpus uteri (Stage I) [129]. In 2017, 66.9% of the total cases were diagnosed at Stage I (Table 9.9.3).

The ASIR of uterine cancer in Singapore (2008-2012) was one of the highest among Asian countries, surpassing Malaysia (Penang), Japan (Osaka), South Korea and China (Shanghai), but was lower than those in USA and Hawaii (Figure 9.9.5).

Figure 9.9.1: AGE-STANDARDISED INCIDENCE RATE (PER 100,000 POPULATION) FOR UTERINE CANCER BY FIVE-YEAR PERIOD, 1968-2017

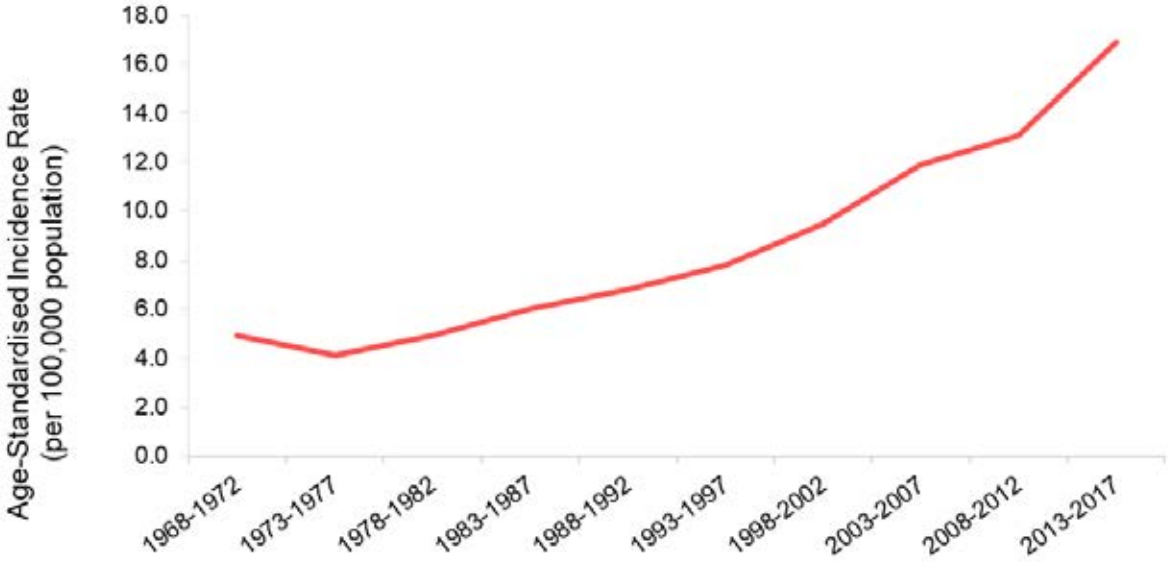


Table 9.9.1: INCIDENCE NUMBER AND RATE (PER 100,000 POPULATION) AND RELATIVE RISK FOR UTERINE CANCER BY ETHNICITY AND FIVE-YEAR PERIOD, 1968-2017

Period		1968-1972	1973-1977	1978-1982	1983-1987	1988-1992
All	Number (%)	159 (100.0%)	154 (100.0%)	217 (100.0%)	314 (100.0%)	435 (100.0%)
	CIR	3.2	3.0	3.9	5.1	6.5
	ASIR	4.9	4.1	4.9	6.0	6.8
Chinese	Number (%)	136 (85.5%)	123 (79.9%)	190 (87.6%)	276 (87.9%)	370 (85.1%)
	CIR	3.5	3.0	4.3	5.7	7.0
	ASIR	4.9	3.9	5.1	6.4	7.1
	RR	1.00	1.00	1.00	1.00	1.00
Malay	Number (%)	13 (8.2%)	17 (11.0%)	19 (8.8%)	25 (8.0%)	38 (8.7%)
	CIR	1.8	2.3	2.4	2.9	4.0
	ASIR	4.0	4.5	3.9	4.0	5.0
	RR and 95% CI	0.84 (0.42-1.69)	1.12 (0.70-1.79)	0.75 (0.47-1.19)	0.65 (0.47-0.89)	0.74 (0.53-1.03)
Indian	Number (%)	5 (3.1%)	11 (7.1%)	6 (2.8%)	9 (2.9%)	20 (4.6%)
	CIR	1.8	3.8	1.9	2.4	4.5
	ASIR	3.2	6.7	3.7	3.1	7.1
	RR and 95% CI	1.02 (0.47-2.22)	2.09 (1.07-4.08)	0.61 (0.30-1.25)	0.53 (0.30-0.93)	0.79 (0.50-1.24)
Period		**1993-1997**	**1998-2002**	**2003-2007**	**2008-2012**	**2013-2017**
All	Number (%)	609 (100.0%)	908 (100.0%)	1356 (100.0%)	1787 (100.0%)	2610 (100.0%)
	CIR	8.1	11.1	15.5	18.8	26.3
	ASIR	7.8	9.5	11.9	13.1	16.9
Chinese	Number (%)	497 (81.6%)	758 (83.5%)	1120 (82.6%)	1417 (79.3%)	2077 (79.6%)
	CIR	8.5	12.0	16.8	20.0	28.0
	ASIR	7.8	9.7	12.2	13.1	17.1
	RR	1.00	1.00	1.00	1.00	1.00
Malay	Number (%)	69 (11.3%)	91 (10.0%)	140 (10.3%)	202 (11.3%)	302 (11.6%)
	CIR	6.6	8.0	11.7	16.0	23.1
	ASIR	7.7	8.8	11.2	12.9	17.6
	RR and 95% CI	1.02 (0.81-1.29)	0.88 (0.67-1.16)	0.90 (0.78-1.05)	1.00 (0.85-1.17)	1.00 (0.88-1.14)
Indian	Number (%)	35 (5.7%)	49 (5.4%)	83 (6.1%)	132 (7.4%)	193 (7.4%)
	CIR	6.7	7.9	11.7	15.9	22.3
	ASIR	7.5	8.4	11.9	15.1	17.5
	RR and 95% CI	0.95 (0.69-1.30)	0.81 (0.62-1.05)	0.90 (0.68-1.20)	1.07 (0.77-1.49)	1.01 (0.76-1.35)

Figure 9.9.2: AGE-SPECIFIC INCIDENCE RATE (PER 100,000 POPULATION) FOR UTERINE CANCER BY AGE GROUP, 1968-1972, 1988-1992, 2013-2017

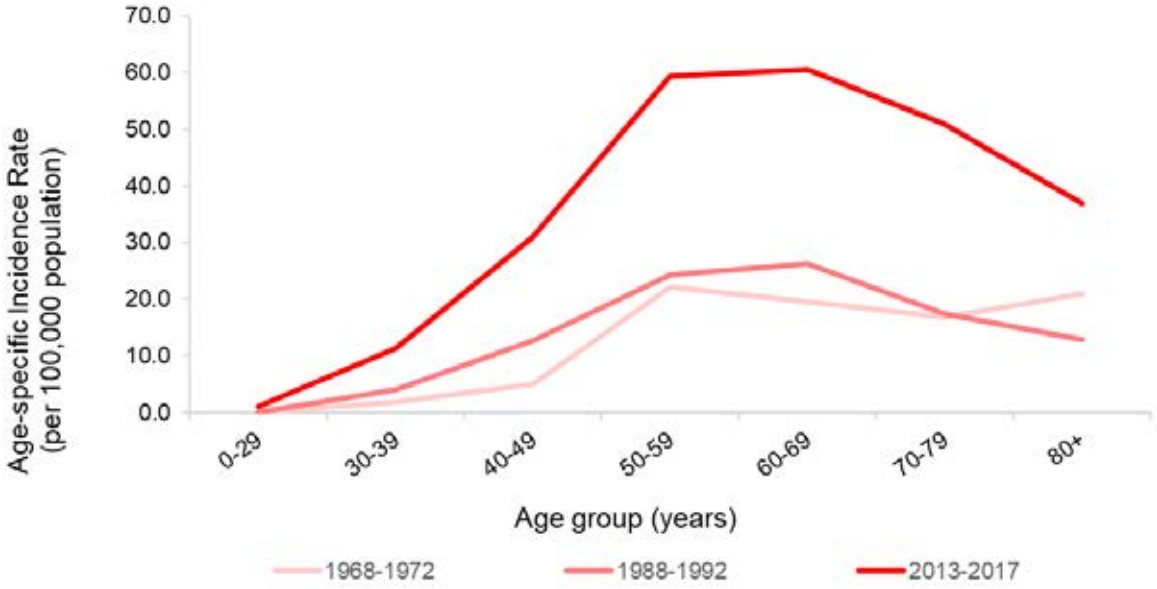


Figure 9.9.3: AGE-STANDARDISED MORTALITY RATE (PER 100,000 POPULATION) FOR UTERINE CANCER BY FIVE-YEAR PERIOD, 1968-2017

Table 9.9.2: MORTALITY NUMBER AND RATE (PER 100,000 POPULATION) FOR UTERINE CANCER BY ETHNICITY AND FIVE-YEAR PERIOD, 1968-2017

Period		1968-1972	1973-1977	1978-1982	1983-1987	1988-1992
All	Number (%)	42 (100.0%)	50 (100.0%)	24 (100.0%)	27 (100.0%)	85 (100.0%)
	CMR	0.9	1.0	0.4	0.4	1.3
	ASMR	1.3	1.4	0.5	0.5	1.4
Chinese	Number (%)	36 (85.7%)	44 (88.0%)	23 (95.8%)	21 (77.8%)	69 (81.2%)
	CMR	0.9	1.1	0.5	0.4	1.3
	ASMR	1.3	1.4	0.6	0.5	1.3
Malay	Number (%)	3 (7.1%)	3 (6.0%)	1 (4.2%)	5 (18.5%)	10 (11.8%)
	CMR	0.4	0.4	0.1	0.6	1.1
	ASMR	0.8	0.8	0.2	1.1	1.7
Indian	Number (%)	1 (2.4%)	2 (4.0%)	0 (0.0%)	0 (0.0%)	3 (3.5%)
	CMR	0.4	0.7	0.0	0.0	0.7
	ASMR	0.7	1.4	0.0	0.0	1.2
Period		**1993-1997**	**1998-2002**	**2003-2007**	**2008-2012**	**2013-2017**
All	Number (%)	98 (100.0%)	100 (100.0%)	120 (100.0%)	203 (100.0%)	321 (100.0%)
	CMR	1.3	1.2	1.4	2.1	3.2
	ASMR	1.3	1.1	1.1	1.5	1.9
Chinese	Number (%)	73 (74.5%)	72 (72.0%)	96 (80.0%)	151 (74.4%)	235 (73.2%)
	CMR	1.3	1.1	1.4	2.1	3.2
	ASMR	1.2	0.9	1.0	1.3	1.7
Malay	Number (%)	20 (20.4%)	17 (17.0%)	14 (11.7%)	35 (17.2%)	50 (15.6%)
	CMR	1.9	1.5	1.2	2.8	3.8
	ASMR	2.6	1.9	1.2	2.5	2.8
Indian	Number (%)	5 (5.1%)	9 (9.0%)	9 (7.5%)	16 (7.9%)	32 (10.0%)
	CMR	1.0	1.5	1.3	1.9	3.7
	ASMR	1.4	1.7	1.5	2.1	3.0

Figure 9.9.4: TRENDS IN AGE-STANDARDISED INCIDENCE RATE (PER 100,000 POPULATION), AGE-STANDARDISED MORTALITY RATE (PER 100,000 POPULATION), AND FIVE-YEAR AGE-STANDARDISED RELATIVE SURVIVAL RATE (%) FOR UTERINE CANCER BY FIVE-YEAR PERIOD, 1968-2017

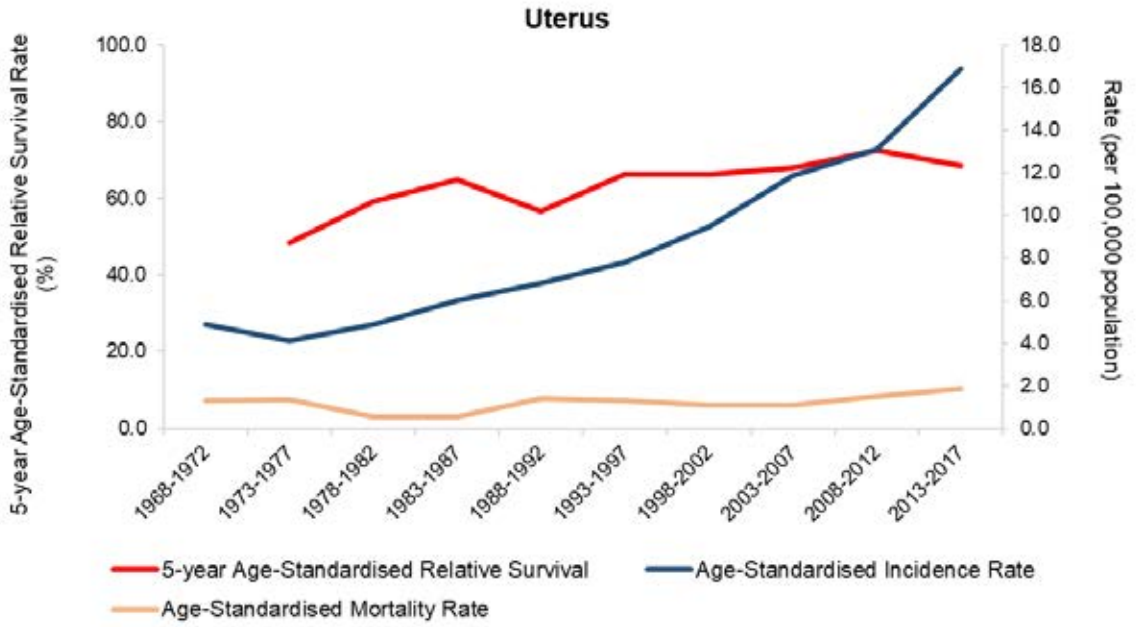
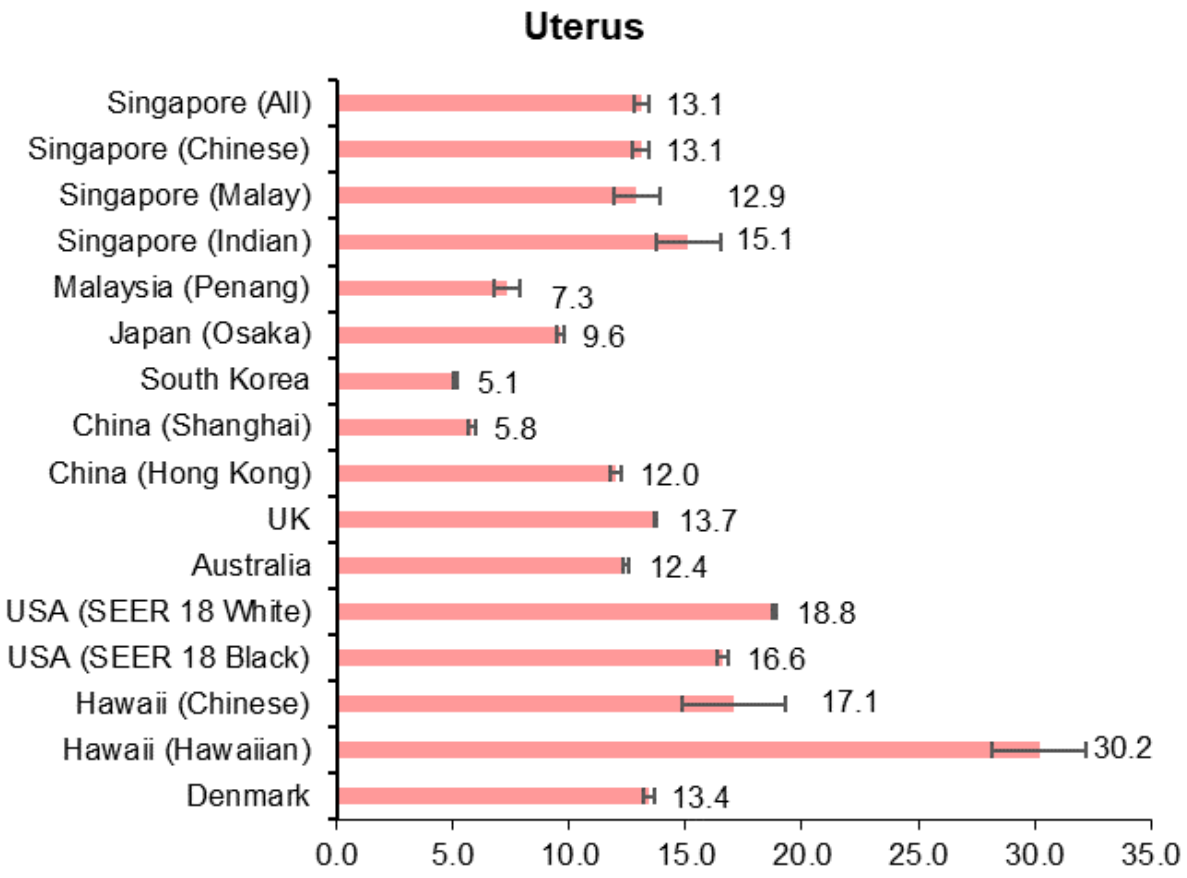


Table 9.9.3: STAGE DISTRIBUTION OF UTERINE CANCER, 2008-2017

Year	Stage I		Stage II		Stage III		Stage IV	
	Number	%	Number	%	Number	%	Number	%
2008	181	66.1	26	9.5	42	15.3	25	9.1
2009	154	60.9	22	8.7	48	19.0	29	11.5
2010	215	66.6	35	10.8	39	12.1	34	10.5
2011	232	74.1	18	5.8	30	9.6	33	10.5
2012	262	67.0	31	7.9	65	16.6	33	8.4
2013	293	70.1	19	4.5	68	16.3	38	9.1
2014	275	65.8	27	6.5	66	15.8	50	12.0
2015	351	70.6	35	7.0	62	12.5	49	9.9
2016	347	68.3	36	7.1	71	14.0	54	10.6
2017	332	66.9	37	7.5	68	13.7	59	11.9

Figure 9.9.5: AGE-STANDARDISED INCIDENCE RATE (PER 100,000 POPULATION) FOR UTERINE CANCER IN SELECTED COUNTRIES, 2008-2012



9.10 OVARY & FALLOPIAN TUBE (ICD-10: C56-C57.0)

In Singapore, ovarian cancer moved from being the eighth most common cancer among females in 1968-1972 to fifth place in 2013-2017 (Table 5.1.2(b)). In 2013-2017, 1,874 new cases were diagnosed, accounting for 5.1% of all cancers diagnosed among females during this period. It was the seventh leading cause of cancer deaths among females in 2013-2017, with 645 deaths, accounting for 5.1% of all cancer deaths among females (Table 6.2.2(b)).

Similar to the temporal trends of breast and uterine cancers, the ASIR of ovarian cancer increased steadily, with a more than twofold increase from 6.0 per 100,000 population in 1968-1972 to 13.1 per 100,000 population 2013-2017 (Figure 9.10.1). The rise in incidence might be associated with changes in reproductive patterns which included delayed childbearing and having fewer children, as well as changes in lifestyle risk factors which included use of hormone replacement therapy and reduced physical activity [130]. This upward trend was observed across all three ethnic groups (Table 9.10.1). Even though parity is linked with reduced risk for ovarian cancer [131] and total fertility rate was the highest among the Malays [28], the Malays had the highest risk of developing ovarian cancer compared to the Chinese and Indians. This might be explained in part by other potential risk factors for ovarian cancer – the highest prevalence of obesity and cigarette smoking were observed among Malay females in the 2004 and 2010 National Health Surveys [95] [132] [133] [134]. The age-adjusted relative risk was 1.42 (95% CI: 1.32-1.52) for the Malays and 0.82 (95% CI: 0.66-1.03) for the Indians for 2013-2017. In the same period, the risk of developing ovarian cancer was observed to rise sharply after the age of 30 years, peaking among females aged 50-69 years (Figure 9.10.2). In 2013-2017, 64.2% of ovarian cancers were diagnosed among those aged 50 years and above.

Although the ASIR of ovarian cancer continued to climb, the ASMR, after an upward climb in the earlier years, started to stabilise from 1993-1997 onwards (Figure 9.10.3). In 2013-2017, similar to the ASIR, the ASMR was the highest among the Malays (Table 9.10.2). Although modest improvement in the five-year ASRS was observed in the past fifty years, from 32.2% in 1973-1977 to 42.5% in 2013-2017 (Figure 9.10.4), it was the lowest among common cancers occurring in females including breast cancer (80.6%), cervical cancer (60.4%) and uterine cancer (68.7%). Due to the lack of an effective national screening strategy among asymptomatic females as well as the absence of specific symptoms for early stage ovarian cancer [135], patients are frequently diagnosed with locally advanced or metastatic disease. In 2017, 31.1% and 20.1% of the total cases were diagnosed at Stages III and IV respectively (Table 9.10.3). The stage at diagnosis is highly prognostic for ovarian cancer. In 2013-2017, the five-year ASRS for Stages I and II ovarian cancer were 86.8% and 76.5%

respectively, compared with 34.7% and 19.0% for cases diagnosed at Stages III and IV respectively (Appendix E2).

The ASIR of invasive ovarian cancer (excluding fallopian tube) in Singapore (2008-2012) was lower than those in UK and Denmark, but was the highest among the Asian countries (Figure 9.10.5). The age-standardised five-year net survival (2010-2014) of ovarian cancer in Singapore was slightly lower than those in Malaysia (Penang), Japan and South Korea, comparable to those in Australia and USA, but higher than those in UK and Denmark (Figure 9.10.6).

Figure 9.10.1: AGE-STANDARDISED INCIDENCE RATE (PER 100,000 POPULATION) FOR OVARIAN CANCER BY FIVE-YEAR PERIOD, 1968-2017

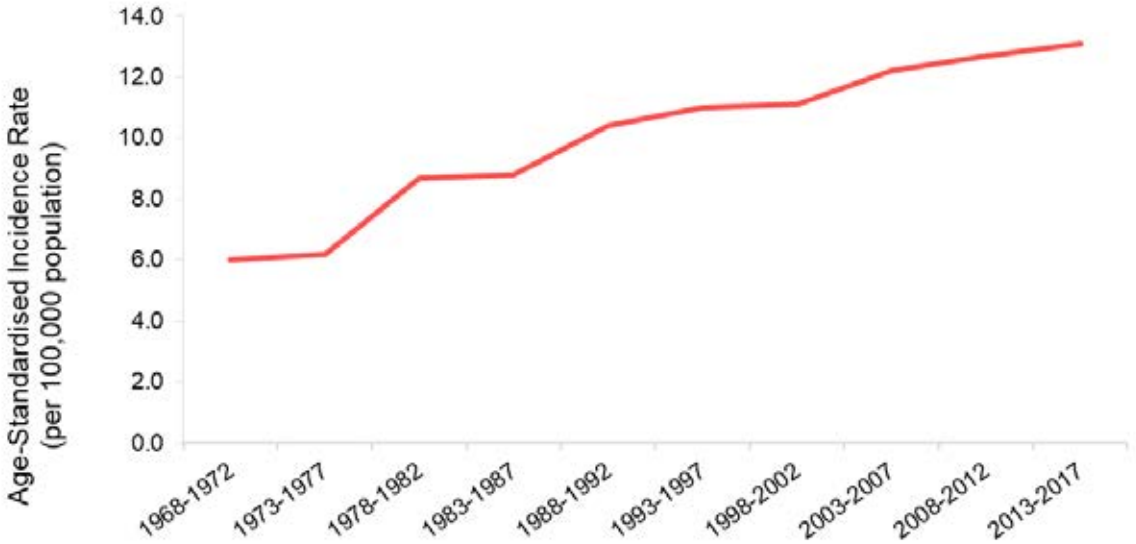


Table 9.10.1: INCIDENCE NUMBER AND RATE (PER 100,000 POPULATION) AND RELATIVE RISK FOR OVARIAN CANCER BY ETHNICITY AND FIVE-YEAR PERIOD, 1968-2017

Period		1968-1972	1973-1977	1978-1982	1983-1987	1988-1992
All	Number (%)	222 (100.0%)	262 (100.0%)	414 (100.0%)	504 (100.0%)	703 (100.0%)
	CIR	4.5	5.0	7.4	8.2	10.4
	ASIR	6.0	6.2	8.7	8.8	10.4
Chinese	Number (%)	184 (82.9%)	201 (76.7%)	342 (82.6%)	404 (80.2%)	588 (83.6%)
	CIR	4.8	4.9	7.7	8.4	11.2
	ASIR	6.0	5.8	8.8	8.6	10.7
	RR	1.00	1.00	1.00	1.00	1.00
Malay	Number (%)	29 (13.1%)	49 (18.7%)	57 (13.8%)	65 (12.9%)	81 (11.5%)
	CIR	4.0	6.5	7.1	7.5	8.6
	ASIR	6.2	10.6	9.7	9.1	10.0
	RR and 95% CI	1.09 (0.84-1.42)	1.74 (1.43-2.11)	1.14 (0.92-1.41)	1.09 (0.89-1.34)	0.94 (0.77-1.15)
Indian	Number (%)	6 (2.7%)	12 (4.6%)	12 (2.9%)	29 (5.8%)	28 (4.0%)
	CIR	2.1	4.1	3.8	7.7	6.3
	ASIR	5.3	7.9	4.5	9.4	7.6
	RR and 95% CI	0.63 (0.27-1.48)	1.13 (0.60-2.13)	0.60 (0.34-1.05)	1.09 (0.71-1.67)	0.66 (0.47-0.91)
Period		**1993-1997**	**1998-2002**	**2003-2007**	**2008-2012**	**2013-2017**
All	Number (%)	886 (100.0%)	1061 (100.0%)	1347 (100.0%)	1625 (100.0%)	1874 (100.0%)
	CIR	11.8	12.9	15.4	17.1	18.9
	ASIR	11.0	11.1	12.2	12.7	13.1
Chinese	Number (%)	711 (80.2%)	842 (79.4%)	1085 (80.5%)	1283 (79.0%)	1414 (75.5%)
	CIR	12.2	13.3	16.3	18.1	19.0
	ASIR	10.8	10.9	12.3	12.7	12.6
	RR	1.00	1.00	1.00	1.00	1.00
Malay	Number (%)	112 (12.6%)	146 (13.8%)	165 (12.2%)	212 (13.0%)	303 (16.2%)
	CIR	10.7	12.9	13.7	16.8	23.1
	ASIR	11.7	13.4	12.8	13.9	17.8
	RR and 95% CI	1.10 (0.93-1.31)	1.22 (1.11-1.35)	1.05 (0.85-1.29)	1.11 (0.99-1.25)	1.42 (1.32-1.52)
Indian	Number (%)	51 (5.8%)	59 (5.6%)	77 (5.7%)	96 (5.9%)	111 (5.9%)
	CIR	9.8	9.5	10.9	11.6	12.8
	ASIR	10.7	9.0	10.1	10.9	10.6
	RR and 95% CI	0.93 (0.68-1.27)	0.85 (0.74-0.97)	0.83 (0.67-1.03)	0.82 (0.67-1.01)	0.82 (0.66-1.03)

Figure 9.10.2: AGE-SPECIFIC INCIDENCE RATE (PER 100,000 POPULATION) FOR OVARIAN CANCER BY AGE GROUP, 1968-1972, 1988-1992, 2013-2017

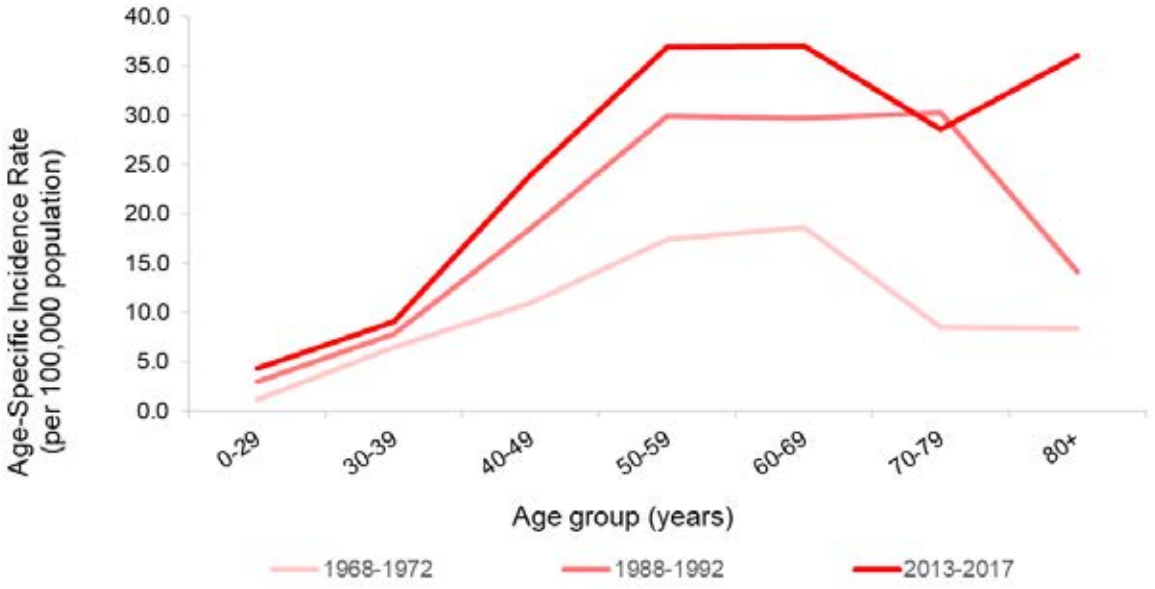


Figure 9.10.3: AGE-STANDARDISED MORTALITY RATE (PER 100,000 POPULATION) FOR OVARIAN CANCER BY FIVE-YEAR PERIOD, 1968-2017

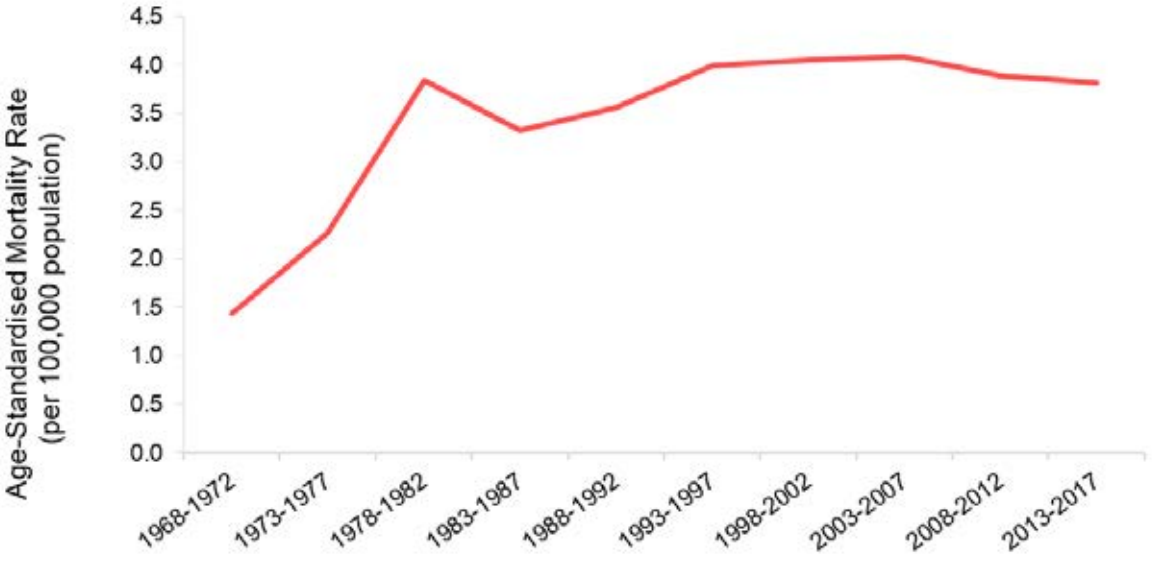


Table 9.10.2: MORTALITY NUMBER AND RATE (PER 100,000 POPULATION) FOR OVARIAN CANCER BY ETHNICITY AND FIVE-YEAR PERIOD, 1968-2017

Period		1968-1972	1973-1977	1978-1982	1983-1987	1988-1992
All	Number (%)	54 (100.0%)	91 (100.0%)	172 (100.0%)	181 (100.0%)	230 (100.0%)
	CMR	1.1	1.7	3.1	3.0	3.4
	ASMR	1.4	2.3	3.8	3.3	3.6
Chinese	Number (%)	46 (85.2%)	67 (73.6%)	150 (87.2%)	150 (82.9%)	193 (83.9%)
	CMR	1.2	1.6	3.4	3.1	3.7
	ASMR	1.5	2.0	4.0	3.4	3.6
Malay	Number (%)	6 (11.1%)	19 (20.9%)	16 (9.3%)	19 (10.5%)	24 (10.4%)
	CMR	0.8	2.5	2.0	2.2	2.5
	ASMR	1.2	5.1	2.6	3.2	3.4
Indian	Number (%)	1 (1.9%)	5 (5.5%)	5 (2.9%)	9 (5.0%)	12 (5.2%)
	CMR	0.4	1.7	1.6	2.4	2.7
	ASMR	0.5	3.3	3.1	3.8	4.0
Period		**1993-1997**	**1998-2002**	**2003-2007**	**2008-2012**	**2013-2017**
All	Number (%)	305 (100.0%)	380 (100.0%)	470 (100.0%)	555 (100.0%)	645 (100.0%)
	CMR	4.1	4.6	5.4	5.8	6.5
	ASMR	4.0	4.0	4.1	3.9	3.8
Chinese	Number (%)	246 (80.7%)	294 (77.4%)	383 (81.5%)	429 (77.3%)	493 (76.4%)
	CMR	4.2	4.6	5.8	6.0	6.6
	ASMR	3.8	3.8	4.1	3.7	3.6
Malay	Number (%)	41 (13.4%)	58 (15.3%)	47 (10.0%)	81 (14.6%)	105 (16.3%)
	CMR	3.9	5.1	3.9	6.4	8.0
	ASMR	5.2	5.9	3.8	5.4	5.8
Indian	Number (%)	12 (3.9%)	24 (6.3%)	28 (6.0%)	36 (6.5%)	39 (6.0%)
	CMR	2.3	3.9	4.0	4.3	4.5
	ASMR	2.8	4.3	4.2	4.6	3.7

Figure 9.10.4: TRENDS IN AGE-STANDARDISED INCIDENCE RATE (PER 100,000 POPULATION), AGE-STANDARDISED MORTALITY RATE (PER 100,000 POPULATION), AND FIVE-YEAR AGE-STANDARDISED RELATIVE SURVIVAL RATE (%) FOR OVARIAN CANCER BY FIVE-YEAR PERIOD, 1968-2017

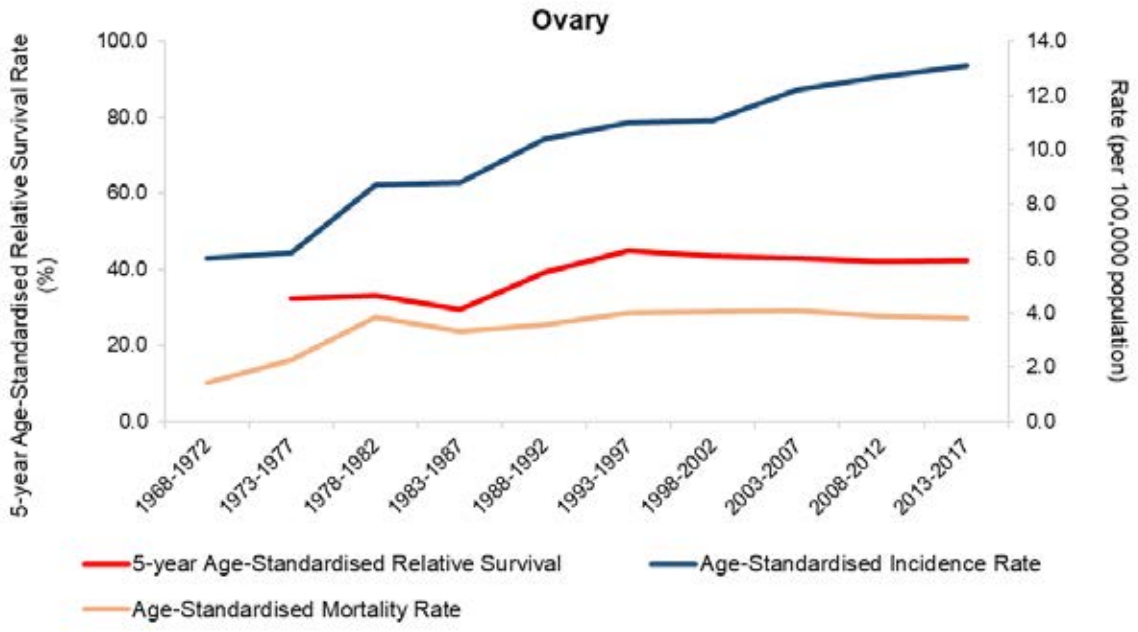
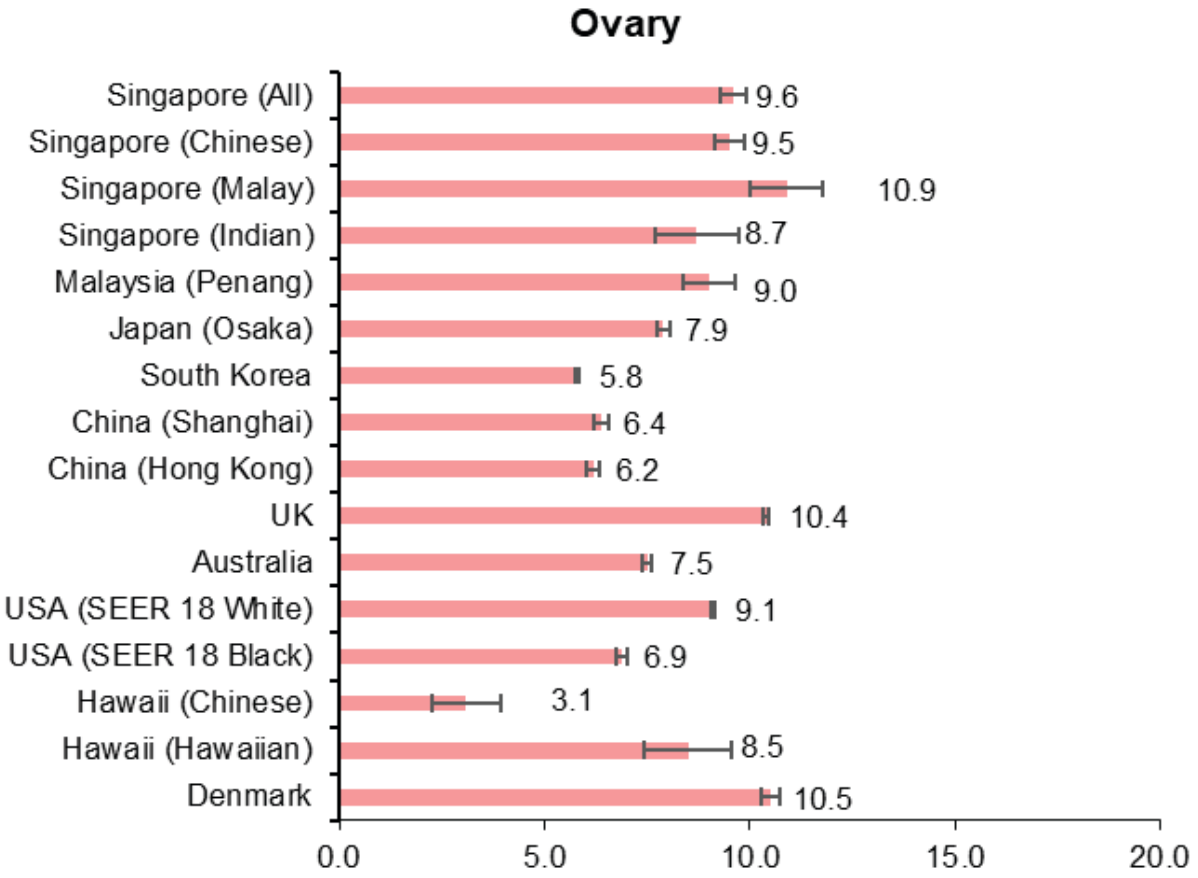


Table 9.10.3: STAGE DISTRIBUTION OF OVARIAN CANCER, 2008-2017

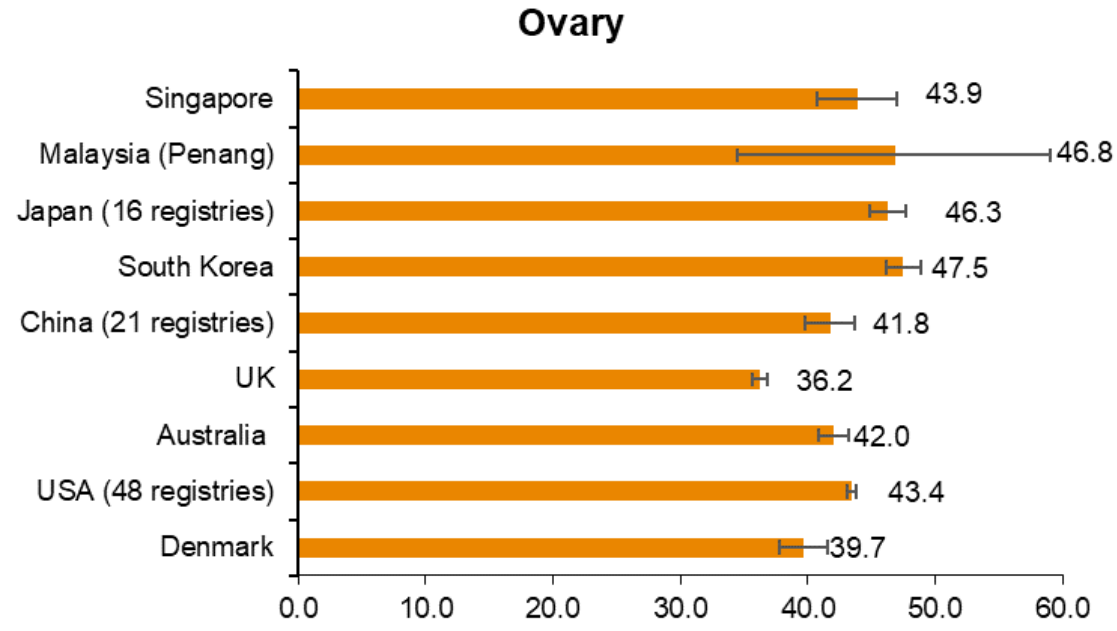
	Stage I		Stage II		Stage III		Stage IV	
Year	Number	%	Number	%	Number	%	Number	%
2008	81	34.8	32	13.7	84	36.1	36	15.5
2009	67	33.0	16	7.9	78	38.4	42	20.7
2010	81	36.7	14	6.3	82	37.1	44	19.9
2011	90	39.6	21	9.3	78	34.4	38	16.7
2012	108	38.2	27	9.5	95	33.6	53	18.7
2013	126	43.2	17	5.8	90	30.8	59	20.2
2014	122	43.9	22	7.9	91	32.7	43	15.5
2015	122	38.0	36	11.2	99	30.8	64	19.9
2016	110	38.5	38	13.3	101	35.3	37	12.9
2017	98	37.8	28	10.8	81	31.3	52	20.1

Figure 9.10.5: AGE-STANDARDISED INCIDENCE RATE (PER 100,000 POPULATION) FOR OVARIAN CANCER* IN SELECTED COUNTRIES, 2008-2012



* excludes fallopian tube for comparability

Figure 9.10.6: FIVE-YEAR AGE-STANDARDISED NET SURVIVAL (%) FOR OVARIAN CANCER IN SELECTED COUNTRIES, 2010-2014



9.11 PROSTATE (ICD-10: C61)

In Singapore, prostate cancer first emerged among the top ten ranking cancers for males in 1983-1987 as the ninth most common cancer. Over the years, it rose to become the third most common cancer among males in 2013-2017 (4,853 cases, accounting for 14.1% of all cancers diagnosed among males during this period) (Table 5.1.2(a)). Relative to incidence, prostate cancer accounted for comparatively fewer cancer deaths, 5.8% of the total cancer deaths among males with 884 cancer deaths in 2013-2017 (Table 6.2.2(a)).

The ASIR of prostate cancer grew steadily over the past fifty years, with an eightfold increase from 4.0 per 100,000 population in 1968-1972 to 31.8 per 100,000 population in 2013-2017 (Figure 9.11.1). The introduction of the prostate-specific antigen (PSA) test could be a possible reason for the increase, especially after the 1990s [136]. This upward trend was observed across all three ethnic groups, with the steepest increase observed in the Chinese. In 2013-2017, the Chinese were at the highest risk of developing prostate cancer compared to the Malays and Indians. The age-adjusted relative risk was 0.68 (95% CI: 0.54-0.85) for Malays and 0.62 (95% CI: 0.56-0.68) for Indians (Table 9.11.1). The risk of developing prostate cancer increased sharply with age, especially after 50 years of age (Figure 9.11.2). In 2013-2017, the incidence rate was the highest among those aged 70-79 years and 51.2% of the cases occurred among those aged 70 years and above.

Although the ASIR of prostate cancer continued to climb, the overall ASMR, after an upward climb in the earlier years, began to stabilise from 1998-2002 onwards (Figure 9.11.3). Among the Malays, however, the upward trend in the ASMR of prostate cancer continued (Table 9.11.2). From 1988-1992 onwards, the Malays had the highest ASMR among the ethnic groups although the ASIR among the Malays was consistently lower than that among the Chinese during this period (Table 9.11.1). The five-year ASRS increased from 47.3% in 1973-1977 to 86.8% in 2013-2017 (Figure 9.11.4). Prostate cancer has a low fatality rate, especially in its earlier stages [137]. Generally, the majority of prostate cancer cases were diagnosed in the earlier stages, although a slight shift in the pattern was observed in more recent years as seen in the decrease in percentage of Stage II cases of prostate cancer and corresponding increase in Stage III cases (Table 9.11.3). In 2013-2017, the five-year ASRS for prostate cancer diagnosed at Stages I-III were above 98% (Appendix E1).

The ASIR of prostate cancer in Singapore (2008-2012) was much lower than those in UK, Australia, USA and Denmark, where high incidence was partly due to diagnosis of indolent prostate cancers (less aggressive tumours that may never cause symptoms during the patient's lifetime) through PSA screening [138] [139]. However, it was

higher than those in Malaysia (Penang), South Korea and China (Shanghai and Hong Kong) (Figure 9.11.5). The age-standardised five-year net survival (2010-2014) of prostate cancer in Singapore was comparable to those in Malaysia (Penang), UK, and Denmark, but was lower than those in Japan, Australia and USA (Figure 9.11.6).

Figure 9.11.1: AGE-STANDARDISED INCIDENCE RATE (PER 100,000 POPULATION) FOR PROSTATE CANCER BY FIVE-YEAR PERIOD, 1968-2017

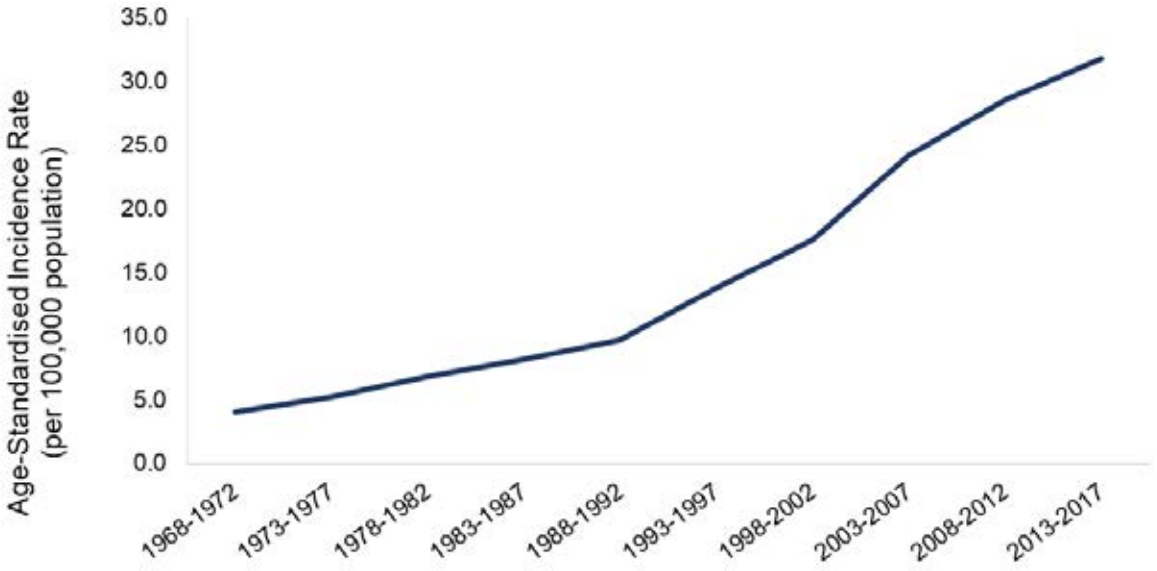


Table 9.11.1: INCIDENCE NUMBER AND RATE (PER 100,000 POPULATION) AND RELATIVE RISK FOR PROSTATE CANCER BY ETHNICITY AND FIVE-YEAR PERIOD, 1968-2017

Period		1968-1972	1973-1977	1978-1982	1983-1987	1988-1992
All	Number (%)	94 (100.0%)	144 (100.0%)	240 (100.0%)	356 (100.0%)	529 (100.0%)
	CIR	1.8	2.7	4.1	5.7	7.7
	ASIR	4.0	5.2	6.8	8.2	9.7
Chinese	Number (%)	74 (78.7%)	104 (72.2%)	180 (75.0%)	257 (72.2%)	413 (78.1%)
	CIR	1.9	2.5	4.0	5.3	7.8
	ASIR	3.8	4.6	6.3	7.5	9.7
	RR	1.00	1.00	1.00	1.00	1.00
Malay	Number (%)	9 (9.6%)	20 (13.9%)	25 (10.4%)	45 (12.6%)	54 (10.2%)
	CIR	1.2	2.6	3.0	5.0	5.5
	ASIR	4.2	7.0	7.0	9.4	9.0
	RR and 95% CI	1.00 (0.77-1.31)	1.51 (1.14-2.00)	1.04 (0.80-1.35)	1.29 (0.99-1.68)	0.91 (0.74-1.12)
Indian	Number (%)	8 (8.5%)	16 (11.1%)	26 (10.8%)	41 (11.5%)	43 (8.1%)
	CIR	1.9	3.9	6.4	8.9	8.3
	ASIR	3.5	7.1	9.4	9.9	8.1
	RR and 95% CI	1.13 (0.60-2.15)	1.68 (1.25-2.27)	1.48 (1.20-1.82)	1.53 (1.15-2.05)	0.84 (0.68-1.04)
Period		**1993-1997**	**1998-2002**	**2003-2007**	**2008-2012**	**2013-2017**
All	Number (%)	901 (100.0%)	1359 (100.0%)	2209 (100.0%)	3336 (100.0%)	4853 (100.0%)
	CIR	11.9	16.6	25.6	36.0	50.6
	ASIR	13.8	17.6	24.2	28.6	31.8
Chinese	Number (%)	716 (79.5%)	1097 (80.7%)	1869 (84.6%)	2867 (85.9%)	4183 (86.2%)
	CIR	12.3	17.5	28.8	42.0	59.1
	ASIR	14.4	18.5	25.5	30.0	33.3
	RR	1.00	1.00	1.00	1.00	1.00
Malay	Number (%)	89 (9.9%)	140 (10.3%)	173 (7.8%)	218 (6.5%)	322 (6.6%)
	CIR	8.3	12.2	14.4	17.4	24.8
	ASIR	12.6	16.6	18.1	19.5	22.5
	RR and 95% CI	0.83 (0.63-1.08)	0.87 (0.72-1.06)	0.72 (0.62-0.83)	0.64 (0.54-0.76)	0.68 (0.54-0.85)
Indian	Number (%)	69 (7.7%)	86 (6.3%)	117 (5.3%)	158 (4.7%)	201 (4.1%)
	CIR	11.8	12.8	15.6	17.8	22.1
	ASIR	9.8	11.8	15.9	20.4	20.2
	RR and 95% CI	0.68 (0.58-0.81)	0.55 (0.40-0.75)	0.64 (0.57-0.72)	0.66 (0.57-0.76)	0.62 (0.56-0.68)

Figure 9.11.2: AGE-SPECIFIC INCIDENCE RATE (PER 100,000 POPULATION) FOR PROSTATE CANCER BY AGE GROUP, 1968-1972, 1988-1992, 2013-2017

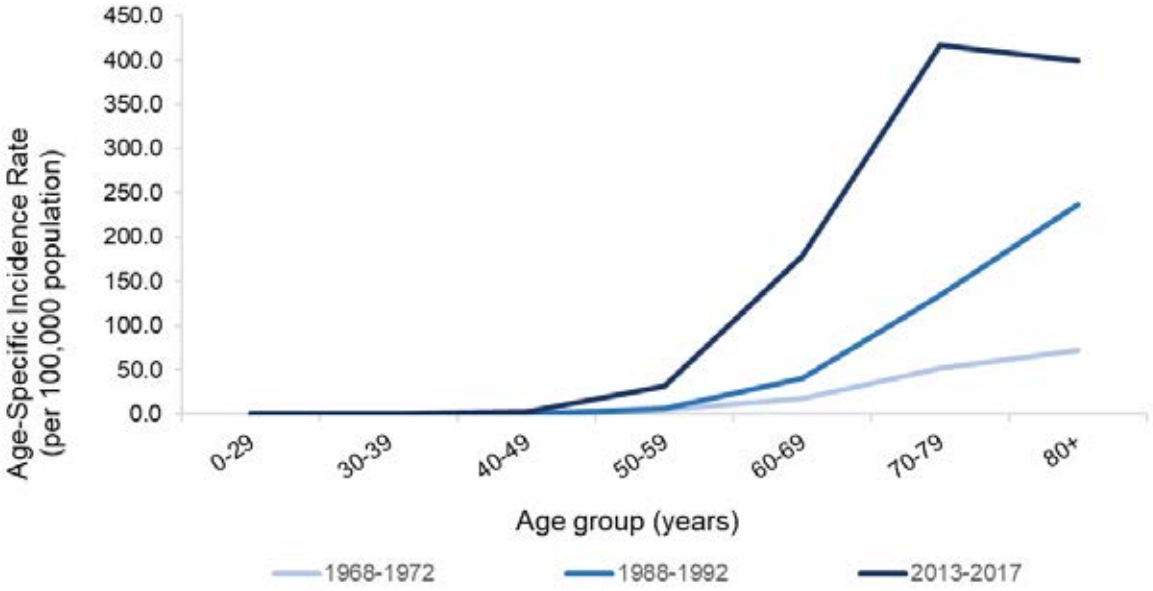


Figure 9.11.3: AGE-STANDARDISED MORTALITY RATE (PER 100,000 POPULATION) FOR PROSTATE CANCER BY FIVE-YEAR PERIOD, 1968-2017

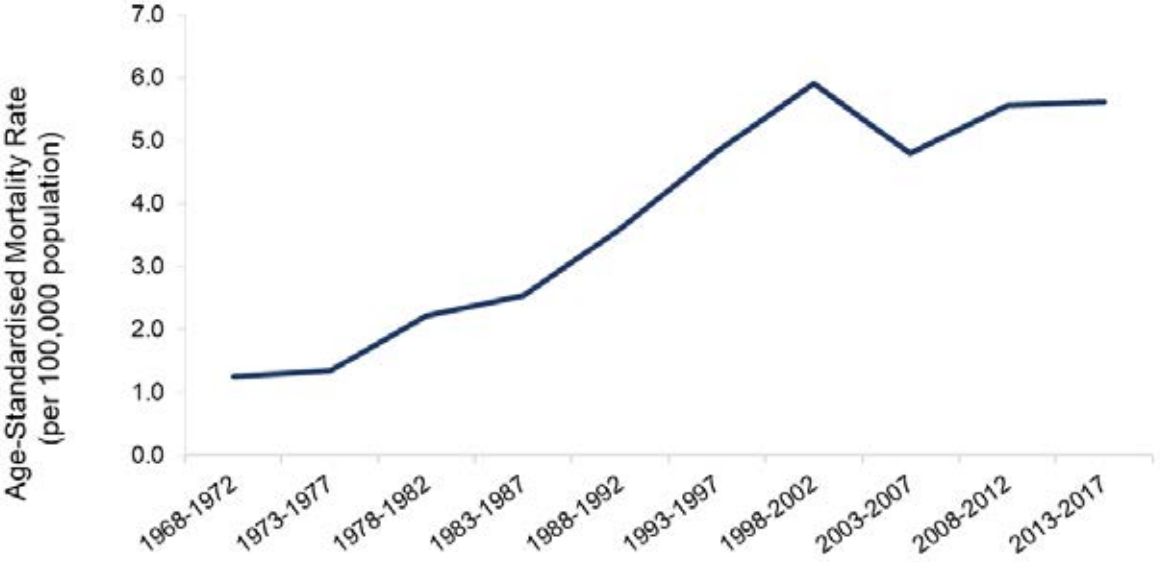


Table 9.11.2: MORTALITY NUMBER AND RATE (PER 100,000 POPULATION) FOR PROSTATE CANCER BY ETHNICITY AND FIVE-YEAR PERIOD, 1968-2017

Period		1968-1972	1973-1977	1978-1982	1983-1987	1988-1992
All	Number (%)	32 (100.0%)	38 (100.0%)	76 (100.0%)	111 (100.0%)	198 (100.0%)
	CMR	0.6	0.7	1.3	1.8	2.9
	ASMR	1.3	1.4	2.2	2.5	3.6
Chinese	Number (%)	26 (81.3%)	33 (86.8%)	59 (77.6%)	79 (71.2%)	157 (79.3%)
	CMR	0.7	0.8	1.3	1.6	2.9
	ASMR	1.2	1.5	2.1	2.3	3.5
Malay	Number (%)	3 (9.4%)	2 (5.3%)	7 (9.2%)	14 (12.6%)	22 (11.1%)
	CMR	0.4	0.3	0.8	1.6	2.2
	ASMR	1.3	0.6	1.8	2.9	3.7
Indian	Number (%)	2 (6.3%)	3 (7.9%)	5 (6.6%)	13 (11.7%)	13 (6.6%)
	CMR	0.5	0.7	1.2	2.8	2.5
	ASMR	1.0	1.2	1.8	3.7	3.3
Period		**1993-1997**	**1998-2002**	**2003-2007**	**2008-2012**	**2013-2017**
All	Number (%)	314 (100.0%)	448 (100.0%)	436 (100.0%)	652 (100.0%)	884 (100.0%)
	CMR	4.1	5.5	5.1	7.0	9.2
	ASMR	4.8	5.9	4.8	5.6	5.6
Chinese	Number (%)	249 (79.3%)	355 (79.2%)	350 (80.3%)	509 (78.1%)	713 (80.7%)
	CMR	4.3	5.7	5.4	7.5	10.1
	ASMR	4.9	6.1	4.9	5.4	5.5
Malay	Number (%)	39 (12.4%)	48 (10.7%)	53 (12.2%)	86 (13.2%)	112 (12.7%)
	CMR	3.6	4.2	4.4	6.9	8.6
	ASMR	5.8	6.4	5.7	7.6	7.7
Indian	Number (%)	13 (4.1%)	29 (6.5%)	27 (6.2%)	43 (6.6%)	45 (5.1%)
	CMR	2.2	4.3	3.6	4.8	4.9
	ASMR	1.8	3.4	3.2	4.9	4.5

Figure 9.11.4: TRENDS IN AGE-STANDARDISED INCIDENCE RATE (PER 100,000 POPULATION), AGE-STANDARDISED MORTALITY RATE (PER 100,000 POPULATION), AND FIVE-YEAR AGE-STANDARDISED RELATIVE SURVIVAL RATE (%) FOR PROSTATE CANCER BY FIVE-YEAR PERIOD, 1968-2017

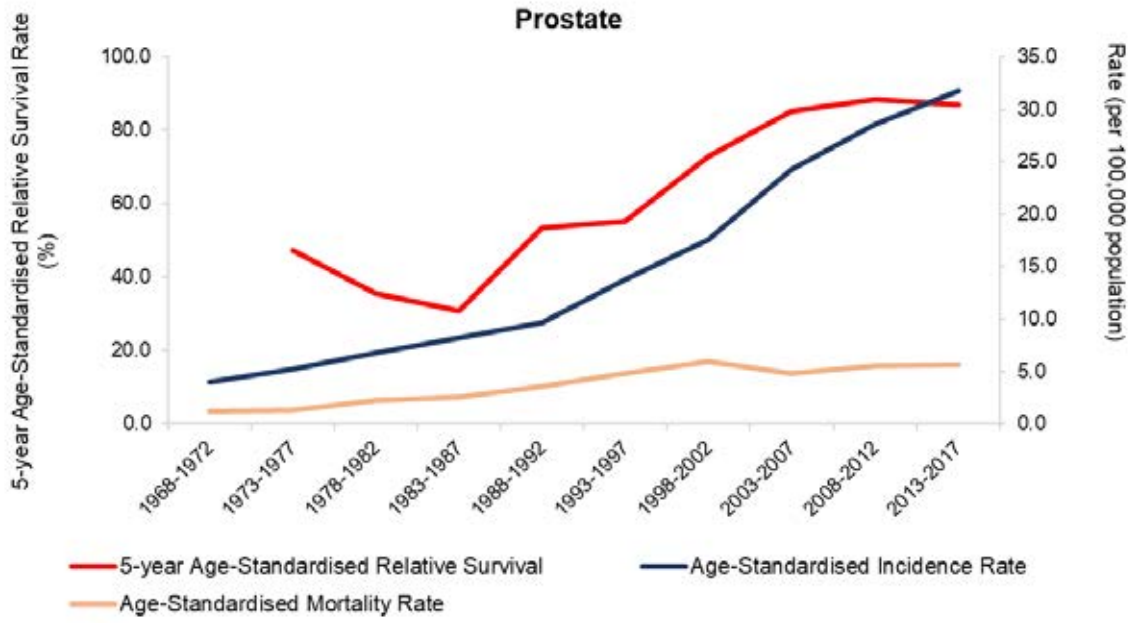


Table 9.11.3: STAGE DISTRIBUTION OF PROSTATE CANCER, 2008-2017

Year	Stage I		Stage II		Stage III		Stage IV	
	Number	%	Number	%	Number	%	Number	%
2008	1	0.2	329	65.0	49	9.7	127	25.1
2009	2	0.3	380	65.6	52	9.0	145	25.0
2010	76	12.5	322	52.9	59	9.7	152	25.0
2011	100	15.3	301	46.0	69	10.6	184	28.1
2012	128	17.8	312	43.3	72	10.0	209	29.0
2013	98	14.3	279	40.8	93	13.6	214	31.3
2014	121	15.1	292	36.5	106	13.3	280	35.0
2015	150	16.5	299	32.9	152	16.7	307	33.8
2016	173	18.3	326	34.5	189	20.0	257	27.2
2017	125	12.9	370	38.1	179	18.4	298	30.7

Figure 9.11.5: AGE-STANDARDISED INCIDENCE RATE (PER 100,000 POPULATION) FOR PROSTATE CANCER IN SELECTED COUNTRIES, 2008-2012

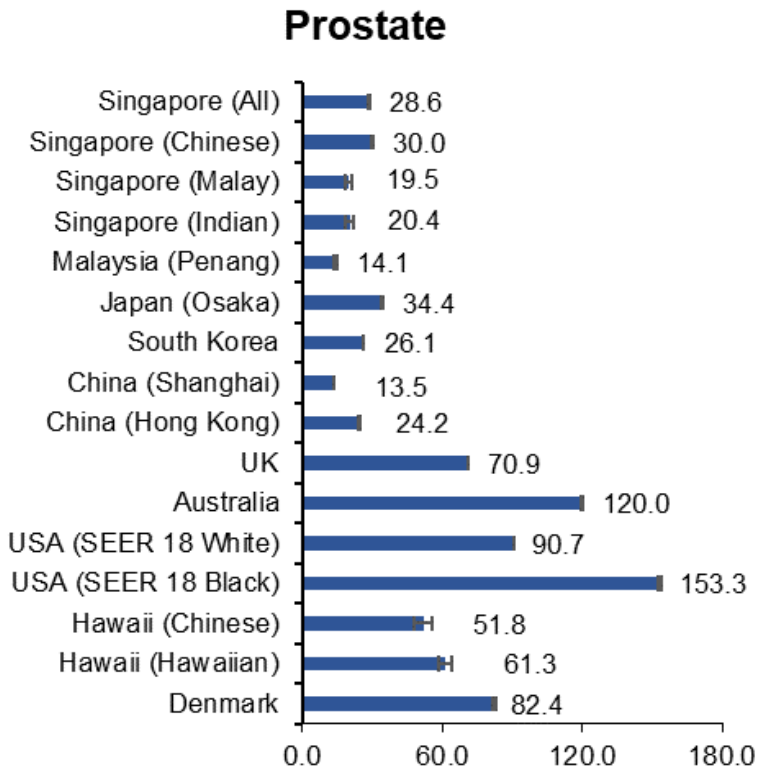
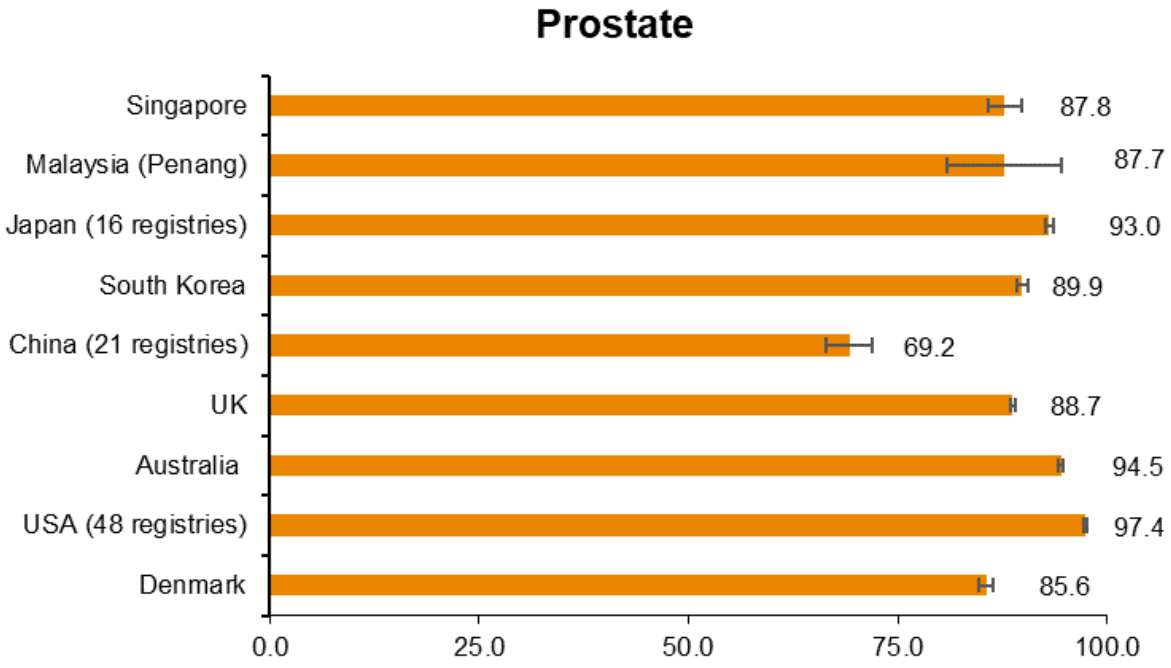


Figure 9.11.6: FIVE-YEAR AGE-STANDARDISED NET SURVIVAL (%) FOR PROSTATE CANCER IN SELECTED COUNTRIES, 2010-2014



9.12 KIDNEY & OTHER URINARY ORGANS (ICD-10: C64-C66, C68)

Kidney cancer was not among the ten most common cancers diagnosed in males until 1998-2002 when it appeared in tenth place. Its gradually rising ASIR put it in eighth place among the ten most common cancers among males in 2013-2017 (Table 5.1.2(a)). However, kidney cancer was never among the ten most common cancers diagnosed in females throughout the fifty years (Table 5.1.2(b)). In 2013-2017, a total of 2,115 cases of kidney cancer were diagnosed among the resident population with about twice as many males (1,381 cases, which accounted for 4.0% of all cancer among males) as females (734 cases, which accounted for 2.0% of all cancer among females) being afflicted with the condition (Figure 9.12.1, Tables 9.12.1(a) and 9.12.1(b)). This pattern of male predominance had also been observed worldwide along with an increasing incidence of kidney cancer [140] [141] [142]. The ASIR of kidney cancer has gradually risen for both genders, from 2.4 per 100,000 population in 1968-1972 to 9.4 per 100,000 population in 2013-2017 among males and from 1.7 to 4.6 per 100,000 population among females over the same period. Rising affluence in developed nations has been linked with increased kidney cancer incidence through its associations with smoking, alcoholism, occupational exposure to chemical carcinogens, hypertension and obesity [140] [142] [143]; this could explain the rise in the ASIR of kidney cancer over the years as industrialisation brought increasing affluence to Singapore.

The male-to-female ratio of kidney cancer diagnoses rose from 1.4:1 in 1968-1972 to 2:1 in 2013-2017 (Tables 9.12.1(a) and 9.12.1(b)). As kidney cancer is associated with other chronic diseases such as hypertension and chronic kidney disease, as well as risk factors such as smoking and obesity, the higher prevalence of such conditions in males could explain why kidney cancer was consistently observed to be more common among males [67]. With the exception of 1978-1982, Chinese males were at the highest risk for kidney cancer - in 2013-2017, the age-adjusted relative risk was 0.66 (95%CI: 0.57-0.78) for Malay males and 0.65 (95%CI: 0.53-0.80) for Indian males. However, the relative risk for kidney cancer among females were observed to fluctuate over the years due to the relatively smaller numbers. With the exception of the earlier years, the incidence of kidney cancer was observed to increase with age, particularly after the age of 50 years (Figure 9.12.2).

Following the pattern of increasing ASIR, the ASMR of kidney cancer was also on the rise (Figure 9.12.3, Tables 9.12.2(a) and 9.12.2(b)). Among males, it rose from 0.7 to 3.0 per 100,000 population from 1968-1972 to 2013-2017; among females, the ASMR rose from 0.7 to 1.4 per 100,000 population during the same period. While kidney cancer only emerged among the ten most frequent causes of cancer mortality in males

from 2003-2007 onwards, it was never among the top ten causes of cancer mortality among females (Tables 6.5.1(a) - 6.5.1(b)).

Most cases of kidney cancer were diagnosed at Stage I – approximately half were diagnosed at Stage I in 2008-2017 (Table 9.12.3). Most of the renal cancers in Singapore were diagnosed at earlier stages, and a shift towards smaller tumour sizes for Stage I tumours had been observed [141]. This explains why the ASRS of kidney cancer was fairly high, at 61.1% for males and 70.6% for females in 2013-2017, up from 25.7% and 35.2% respectively in 1973-1977 (Figures 9.12.4(a) and 9.12.4(b)). This also accounts for the widening gap between incidence and mortality of kidney cancer observed, with the ASIR increasing at a faster rate than the ASMR.

For the period 2008-2012, the ASIR of kidney cancer in Singapore was similar to those of other Asian countries such as Japan, South Korea, and China (Figure 9.12.5). In general, the ASIR of kidney cancers were higher in western countries such as the USA, UK, and Australia, as compared to other countries [140] [141] [143] [144]. This could be due to the association of kidney cancer with obesity and its related afflictions such as hypertension, and high-fat diets, which are more prevalent in these regions [142] [144] [143]. The increasing prevalence of obesity in developed countries is likely to partly account for the rise in the incidence of kidney cancer – the proportion of kidney cancers attributable to obesity could be as high as 40% in North America and 30% in Europe [141] [143].

Figure 9.12.1: AGE-STANDARDISED INCIDENCE RATE (PER 100,000 POPULATION) FOR KIDNEY CANCER BY GENDER AND FIVE-YEAR PERIOD, 1968-2017

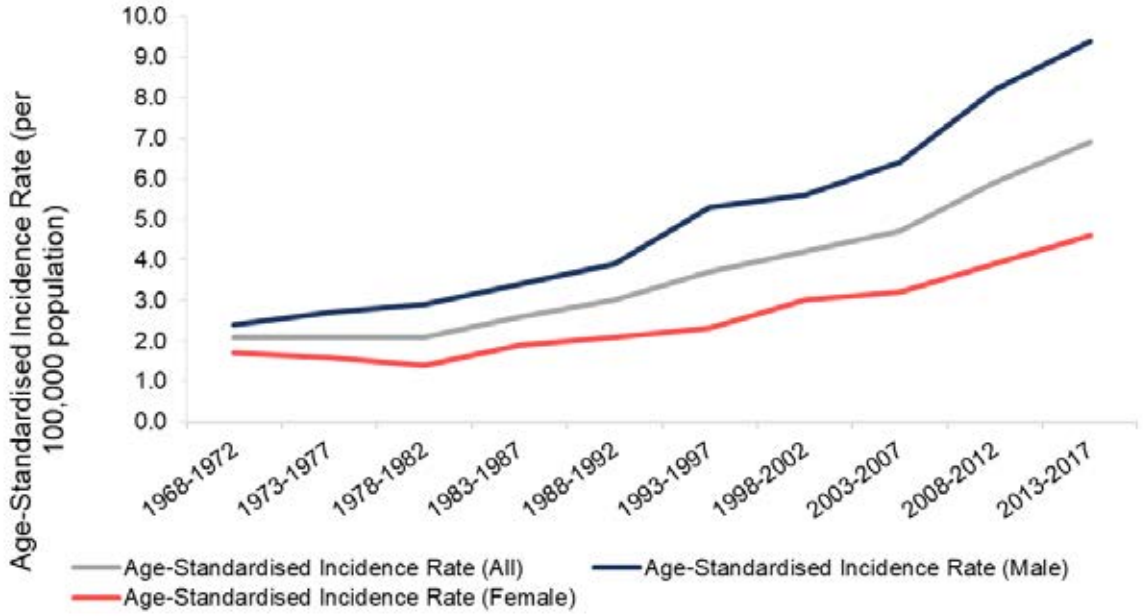


Table 9.12.1(a): INCIDENCE NUMBER AND RATE (PER 100,000 POPULATION) AND RELATIVE RISK FOR KIDNEY CANCER IN MALES BY ETHNICITY AND FIVE-YEAR PERIOD, 1968-2017

Period		1968-1972	1973-1977	1978-1982	1983-1987	1988-1992
All	Number (%)	77 (100.0%)	100 (100.0%)	118 (100.0%)	161 (100.0%)	223 (100.0%)
	CIR	1.5	1.9	2.0	2.6	3.2
	ASIR	2.4	2.7	2.9	3.4	3.9
Chinese	Number (%)	64 (83.1%)	84 (84.0%)	94 (79.7%)	135 (83.9%)	186 (83.4%)
	CIR	1.6	2.0	2.1	2.8	3.5
	ASIR	2.5	3.0	3.0	3.7	4.3
	RR	1.00	1.00	1.00	1.00	1.00
Malay	Number (%)	3 (3.9%)	6 (6.0%)	16 (13.6%)	13 (8.1%)	17 (7.6%)
	CIR	0.4	0.8	1.9	1.4	1.7
	ASIR	0.7	1.1	3.0	2.1	2.3
	RR and 95% CI	0.30 (0.09-1.01)	0.45 (0.21-0.99)	1.02 (0.69-1.50)	0.60 (0.36-1.01)	0.58 (0.29-1.15)
Indian	Number (%)	7 (9.1%)	9 (9.0%)	8 (6.8%)	11 (6.8%)	17 (7.6%)
	CIR	1.6	2.2	2.0	2.4	3.3
	ASIR	3.3	2.8	1.9	2.6	3.3
	RR and 95% CI	0.79 (0.40-1.54)	0.87 (0.47-1.61)	0.67 (0.34-1.29)	0.66 (0.39-1.12)	0.70 (0.46-1.07)
Period		**1993-1997**	**1998-2002**	**2003-2007**	**2008-2012**	**2013-2017**
All	Number (%)	366 (100.0%)	468 (100.0%)	647 (100.0%)	1006 (100.0%)	1381 (100.0%)
	CIR	4.8	5.7	7.5	10.9	14.4
	ASIR	5.3	5.6	6.4	8.2	9.4
Chinese	Number (%)	321 (87.7%)	413 (88.2%)	537 (83.0%)	868 (86.3%)	1183 (85.7%)
	CIR	5.5	6.6	8.3	12.7	16.7
	ASIR	6.1	6.4	6.7	8.8	10.1
	RR	1.00	1.00	1.00	1.00	1.00
Malay	Number (%)	25 (6.8%)	32 (6.8%)	55 (8.5%)	68 (6.8%)	103 (7.5%)
	CIR	2.3	2.8	4.6	5.4	7.9
	ASIR	2.9	3.2	5.1	5.4	6.7
	RR and 95% CI	0.53 (0.36-0.77)	0.53 (0.43-0.66)	0.76 (0.62-0.93)	0.60 (0.46-0.77)	0.66 (0.57-0.78)
Indian	Number (%)	16 (4.4%)	15 (3.2%)	37 (5.7%)	47 (4.7%)	73 (5.3%)
	CIR	2.7	2.2	4.9	5.3	8.0
	ASIR	2.6	2.1	5.1	5.4	6.3
	RR and 95% CI	0.40 (0.20-0.78)	0.29 (0.19-0.45)	0.72 (0.49-1.04)	0.58 (0.45-0.75)	0.65 (0.53-0.80)

Table 9.12.1(b): INCIDENCE NUMBER AND RATE (PER 100,000 POPULATION) AND RELATIVE RISK FOR KIDNEY CANCER IN FEMALES BY ETHNICITY AND FIVE-YEAR PERIOD, 1968-2017

Period		1968-1972	1973-1977	1978-1982	1983-1987	1988-1992
All	Number (%)	57 (100.0%)	58 (100.0%)	64 (100.0%)	100 (100.0%)	130 (100.0%)
	CIR	1.2	1.1	1.1	1.6	1.9
	ASIR	1.7	1.6	1.4	1.9	2.1
Chinese	Number (%)	47 (82.5%)	54 (93.1%)	55 (85.9%)	92 (92.0%)	114 (87.7%)
	CIR	1.2	1.3	1.2	1.9	2.2
	ASIR	1.7	1.7	1.4	2.1	2.2
	RR	1.00	1.00	1.00	1.00	1.00
Malay	Number (%)	6 (10.5%)	3 (5.2%)	7 (10.9%)	5 (5.0%)	7 (5.4%)
	CIR	0.8	0.4	0.9	0.6	0.7
	ASIR	0.9	0.8	1.3	0.9	0.9
	RR and 95% CI	1.01 (0.50-2.04)	0.45 (0.17-1.21)	1.06 (0.46-2.44)	0.44 (0.19-1.02)	0.48 (0.24-0.96)
Indian	Number (%)	1 (1.8%)	1 (1.7%)	1 (1.6%)	3 (3.0%)	9 (6.9%)
	CIR	0.4	0.3	0.3	0.8	2.0
	ASIR	0.3	0.3	0.4	1.7	3.2
	RR and 95% CI	0.51 (0.07-3.58)	0.45 (0.06-3.38)	0.41 (0.06-2.69)	0.66 (0.16-2.80)	1.39 (0.96-2.00)
Period		**1993-1997**	**1998-2002**	**2003-2007**	**2008-2012**	**2013-2017**
All	Number (%)	175 (100.0%)	283 (100.0%)	339 (100.0%)	542 (100.0%)	734 (100.0%)
	CIR	2.3	3.4	3.9	5.7	7.4
	ASIR	2.3	3.0	3.2	3.9	4.6
Chinese	Number (%)	140 (80.0%)	243 (85.9%)	284 (83.8%)	460 (84.9%)	614 (83.7%)
	CIR	2.4	3.8	4.3	6.5	8.3
	ASIR	2.2	3.1	3.2	4.1	4.8
	RR	1.00	1.00	1.00	1.00	1.00
Malay	Number (%)	24 (13.7%)	28 (9.9%)	28 (8.3%)	43 (7.9%)	71 (9.7%)
	CIR	2.3	2.5	2.3	3.4	5.4
	ASIR	2.8	2.6	2.3	2.8	4.3
	RR and 95% CI	1.30 (1.04-1.64)	0.92 (0.70-1.21)	0.77 (0.55-1.07)	0.73 (0.54-1.01)	0.89 (0.76-1.04)
Indian	Number (%)	9 (5.1%)	8 (2.8%)	22 (6.5%)	27 (5.0%)	38 (5.2%)
	CIR	1.7	1.3	3.1	3.3	4.4
	ASIR	2.6	1.4	3.4	3.2	3.6
	RR and 95% CI	0.97 (0.57-1.65)	0.48 (0.19-1.23)	1.06 (0.70-1.61)	0.78 (0.55-1.10)	0.77 (0.58-1.02)

Figure 9.12.2: AGE-SPECIFIC INCIDENCE RATE (PER 100,000 POPULATION) FOR KIDNEY CANCER BY AGE GROUP, 1968-1972, 1988-1992, 2013-2017

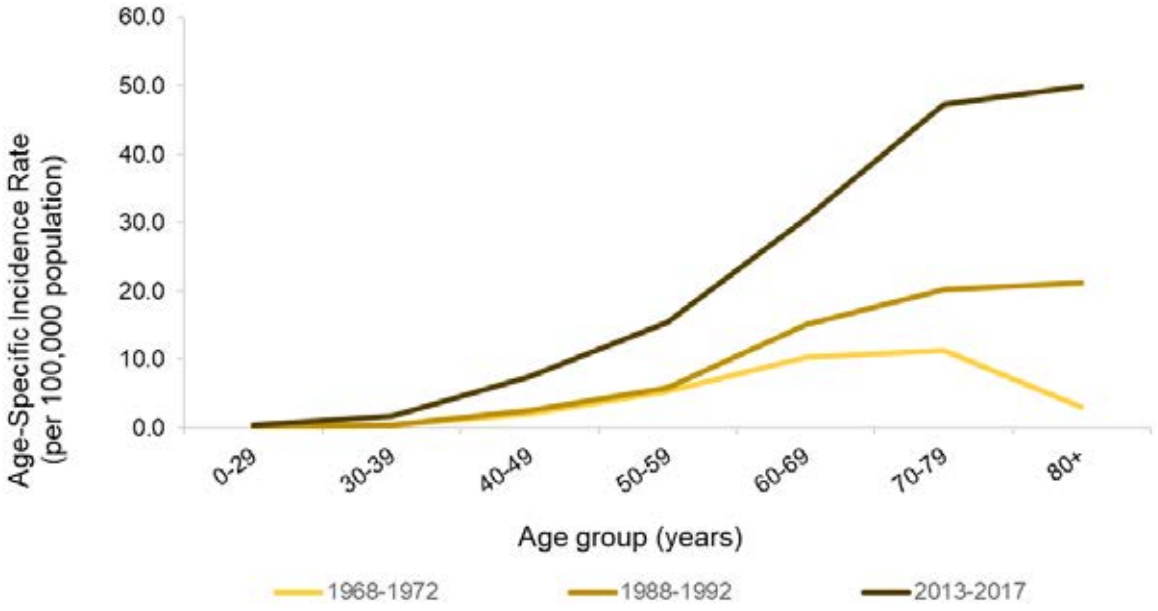


Figure 9.12.3: AGE-STANDARDISED MORTALITY RATE (PER 100,000 POPULATION) FOR KIDNEY CANCER BY GENDER AND FIVE-YEAR PERIOD, 1968-2017

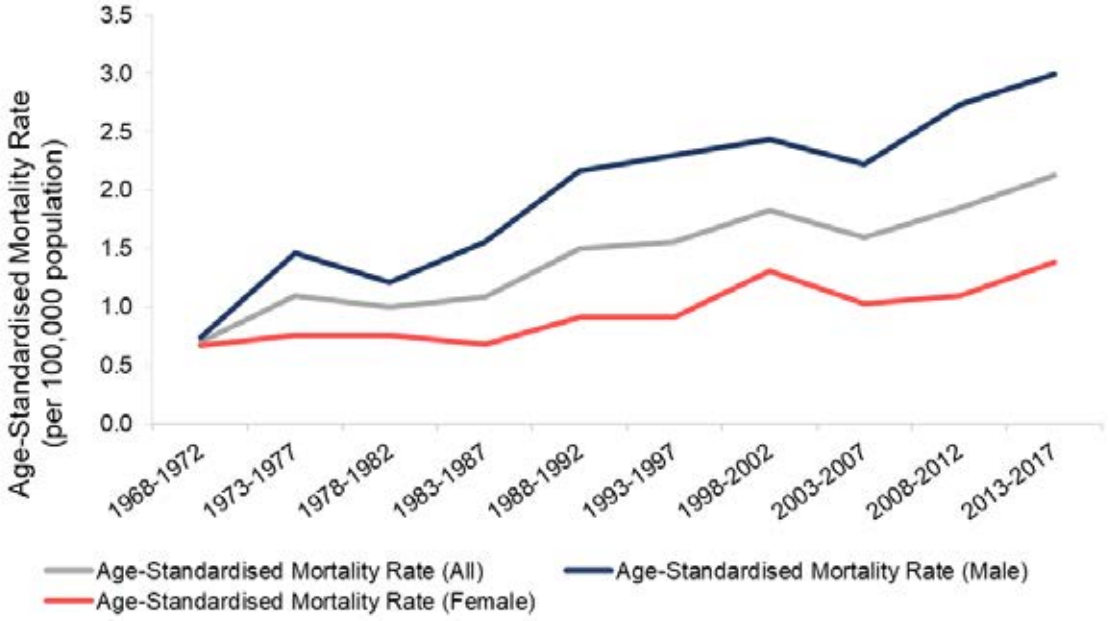


Table 9.12.2(a): MORTALITY NUMBER AND RATE (PER 100,000 POPULATION) FOR KIDNEY CANCER IN MALES BY ETHNICITY AND FIVE-YEAR PERIOD, 1968-2017

Period		1968-1972	1973-1977	1978-1982	1983-1987	1988-1992
All	Number (%)	21 (100.0%)	49 (100.0%)	49 (100.0%)	72 (100.0%)	120 (100.0%)
	CMR	0.4	0.9	0.8	1.1	1.7
	ASMR	0.7	1.5	1.2	1.6	2.2
Chinese	Number (%)	20 (95.2%)	42 (85.7%)	38 (77.6%)	62 (86.1%)	98 (81.7%)
	CMR	0.5	1.0	0.8	1.3	1.8
	ASMR	0.9	1.6	1.2	1.8	2.3
Malay	Number (%)	1 (4.8%)	3 (6.1%)	4 (8.2%)	6 (8.3%)	13 (10.8%)
	CMR	0.1	0.4	0.5	0.7	1.3
	ASMR	0.2	0.8	0.7	1.1	1.9
Indian	Number (%)	0 (0.0%)	3 (6.1%)	6 (12.2%)	4 (5.6%)	9 (7.5%)
	CMR	0.0	0.7	1.5	0.9	1.7
	ASMR	0.0	0.5	1.5	0.7	1.9
Period		**1993-1997**	**1998-2002**	**2003-2007**	**2008-2012**	**2013-2017**
All	Number (%)	154 (100.0%)	201 (100.0%)	220 (100.0%)	339 (100.0%)	460 (100.0%)
	CMR	2.0	2.5	2.6	3.7	4.8
	ASMR	2.3	2.4	2.2	2.7	3.0
Chinese	Number (%)	132 (85.7%)	175 (87.1%)	172 (78.2%)	293 (86.4%)	385 (83.7%)
	CMR	2.3	2.8	2.6	4.3	5.4
	ASMR	2.6	2.8	2.2	2.9	3.1
Malay	Number (%)	15 (9.7%)	19 (9.5%)	30 (13.6%)	26 (7.7%)	54 (11.7%)
	CMR	1.4	1.7	2.5	2.1	4.2
	ASMR	2.0	1.9	2.6	2.1	3.5
Indian	Number (%)	7 (4.5%)	5 (2.5%)	14 (6.4%)	15 (4.4%)	16 (3.5%)
	CMR	1.2	0.7	1.9	1.7	1.8
	ASMR	1.1	0.7	2.0	1.9	1.6

Table 9.12.2(b): MORTALITY NUMBER AND RATE (PER 100,000 POPULATION) FOR KIDNEY CANCER IN FEMALES BY ETHNICITY AND FIVE-YEAR PERIOD, 1968-2017

Period		1968-1972	1973-1977	1978-1982	1983-1987	1988-1992
All	Number (%)	22 (100.0%)	29 (100.0%)	33 (100.0%)	35 (100.0%)	60 (100.0%)
	CMR	0.4	0.6	0.6	0.6	0.9
	ASMR	0.7	0.8	0.8	0.7	0.9
Chinese	Number (%)	19 (86.4%)	26 (89.7%)	31 (93.9%)	30 (85.7%)	53 (88.3%)
	CMR	0.5	0.6	0.7	0.6	1.0
	ASMR	0.7	0.8	0.8	0.7	1.0
Malay	Number (%)	2 (9.1%)	1 (3.4%)	0 (0.0%)	4 (11.4%)	4 (6.7%)
	CMR	0.3	0.1	0.0	0.5	0.4
	ASMR	0.2	0.4	0.0	0.7	0.6
Indian	Number (%)	0 (0.0%)	2 (6.9%)	1 (3.0%)	1 (2.9%)	3 (5.0%)
	CMR	0.0	0.7	0.3	0.3	0.7
	ASMR	0.0	0.5	0.4	0.7	1.6
Period		**1993-1997**	**1998-2002**	**2003-2007**	**2008-2012**	**2013-2017**
All	Number (%)	71 (100.0%)	130 (100.0%)	122 (100.0%)	163 (100.0%)	258 (100.0%)
	CMR	0.9	1.6	1.4	1.7	2.6
	ASMR	0.9	1.3	1.0	1.1	1.4
Chinese	Number (%)	60 (84.5%)	116 (89.2%)	102 (83.6%)	138 (84.7%)	224 (86.8%)
	CMR	1.0	1.8	1.5	1.9	3.0
	ASMR	0.9	1.4	1.0	1.1	1.4
Malay	Number (%)	9 (12.7%)	5 (3.8%)	11 (9.0%)	15 (9.2%)	21 (8.1%)
	CMR	0.9	0.4	0.9	1.2	1.6
	ASMR	1.1	0.5	0.9	1.0	1.2
Indian	Number (%)	2 (2.8%)	4 (3.1%)	7 (5.7%)	8 (4.9%)	12 (4.7%)
	CMR	0.4	0.6	1.0	1.0	1.4
	ASMR	0.5	0.9	1.1	1.0	1.1

Figure 9.12.4(a): TRENDS IN AGE-STANDARDISED INCIDENCE RATE (PER 100,000 POPULATION), AGE-STANDARDISED MORTALITY RATE (PER 100,000 POPULATION), AND FIVE-YEAR AGE-STANDARDISED RELATIVE SURVIVAL RATE (%) FOR KIDNEY CANCER IN MALES BY FIVE-YEAR PERIOD, 1968-2017

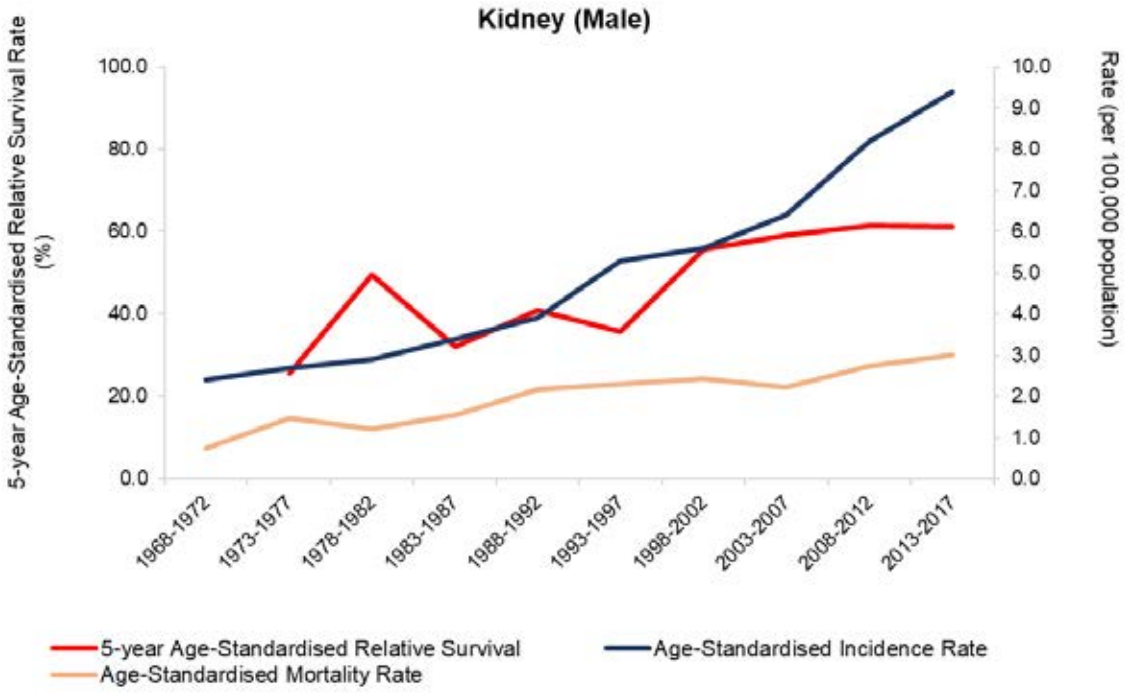


Figure 9.12.4(b): TRENDS IN AGE-STANDARDISED INCIDENCE RATE (PER 100,000 POPULATION), AGE-STANDARDISED MORTALITY RATE (PER 100,000 POPULATION), AND FIVE-YEAR AGE-STANDARDISED RELATIVE SURVIVAL RATE (%) FOR KIDNEY CANCER IN FEMALES BY FIVE-YEAR PERIOD, 1968-2017

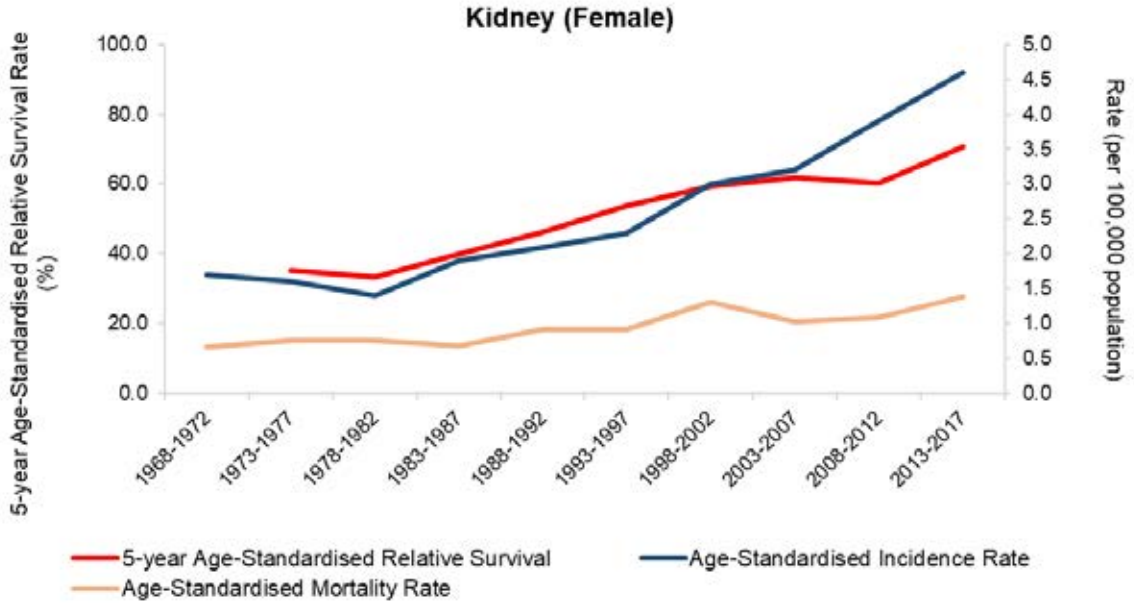
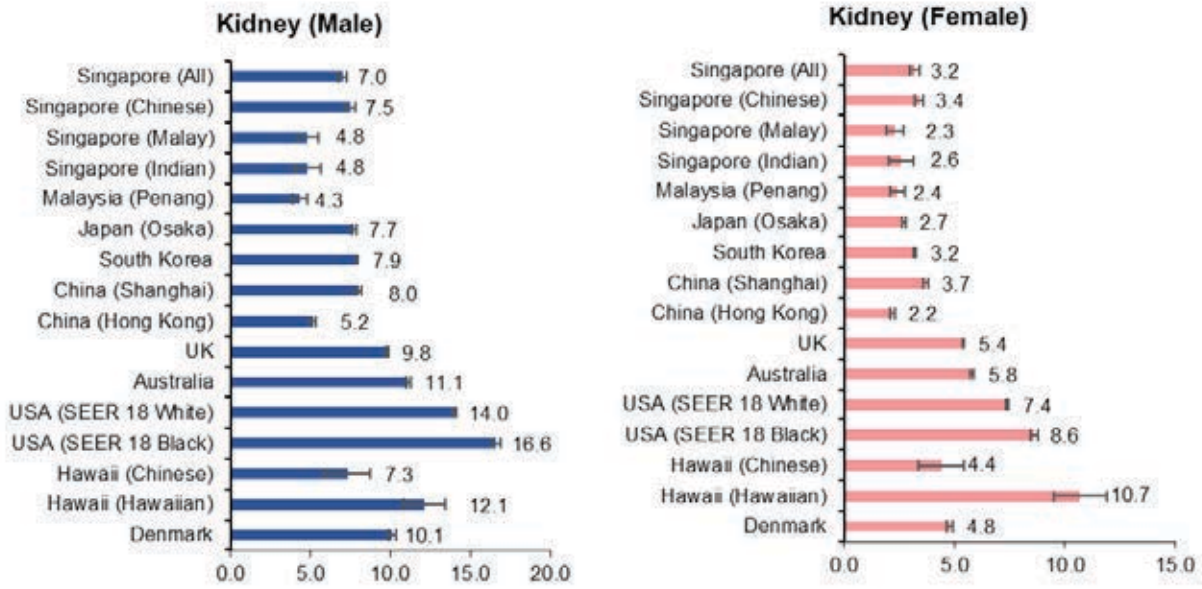


Table 9.12.3: STAGE DISTRIBUTION OF KIDNEY CANCER, 2008-2017

Year	Stage I		Stage II		Stage III		Stage IV	
	Number	%	Number	%	Number	%	Number	%
2008	95	42.4	30	13.4	51	22.8	48	21.4
2009	99	38.1	35	13.5	41	15.8	85	32.7
2010	137	49.5	26	9.4	38	13.7	76	27.4
2011	146	47.6	46	15.0	45	14.7	70	22.8
2012	144	48.2	26	8.7	40	13.4	89	29.8
2013	151	45.6	35	10.6	54	16.3	91	27.5
2014	188	50.1	28	7.5	68	18.1	91	24.3
2015	204	52.3	38	9.7	45	11.5	103	26.4
2016	201	50.9	32	8.1	66	16.7	96	24.3
2017	161	49.5	18	5.5	59	18.2	87	26.8

Figure 9.12.5: AGE-STANDARDISED INCIDENCE RATE (PER 100,000 POPULATION) FOR KIDNEY CANCER* IN SELECTED COUNTRIES, 2008-2012



* excludes other urinary organs for comparability

9.13 THYROID GLAND (ICD-10: C73)

In Singapore, while thyroid cancer was frequently found among the top ten leading cancers for females in the past fifty years, it was never within the top ten ranking cancers for males (Tables 5.1.2(a) and 5.1.2(b)). In 2013-2017, it ranked thirteenth among males (502 cases, accounting for 1.5% of all cancers diagnosed among males) and eighth among females (1,426 cases, accounting for 3.9% of all cancers diagnosed among females). Thyroid cancer is one of the least deadly cancers, with a low case fatality rate [145]. In 2013-2017, there were 125 deaths from thyroid cancer, about 25 cases per year, accounting for 0.5% of total cancer deaths (Tables 9.13.2(a) and 9.13.2(b)).

The ASIR appeared to be fairly stable before 2003-2007, but there was an upward trend since 2003-2007 (Figure 9.13.1). The ASIR was higher among females, with a the female-to-male ratio of 2.8:1 in 2013-2017. While the exact mechanism for this gender disparity is unknown, hormonal differences between genders probably play an important role in thyroid cancer development [146] [147]. Among males, Malay males (4.4 per 100,000 population) had the highest ASIR, followed by Chinese males (3.7 per 100,000 population) and Indian males (2.5 per 100,000 population) in 2013-2017 (Table 9.13.1(a)). Among females, however, the ASIR was the highest among Chinese females (10.3 per 100,000 population), and lower among Indian females (9.7 per 100,000 population) and Malay females (9.4 per 100,000 population) (Table 9.13.1(b)). The risk of developing thyroid cancer rose with age but it was more frequently diagnosed at a younger age than most other cancers (Figure 9.13.2) - 44.8% of the cases were diagnosed among those age younger than 50 years in 2013-2017.

Although the ASIR of thyroid cancer steadily increased, the ASMR remained low over the past fifty years and a downward trend was observed from 1988-1992 onwards (Figure 9.13.3). The low mortality was due to the fact that the majority of thyroid cancers were low-risk subtypes. About 90.0-95.0% of cases were differentiated thyroid cancer, which usually grow slowly and have excellent prognosis. About 5.0-10.0% were medullary, anaplastic or poorly-differentiated thyroid cancers, which are more aggressive and more likely to spread to other organs thus having relatively poor prognosis [148]. The overall five-year ASRS increased from 64.2% in 1973-1977 to 87.4% in 2013-2017 among males (Figure 9.13.4(a)) and from 56.7% to 89.7% among females during the same period (Figure 9.13.4(b)). The majority of thyroid cancer cases were diagnosed at earlier stages – close to 60% were diagnosed at Stages I and II in 2017 (Table 9.13.3).

The ASIR of thyroid cancer (2008-2012) in Singapore was comparable to those in Japan (Osaka) and China (Hong Kong), but much lower than those in China

(Shanghai), USA (White), and South Korea (Figure 9.13.5). The high incidence of thyroid cancer in South Korea was attributable to the thyroid cancer screening programme launched in 1999, which led to a fifteenfold increase in the incidence from 1993 to 2011 with no effects on corresponding mortality rate [149]. It was estimated that above 99.0% of the screen-detected thyroid cancers were over-diagnosed in South Korea [150].

Figure 9.13.1: AGE-STANDARDISED INCIDENCE RATE (PER 100,000 POPULATION) FOR THYROID CANCER BY GENDER AND FIVE-YEAR PERIOD, 1968-2017

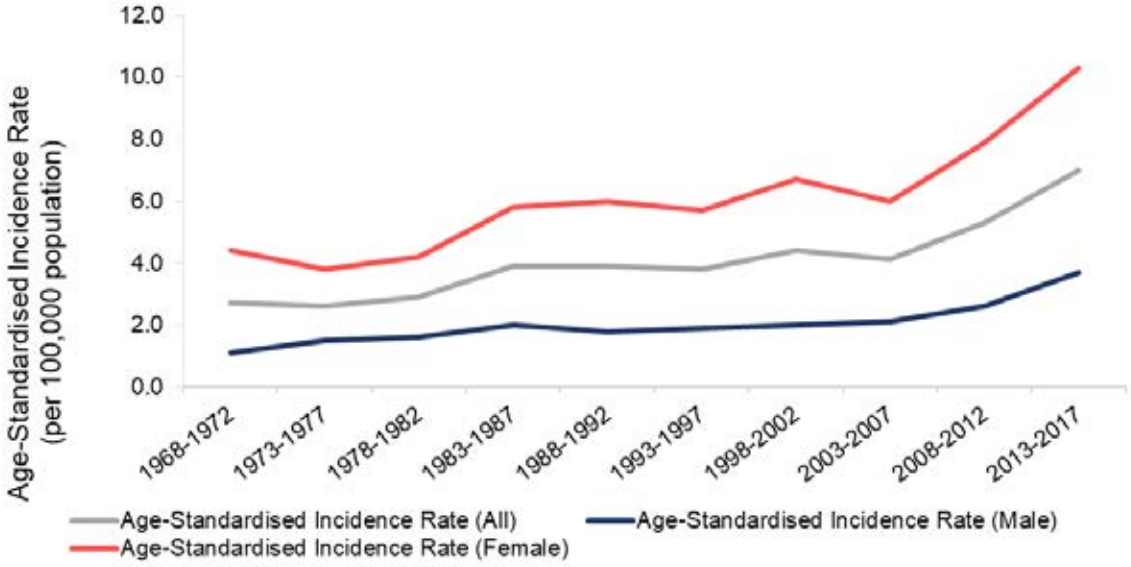


Table 9.13.1(a): INCIDENCE NUMBER AND RATE (PER 100,000 POPULATION) AND RELATIVE RISK FOR THYROID CANCER IN MALES BY ETHNICITY AND FIVE-YEAR PERIOD, 1968-2017

Period		1968-1972	1973-1977	1978-1982	1983-1987	1988-1992
All	Number (%)	40 (100.0%)	61 (100.0%)	74 (100.0%)	115 (100.0%)	115 (100.0%)
	CIR	0.8	1.1	1.3	1.8	1.7
	ASIR	1.1	1.5	1.6	2.0	1.8
Chinese	Number (%)	31 (77.5%)	43 (70.5%)	58 (78.4%)	90 (78.3%)	97 (84.3%)
	CIR	0.8	1.0	1.3	1.8	1.8
	ASIR	1.1	1.3	1.6	2.0	1.9
	RR	1.00	1.00	1.00	1.00	1.00
Malay	Number (%)	4 (10.0%)	7 (11.5%)	11 (14.9%)	16 (13.9%)	11 (9.6%)
	CIR	0.5	0.9	1.3	1.8	1.1
	ASIR	0.8	1.4	2.1	2.6	1.3
	RR and 95% CI	0.80 (0.35-1.81)	1.02 (0.49-2.12)	1.17 (0.77-1.75)	1.06 (0.75-1.49)	0.72 (0.41-1.24)
Indian	Number (%)	5 (12.5%)	9 (14.8%)	5 (6.8%)	7 (6.1%)	6 (5.2%)
	CIR	1.2	2.2	1.2	1.5	1.2
	ASIR	1.1	2.4	1.1	1.4	1.1
	RR and 95% CI	1.21 (0.57-2.57)	1.79 (1.03-3.10)	0.77 (0.39-1.50)	0.71 (0.42-1.18)	0.54 (0.32-0.94)
Period		**1993-1997**	**1998-2002**	**2003-2007**	**2008-2012**	**2013-2017**
All	Number (%)	145 (100.0%)	188 (100.0%)	216 (100.0%)	313 (100.0%)	502 (100.0%)
	CIR	1.9	2.3	2.5	3.4	5.2
	ASIR	1.9	2.0	2.1	2.6	3.7
Chinese	Number (%)	120 (82.8%)	148 (78.7%)	174 (80.6%)	230 (73.5%)	392 (78.1%)
	CIR	2.1	2.4	2.7	3.4	5.5
	ASIR	2.0	2.0	2.1	2.4	3.7
	RR	1.00	1.00	1.00	1.00	1.00
Malay	Number (%)	15 (10.3%)	23 (12.2%)	28 (13.0%)	49 (15.7%)	68 (13.5%)
	CIR	1.4	2.0	2.3	3.9	5.2
	ASIR	1.9	2.5	2.3	3.9	4.4
	RR and 95% CI	0.82 (0.47-1.44)	1.06 (0.73-1.53)	1.11 (0.82-1.51)	1.51 (1.10-2.06)	1.15 (0.96-1.39)
Indian	Number (%)	9 (6.2%)	13 (6.9%)	11 (5.1%)	21 (6.7%)	28 (5.6%)
	CIR	1.5	1.9	1.5	2.4	3.1
	ASIR	1.4	1.5	1.8	2.0	2.5
	RR and 95% CI	0.69 (0.32-1.47)	0.81 (0.52-1.27)	0.63 (0.33-1.19)	0.86 (0.62-1.19)	0.65 (0.43-0.97)

Table 9.13.1(b): INCIDENCE NUMBER AND RATE (PER 100,000 POPULATION) AND RELATIVE RISK FOR THYROID CANCER IN FEMALES BY ETHNICITY AND FIVE-YEAR PERIOD, 1968-2017

Period		1968-1972	1973-1977	1978-1982	1983-1987	1988-1992
All	Number (%)	163 (100.0%)	168 (100.0%)	226 (100.0%)	370 (100.0%)	436 (100.0%)
	CIR	3.3	3.2	4.0	6.1	6.5
	ASIR	4.4	3.8	4.2	5.8	6.0
Chinese	Number (%)	135 (82.8%)	140 (83.3%)	187 (82.7%)	305 (82.4%)	357 (81.9%)
	CIR	3.5	3.4	4.2	6.3	6.8
	ASIR	4.2	3.8	4.2	5.9	6.1
	RR	1.00	1.00	1.00	1.00	1.00
Malay	Number (%)	15 (9.2%)	17 (10.1%)	33 (14.6%)	43 (11.6%)	59 (13.5%)
	CIR	2.0	2.3	4.1	5.0	6.3
	ASIR	4.2	3.7	4.8	4.9	6.2
	RR and 95% CI	0.82 (0.40-1.67)	0.81 (0.52-1.27)	1.15 (0.84-1.57)	0.91 (0.67-1.24)	1.09 (0.87-1.36)
Indian	Number (%)	9 (5.5%)	10 (6.0%)	5 (2.2%)	17 (4.6%)	17 (3.9%)
	CIR	3.2	3.4	1.6	4.5	3.8
	ASIR	11.0	4.8	1.1	6.3	3.6
	RR and 95% CI	1.36 (0.82-2.24)	1.25 (0.69-2.26)	0.43 (0.23-0.79)	0.79 (0.48-1.30)	0.63 (0.37-1.07)
Period		**1993-1997**	**1998-2002**	**2003-2007**	**2008-2012**	**2013-2017**
All	Number (%)	492 (100.0%)	654 (100.0%)	661 (100.0%)	991 (100.0%)	1426 (100.0%)
	CIR	6.6	8.0	7.6	10.4	14.4
	ASIR	5.7	6.7	6.0	7.9	10.3
Chinese	Number (%)	406 (82.5%)	520 (79.5%)	509 (77.0%)	779 (78.6%)	1118 (78.4%)
	CIR	7.0	8.2	7.7	11.0	15.1
	ASIR	5.9	6.7	5.8	8.0	10.3
	RR	1.00	1.00	1.00	1.00	1.00
Malay	Number (%)	54 (11.0%)	79 (12.1%)	96 (14.5%)	116 (11.7%)	152 (10.7%)
	CIR	5.2	7.0	8.0	9.2	11.6
	ASIR	5.4	6.9	7.5	8.0	9.4
	RR and 95% CI	0.89 (0.65-1.21)	1.01 (0.88-1.16)	1.26 (1.11-1.43)	0.99 (0.81-1.21)	0.90 (0.69-1.17)
Indian	Number (%)	22 (4.5%)	46 (7.0%)	39 (5.9%)	60 (6.1%)	102 (7.2%)
	CIR	4.2	7.4	5.5	7.2	11.8
	ASIR	3.5	7.1	4.8	6.2	9.7
	RR and 95% CI	0.68 (0.44-1.05)	1.01 (0.70-1.47)	0.83 (0.64-1.08)	0.78 (0.64-0.95)	0.90 (0.71-1.15)

Figure 9.13.2: AGE-SPECIFIC INCIDENCE RATE (PER 100,000 POPULATION) FOR THYROID CANCER BY AGE GROUP, 1968-1972, 1988-1992, 2013-2017

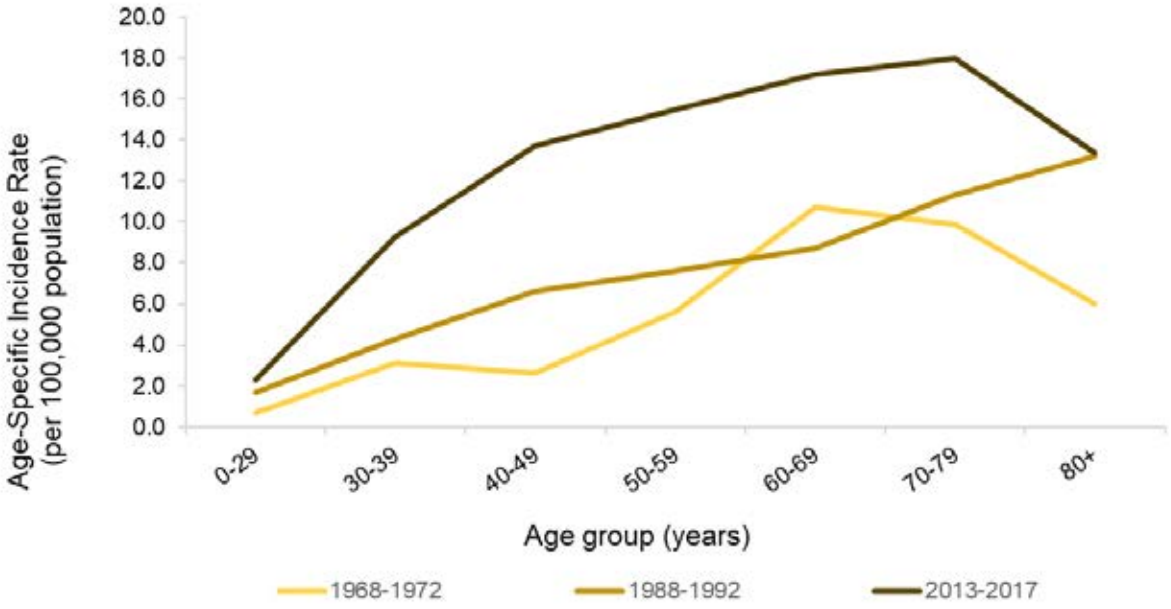


Figure 9.13.3: AGE-STANDARDISED MORTALITY RATE (PER 100,000 POPULATION) FOR THYROID CANCER BY GENDER AND FIVE-YEAR PERIOD, 1968-2017

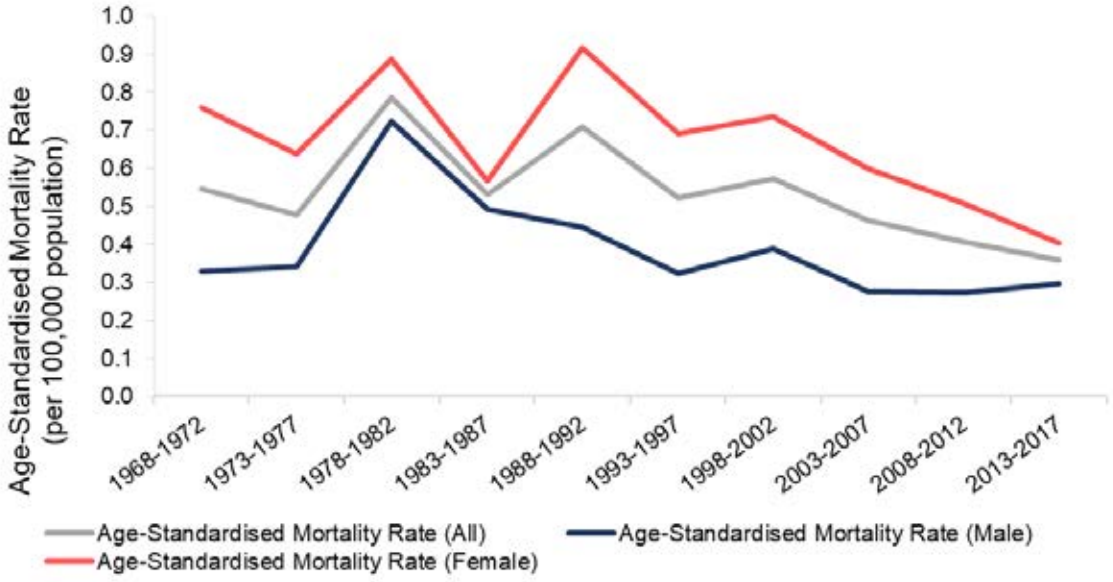


Table 9.13.2(a): MORTALITY NUMBER AND RATE (PER 100,000 POPULATION) FOR THYROID CANCER IN MALES BY ETHNICITY AND FIVE-YEAR PERIOD, 1968-2017

Period		1968-1972	1973-1977	1978-1982	1983-1987	1988-1992
All	Number (%)	10 (100.0%)	11 (100.0%)	26 (100.0%)	22 (100.0%)	24 (100.0%)
	CMR	0.2	0.2	0.4	0.3	0.3
	ASMR	0.3	0.3	0.7	0.5	0.4
Chinese	Number (%)	8 (80.0%)	7 (63.6%)	21 (80.8%)	13 (59.1%)	20 (83.3%)
	CMR	0.2	0.2	0.5	0.3	0.4
	ASMR	0.3	0.2	0.7	0.4	0.5
Malay	Number (%)	2 (20.0%)	2 (18.2%)	3 (11.5%)	6 (27.3%)	3 (12.5%)
	CMR	0.3	0.3	0.4	0.7	0.3
	ASMR	0.5	0.8	1.1	1.2	0.4
Indian	Number (%)	0 (0.0%)	2 (18.2%)	2 (7.7%)	2 (9.1%)	0 (0.0%)
	CMR	0.0	0.5	0.5	0.4	0.0
	ASMR	0.0	0.8	1.3	0.3	0.0
Period		**1993-1997**	**1998-2002**	**2003-2007**	**2008-2012**	**2013-2017**
All	Number (%)	22 (100.0%)	29 (100.0%)	26 (100.0%)	32 (100.0%)	46 (100.0%)
	CMR	0.3	0.4	0.3	0.3	0.5
	ASMR	0.3	0.4	0.3	0.3	0.3
Chinese	Number (%)	14 (63.6%)	21 (72.4%)	22 (84.6%)	23 (71.9%)	27 (58.7%)
	CMR	0.2	0.3	0.3	0.3	0.4
	ASMR	0.3	0.4	0.3	0.3	0.2
Malay	Number (%)	5 (22.7%)	7 (24.1%)	3 (11.5%)	8 (25.0%)	13 (28.3%)
	CMR	0.5	0.6	0.2	0.6	1.0
	ASMR	0.6	0.9	0.3	0.6	0.9
Indian	Number (%)	3 (13.6%)	1 (3.4%)	1 (3.8%)	1 (3.1%)	6 (13.0%)
	CMR	0.5	0.1	0.1	0.1	0.7
	ASMR	0.4	0.1	0.2	0.2	0.6

Table 9.13.2(b): MORTALITY NUMBER AND RATE (PER 100,000 POPULATION) FOR THYROID CANCER IN FEMALES BY ETHNICITY AND FIVE-YEAR PERIOD, 1968-2017

Period		1968-1972	1973-1977	1978-1982	1983-1987	1988-1992
All	Number (%)	24 (100.0%)	24 (100.0%)	40 (100.0%)	30 (100.0%)	61 (100.0%)
	CMR	0.5	0.5	0.7	0.5	0.9
	ASMR	0.8	0.6	0.9	0.6	0.9
Chinese	Number (%)	15 (62.5%)	16 (66.7%)	32 (80.0%)	23 (76.7%)	56 (91.8%)
	CMR	0.4	0.4	0.7	0.5	1.1
	ASMR	0.5	0.5	0.8	0.5	1.0
Malay	Number (%)	5 (20.8%)	7 (29.2%)	7 (17.5%)	3 (10.0%)	2 (3.3%)
	CMR	0.7	0.9	0.9	0.3	0.2
	ASMR	2.0	2.0	1.3	0.6	0.3
Indian	Number (%)	2 (8.3%)	1 (4.2%)	1 (2.5%)	4 (13.3%)	1 (1.6%)
	CMR	0.7	0.3	0.3	1.1	0.2
	ASMR	2.2	1.2	0.4	3.1	0.3
Period		**1993-1997**	**1998-2002**	**2003-2007**	**2008-2012**	**2013-2017**
All	Number (%)	53 (100.0%)	68 (100.0%)	72 (100.0%)	81 (100.0%)	79 (100.0%)
	CMR	0.7	0.8	0.8	0.9	0.8
	ASMR	0.7	0.7	0.6	0.5	0.4
Chinese	Number (%)	38 (71.7%)	45 (66.2%)	56 (77.8%)	59 (72.8%)	54 (68.4%)
	CMR	0.7	0.7	0.8	0.8	0.7
	ASMR	0.6	0.6	0.5	0.4	0.3
Malay	Number (%)	10 (18.9%)	14 (20.6%)	12 (16.7%)	16 (19.8%)	16 (20.3%)
	CMR	1.0	1.2	1.0	1.3	1.2
	ASMR	1.3	1.5	1.1	1.2	0.9
Indian	Number (%)	5 (9.4%)	8 (11.8%)	3 (4.2%)	6 (7.4%)	7 (8.9%)
	CMR	1.0	1.3	0.4	0.7	0.8
	ASMR	1.8	1.6	0.5	0.8	0.7

Figure 9.13.4(a): TRENDS IN AGE-STANDARDISED INCIDENCE RATE (PER 100,000 POPULATION), AGE-STANDARDISED MORTALITY RATE (PER 100,000 POPULATION), AND FIVE-YEAR AGE-STANDARDISED RELATIVE SURVIVAL RATE (%) FOR THYROID CANCER IN MALES BY FIVE-YEAR PERIOD, 1968-2017

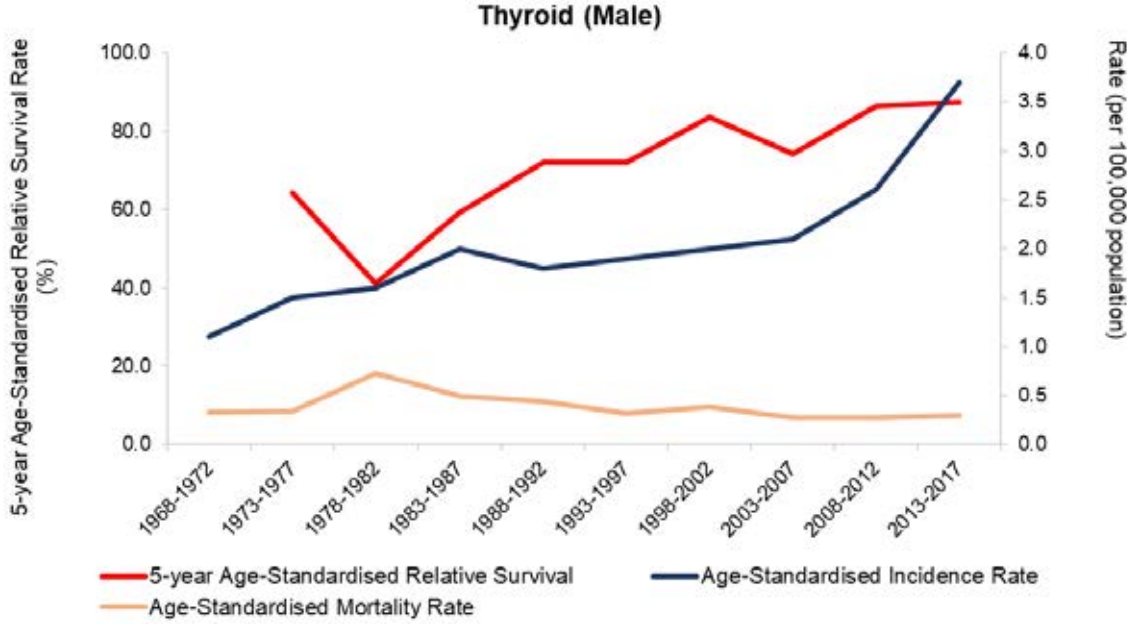


Figure 9.13.4(b): TRENDS IN AGE-STANDARDISED INCIDENCE RATE (PER 100,000 POPULATION), AGE-STANDARDISED MORTALITY RATE (PER 100,000 POPULATION), AND FIVE-YEAR AGE-STANDARDISED RELATIVE SURVIVAL RATE (%) FOR THYROID CANCER IN FEMALES BY FIVE-YEAR PERIOD, 1968-2017

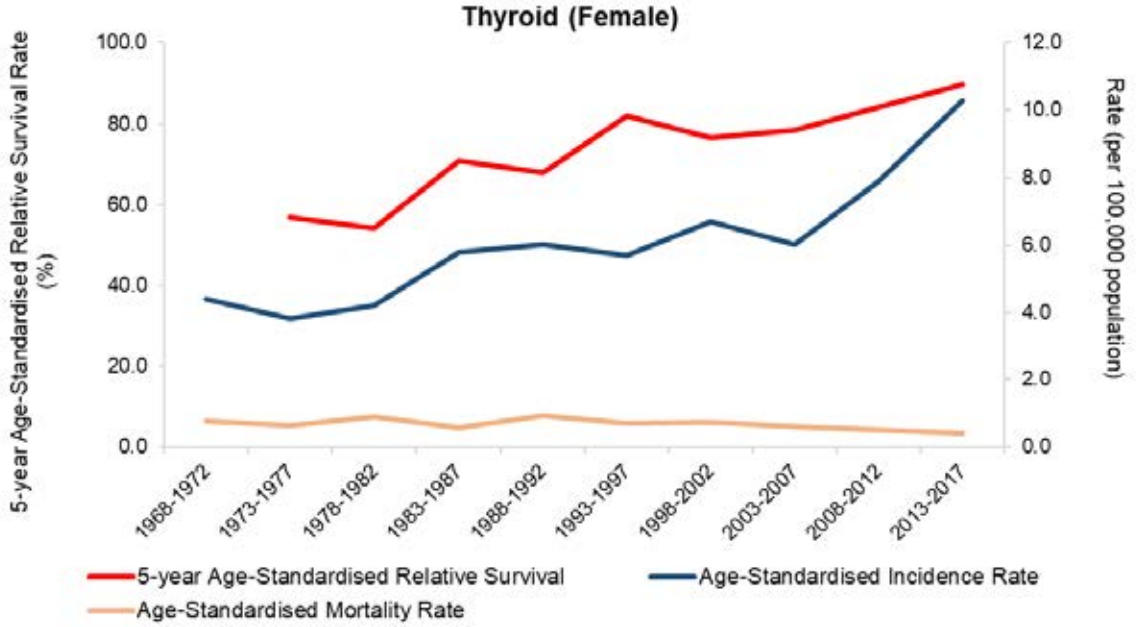
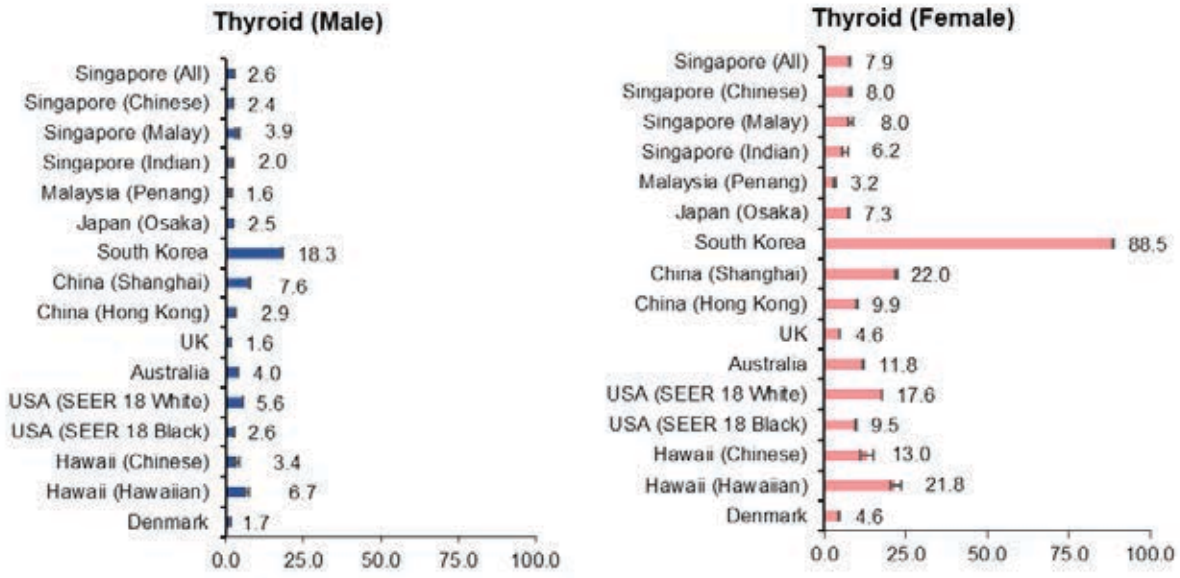


Table 9.13.3: STAGE DISTRIBUTION OF THYROID CANCER, 2008-2017

Year	Stage I		Stage II		Stage III		Stage IV	
	Number	%	Number	%	Number	%	Number	%
2008	81	54.0	18	12.0	20	13.3	31	20.7
2009	95	49.7	24	12.6	25	13.1	47	24.6
2010	155	62.5	25	10.1	30	12.1	38	15.3
2011	144	56.0	18	7.0	53	20.6	42	16.3
2012	180	62.5	16	5.6	53	18.4	39	13.5
2013	176	61.5	15	5.2	54	18.9	41	14.3
2014	170	54.3	25	8.0	66	21.1	52	16.6
2015	145	50.5	16	5.6	68	23.7	58	20.2
2016	173	53.2	21	6.5	72	22.2	59	18.2
2017	188	55.0	13	3.8	77	22.5	64	18.7

Figure 9.13.5: AGE-STANDARDISED INCIDENCE RATE (PER 100,000 POPULATION) FOR THYROID CANCER IN SELECTED COUNTRIES, 2008-2012



9.14 LYMPHOID NEOPLASMS (ICD-10: C81-C85, C88, C90-C91, C96)

Lymphoid neoplasms were consistently among the ten most frequent cancers among males since 1968-1972, starting in seventh place and gradually moving up to fifth place in 2008-2017 (Table 5.1.2(a)). Among females, lymphoid neoplasms first emerged among the ten most frequent cancers in 1973-1977 as the tenth most common cancer and by 2008-2012, it rose to sixth place where it remained thereafter (Table 5.1.2(b)). In 2013-2017, a total of 3,984 cases of lymphoid neoplasms were diagnosed, 2,259 of which occurred among males (comprising 6.6% of all cancer diagnoses in males), and 1,725 occurred among females (comprising 4.7% of all cancer diagnoses in females). The ASIR of lymphoid neoplasms consistently rose for both males and females, nearly tripling among the males from 6.2 per 100,000 population in 1968-1972 to 17.8 per 100,000 population in 2013-2017 (Figure 9.14.1). Among females, the ASIR grew more than threefold, from 3.7 to 12.3 per 100,000 population from 1968-1972 to 2013-2017. Possible reasons for this trend include growing affluence leading to an increased prevalence of obesity; improvements in diagnosis, reporting and classification of lymphoid neoplasms; as well as population ageing as the incidence of lymphoid neoplasms has been demonstrated to be associated with increasing age [151] [152] [153] [154] [155] [156] [157].

The male-to-female ratio of lymphoid neoplasms remained fairly stable over the years, ranging between 1.4-1.7:1 in every five-year period (Tables 9.14.1(a) and 9.14.1(b)). In general, this pattern of a higher incidence of lymphoid neoplasms in males compared to their female counterparts was also observed from studies of other populations [151] [152] [153] [155] [158]. Among males, except in 1973-1977, the Malays were consistently at highest risk of developing lymphoid neoplasms compared to the Chinese and Indians – in 2013-2017, the age-adjusted relative risk was 1.65 (95%CI: 1.5-1.8) for Malay males and 0.98 (95%CI: 0.82-1.16) for Indian males as compared to the Chinese. Among females, the Malays only exhibited a consistently higher relative risk of lymphoid neoplasms from 1988-1992 onwards – in 2013-2017, the age-adjusted relative risk was 1.67 (95%CI: 1.39-2) for Malay females and 0.98 (95%CI: 0.75-1.29) for Indian females, in comparison to Chinese females. With the exception of the earliest years, the incidence of lymphoid neoplasms was observed to rise with age, particularly after the age of 50 years (Figure 9.14.2).

The most common subgroup of lymphoid neoplasms in 2008-2017 was B mature neoplasms, which was consistent with patterns observed in other populations (Table 9.14.2) [152] [153] [158]. B mature neoplasms comprised about 80.0% of all diagnoses of lymphoid neoplasms, followed by T/NK cell neoplasms at about 10.0% for both 2008-2012 and 2013-2017. Asian populations have been observed to have higher

proportions of T/NK-cell lymphoid neoplasms compared to Western populations [151] [153] [154].

Following the trend of a rising ASIR for both males and females, the ASMR of lymphoid neoplasms also increased over the years (Figure 9.14.3, Tables 9.14.3(a) and 9.14.3(b)). Among males, the ASMR of lymphoid neoplasms rose from 1.3 to 4.7 per 100,000 population over the fifty years, while the ASMR of lymphoid neoplasms among females rose from 1.2 to 2.7 per 100,000 population during the same period. Whilst lymphoid neoplasms were consistently among the ten leading causes of cancer mortality in males over the past fifty years ranging between sixth to ninth place, it hovered between eighth to tenth place among females and fell out of the rankings in the years between 1973-1987 (Tables 6.5.1(a) and 6.5.1(b)).

Over the years, the ASIR and ASMR of lymphoid neoplasms diverged, with the ASMR rising at a slower rate than the ASIR (Figures 9.14.4(a) and 9.14.4(b)). Correspondingly, the five-year age-standardised relative survival (ASRS) of lymphoid neoplasms among males rose from 12.0% in 1973-1977 to 57.6% in 2013-2017 and similarly, it rose from 21.2% to 59.4% for females over the same period.

Figure 9.14.1: AGE-STANDARDISED INCIDENCE RATE (PER 100,000 POPULATION) FOR LYMPHOID NEOPLASMS BY GENDER AND FIVE-YEAR PERIOD, 1968-2017

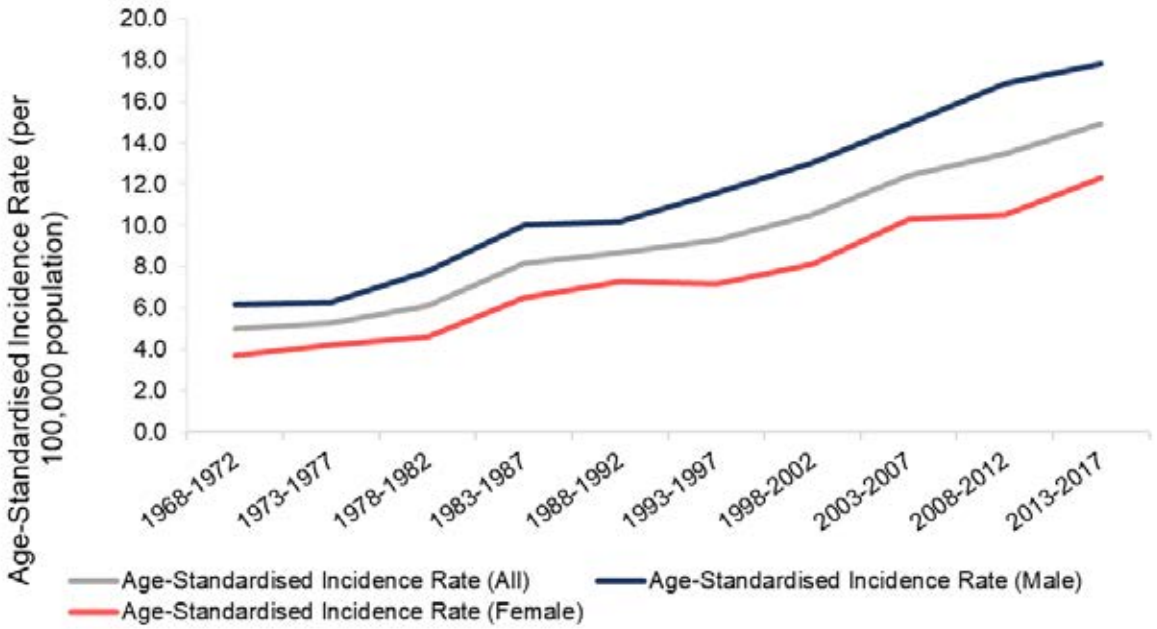


Table 9.14.1(a): INCIDENCE NUMBER AND RATE (PER 100,000 POPULATION) AND RELATIVE RISK FOR LYMPHOID NEOPLASMS IN MALES BY ETHNICITY AND FIVE-YEAR PERIOD, 1968-2017

Period		1968-1972	1973-1977	1978-1982	1983-1987	1988-1992
All	Number (%)	253 (100.0%)	267 (100.0%)	352 (100.0%)	511 (100.0%)	613 (100.0%)
	CIR	4.9	4.9	6.1	8.1	8.9
	ASIR	6.2	6.3	7.8	10.0	10.2
Chinese	Number (%)	182 (71.9%)	213 (79.8%)	263 (74.7%)	385 (75.3%)	458 (74.7%)
	CIR	4.6	5.1	5.8	7.9	8.6
	ASIR	5.9	6.6	7.5	9.9	10.0
	RR	1.00	1.00	1.00	1.00	1.00
Malay	Number (%)	36 (14.2%)	30 (11.2%)	47 (13.4%)	75 (14.7%)	97 (15.8%)
	CIR	4.7	3.8	5.6	8.3	9.9
	ASIR	6.0	4.8	7.3	10.7	12.7
	RR and 95% CI	1.11 (0.81-1.51)	0.82 (0.57-1.18)	1.05 (0.80-1.39)	1.14 (0.95-1.36)	1.28 (1.05-1.56)
Indian	Number (%)	32 (12.6%)	20 (7.5%)	35 (9.9%)	45 (8.8%)	49 (8.0%)
	CIR	7.5	4.9	8.6	9.8	9.4
	ASIR	8.1	6.2	9.9	10.7	9.0
	RR and 95% CI	1.55 (1.12-2.14)	0.87 (0.59-1.29)	1.23 (0.86-1.77)	1.03 (0.78-1.35)	0.94 (0.64-1.38)
Period		**1993-1997**	**1998-2002**	**2003-2007**	**2008-2012**	**2013-2017**
All	Number (%)	824 (100.0%)	1047 (100.0%)	1349 (100.0%)	1842 (100.0%)	2259 (100.0%)
	CIR	10.9	12.8	15.7	19.9	23.6
	ASIR	11.6	13.0	14.9	16.9	17.8
Chinese	Number (%)	625 (75.8%)	796 (76.0%)	1054 (78.1%)	1344 (73.0%)	1651 (73.1%)
	CIR	10.7	12.7	16.2	19.7	23.3
	ASIR	11.4	12.8	14.9	15.8	16.4
	RR	1.00	1.00	1.00	1.00	1.00
Malay	Number (%)	125 (15.2%)	178 (17.0%)	184 (13.6%)	294 (16.0%)	380 (16.8%)
	CIR	11.7	15.5	15.3	23.5	29.3
	ASIR	14.1	18.3	17.3	23.5	26.5
	RR and 95% CI	1.24 (1.05-1.47)	1.41 (1.21-1.63)	1.14 (0.96-1.36)	1.52 (1.37-1.69)	1.65 (1.50-1.80)
Indian	Number (%)	56 (6.8%)	59 (5.6%)	86 (6.4%)	151 (8.2%)	158 (7.0%)
	CIR	9.6	8.8	11.5	17.0	17.3
	ASIR	9.1	8.9	12.2	17.4	16.1
	RR and 95% CI	0.78 (0.56-1.08)	0.63 (0.50-0.79)	0.79 (0.64-0.96)	1.10 (0.95-1.26)	0.98 (0.82-1.16)

Table 9.14.1(b): INCIDENCE NUMBER AND RATE (PER 100,000 POPULATION) AND RELATIVE RISK FOR LYMPHOID NEOPLASMS IN FEMALES BY ETHNICITY AND FIVE-YEAR PERIOD, 1968-2017

Period		1968-1972	1973-1977	1978-1982	1983-1987	1988-1992
All	Number (%)	153 (100.0%)	180 (100.0%)	218 (100.0%)	349 (100.0%)	457 (100.0%)
	CIR	3.1	3.5	3.9	5.7	6.8
	ASIR	3.7	4.2	4.6	6.5	7.3
Chinese	Number (%)	119 (77.8%)	146 (81.1%)	183 (83.9%)	284 (81.4%)	367 (80.3%)
	CIR	3.1	3.6	4.1	5.9	7.0
	ASIR	3.6	4.2	4.7	6.5	7.3
	RR	1.00	1.00	1.00	1.00	1.00
Malay	Number (%)	25 (16.3%)	21 (11.7%)	25 (11.5%)	43 (12.3%)	68 (14.9%)
	CIR	3.4	2.8	3.1	5.0	7.2
	ASIR	4.9	3.6	5.1	7.1	8.9
	RR and 95% CI	0.60 (0.41-0.89)	1.30 (0.78-2.15)	0.99 (0.67-1.46)	0.94 (0.57-1.55)	1.04 (0.79-1.37)
Indian	Number (%)	6 (3.9%)	8 (4.4%)	8 (3.7%)	20 (5.7%)	20 (4.4%)
	CIR	2.1	2.8	2.5	5.3	4.5
	ASIR	4.1	4.5	3.0	7.5	7.5
	RR and 95% CI	1.00 (0.66-1.50)	0.87 (0.45-1.69)	1.06 (0.65-1.75)	0.79 (0.34-1.83)	1.17 (0.85-1.61)
Period		**1993-1997**	**1998-2002**	**2003-2007**	**2008-2012**	**2013-2017**
All	Number (%)	552 (100.0%)	714 (100.0%)	1009 (100.0%)	1246 (100.0%)	1725 (100.0%)
	CIR	7.4	8.7	11.5	13.1	17.4
	ASIR	7.2	8.1	10.3	10.5	12.3
Chinese	Number (%)	450 (81.5%)	548 (76.8%)	773 (76.6%)	924 (74.2%)	1276 (74.0%)
	CIR	7.7	8.7	11.6	13.0	17.2
	ASIR	7.1	7.7	9.9	9.8	11.2
	RR	1.00	1.00	1.00	1.00	1.00
Malay	Number (%)	74 (13.4%)	108 (15.1%)	160 (15.9%)	214 (17.2%)	300 (17.4%)
	CIR	7.1	9.5	13.3	17.0	22.9
	ASIR	8.6	10.7	13.9	15.3	19.2
	RR and 95% CI	1.28 (0.98-1.67)	1.16 (0.97-1.40)	1.39 (1.17-1.65)	1.43 (1.21-1.68)	1.67 (1.39-2.00)
Indian	Number (%)	24 (4.3%)	45 (6.3%)	60 (5.9%)	79 (6.3%)	102 (5.9%)
	CIR	4.6	7.3	8.5	9.5	11.8
	ASIR	5.3	8.5	9.2	9.4	11.5
	RR and 95% CI	0.84 (0.60-1.18)	0.75 (0.58-0.98)	1.05 (0.72-1.52)	0.93 (0.69-1.25)	0.98 (0.75-1.29)

Figure 9.14.2: AGE-SPECIFIC INCIDENCE RATE (PER 100,000 POPULATION) FOR LYMPHOID NEOPLASMS BY AGE GROUP, 1968-1972, 1988-1992, 2013-2017

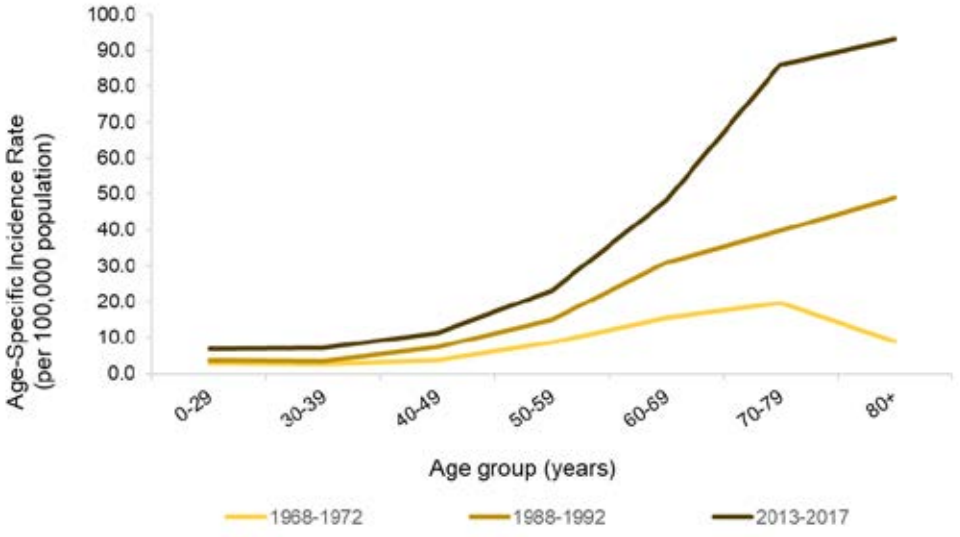


Table 9.14.2: SUBGROUPS OF LYMPHOID NEOPLASMS, 2008-2017

	2008-2012		2013-2017	
Histology	No.	%	No.	%
Precursor Lymphoid Neoplasms	252	8.2	268	6.7
B Mature Neoplasms	2447	79.2	3260	81.8
T/NK Mature Neoplasms	323	10.5	383	9.6
Immunodeficiency-associated lymphoproliferative disorders	7	0.2	7	0.2
Histiocytic and Dendritic Cell Neoplasm	38	1.2	32	0.8
Malignant Lymphoma NOS	21	0.7	34	0.9
Total	**3088**	**100**	**3984**	**100**

Figure 9.14.3: AGE-STANDARDISED MORTALITY RATE (PER 100,000 POPULATION) FOR LYMPHOID NEOPLASMS BY GENDER AND FIVE-YEAR PERIOD, 1968-2017

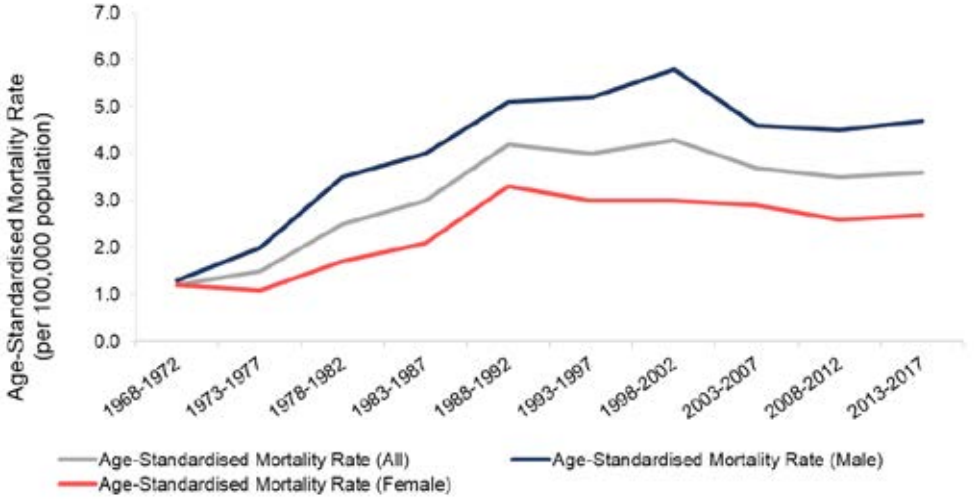


Table 9.14.3(a): MORTALITY NUMBER AND RATE (PER 100,000 POPULATION) FOR LYMPHOID NEOPLASMS IN MALES BY ETHNICITY AND FIVE-YEAR PERIOD, 1968-2017

Period		1968-1972	1973-1977	1978-1982	1983-1987	1988-1992
All	Number (%)	55 (100.0%)	88 (100.0%)	157 (100.0%)	207 (100.0%)	306 (100.0%)
	CMR	1.1	1.6	2.7	3.3	4.4
	ASMR	1.3	2.0	3.5	4.0	5.1
Chinese	Number (%)	37 (67.3%)	66 (75.0%)	121 (77.1%)	159 (76.8%)	225 (73.5%)
	CMR	0.9	1.6	2.7	3.3	4.2
	ASMR	1.2	2.0	3.5	3.9	4.9
Malay	Number (%)	12 (21.8%)	13 (14.8%)	20 (12.7%)	33 (15.9%)	50 (16.3%)
	CMR	1.6	1.7	2.4	3.7	5.1
	ASMR	1.7	1.8	2.8	4.7	6.9
Indian	Number (%)	6 (10.9%)	9 (10.2%)	14 (8.9%)	13 (6.3%)	26 (8.5%)
	CMR	1.4	2.2	3.4	2.8	5.0
	ASMR	1.7	2.7	4.3	3.1	5.2
Period		**1993-1997**	**1998-2002**	**2003-2007**	**2008-2012**	**2013-2017**
All	Number (%)	369 (100.0%)	467 (100.0%)	422 (100.0%)	525 (100.0%)	691 (100.0%)
	CMR	4.9	5.7	4.9	5.7	7.2
	ASMR	5.2	5.8	4.6	4.5	4.7
Chinese	Number (%)	285 (77.2%)	364 (77.9%)	336 (79.6%)	407 (77.5%)	512 (74.1%)
	CMR	4.9	5.8	5.2	6.0	7.2
	ASMR	5.2	5.8	4.6	4.3	4.3
Malay	Number (%)	53 (14.4%)	78 (16.7%)	58 (13.7%)	83 (15.8%)	121 (17.5%)
	CMR	5.0	6.8	4.8	6.6	9.3
	ASMR	6.1	8.8	5.6	6.7	8.0
Indian	Number (%)	24 (6.5%)	20 (4.3%)	23 (5.5%)	26 (5.0%)	44 (6.4%)
	CMR	4.1	3.0	3.1	2.9	4.8
	ASMR	3.5	2.8	3.5	3.5	4.1

Table 9.14.3(b): MORTALITY NUMBER AND RATE (PER 100,000 POPULATION) FOR LYMPHOID NEOPLASMS IN FEMALES BY ETHNICITY AND FIVE-YEAR PERIOD, 1968-2017

Period		1968-1972	1973-1977	1978-1982	1983-1987	1988-1992
All	Number (%)	48 (100.0%)	46 (100.0%)	81 (100.0%)	115 (100.0%)	214 (100.0%)
	CMR	1.0	0.9	1.4	1.9	3.2
	ASMR	1.2	1.1	1.7	2.1	3.3
Chinese	Number (%)	37 (77.1%)	37 (80.4%)	59 (72.8%)	101 (87.8%)	172 (80.4%)
	CMR	1.0	0.9	1.3	2.1	3.3
	ASMR	1.1	1.0	1.4	2.2	3.3
Malay	Number (%)	8 (16.7%)	4 (8.7%)	14 (17.3%)	8 (7.0%)	36 (16.8%)
	CMR	1.1	0.5	1.7	0.9	3.8
	ASMR	1.7	0.8	3.0	1.2	5.0
Indian	Number (%)	3 (6.3%)	4 (8.7%)	5 (6.2%)	6 (5.2%)	5 (2.3%)
	CMR	1.1	1.4	1.6	1.6	1.1
	ASMR	3.1	1.6	1.5	2.3	2.9
Period		**1993-1997**	**1998-2002**	**2003-2007**	**2008-2012**	**2013-2017**
All	Number (%)	236 (100.0%)	281 (100.0%)	321 (100.0%)	368 (100.0%)	485 (100.0%)
	CMR	3.1	3.4	3.7	3.9	4.9
	ASMR	3.0	3.0	2.9	2.6	2.7
Chinese	Number (%)	196 (83.1%)	221 (78.6%)	241 (75.1%)	275 (74.7%)	367 (75.7%)
	CMR	3.4	3.5	3.6	3.9	4.9
	ASMR	2.9	2.8	2.6	2.3	2.5
Malay	Number (%)	33 (14.0%)	42 (14.9%)	61 (19.0%)	73 (19.8%)	91 (18.8%)
	CMR	3.2	3.7	5.1	5.8	6.9
	ASMR	3.9	4.3	5.3	5.4	5.1
Indian	Number (%)	7 (3.0%)	16 (5.7%)	18 (5.6%)	17 (4.6%)	19 (3.9%)
	CMR	1.3	2.6	2.5	2.1	2.2
	ASMR	1.9	3.0	2.9	2.2	1.8

Figure 9.14.4(a): TRENDS IN AGE-STANDARDISED INCIDENCE RATE (PER 100,000 POPULATION), AGE-STANDARDISED MORTALITY RATE (PER 100,000 POPULATION), AND FIVE-YEAR AGE-STANDARDISED RELATIVE SURVIVAL RATE (%) FOR LYMPHOID NEOPLASMS IN MALES BY FIVE-YEAR PERIOD, 1968-2017

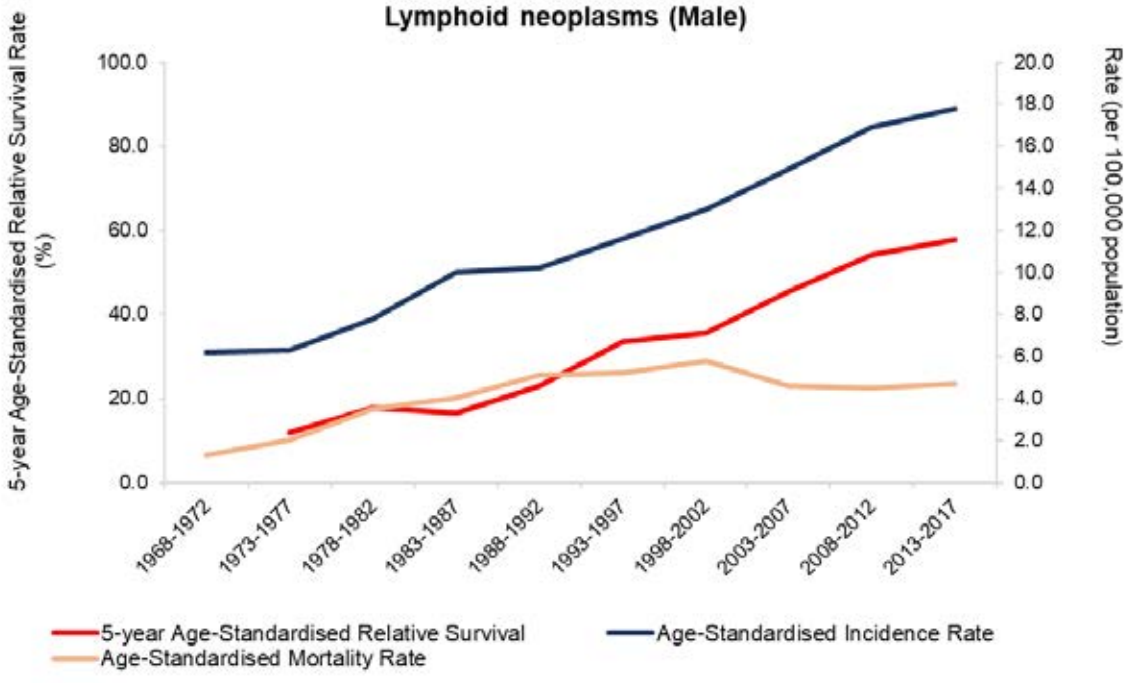
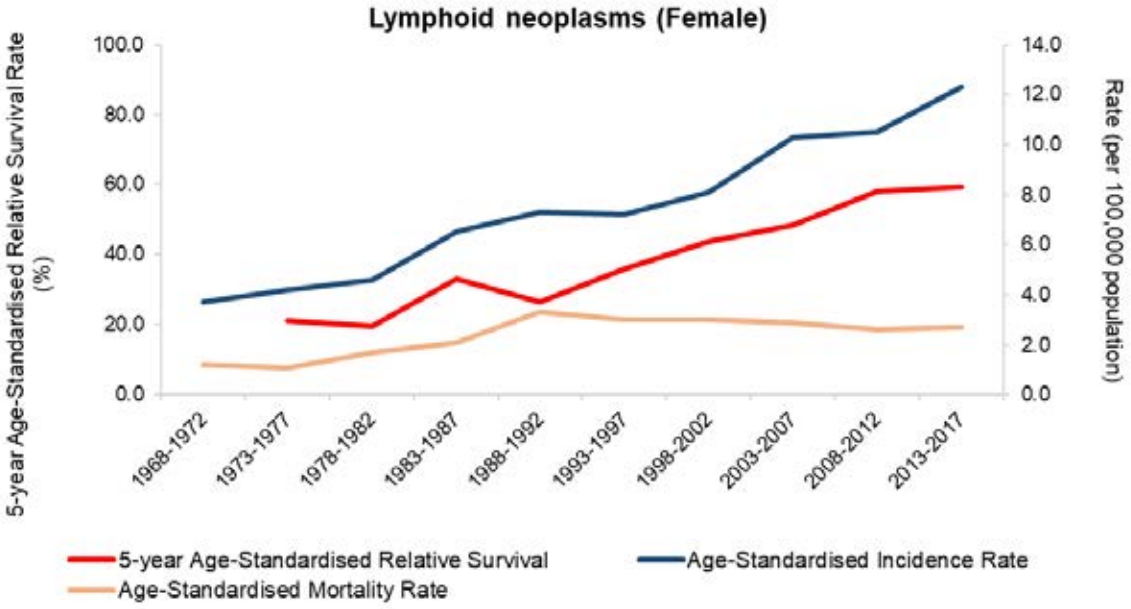


Figure 9.14.4(b): TRENDS IN AGE-STANDARDISED INCIDENCE RATE (PER 100,000 POPULATION), AGE-STANDARDISED MORTALITY RATE (PER 100,000 POPULATION), AND FIVE-YEAR AGE-STANDARDISED RELATIVE SURVIVAL RATE (%) FOR LYMPHOID NEOPLASMS IN FEMALES BY FIVE-YEAR PERIOD, 1968-2017



9.15 MYELOID NEOPLASMS (ICD-10: C92-C93)

Myeloid neoplasms first emerged among the ten most frequent cancers among males at tenth place in 2008-2012, inching up to ninth place in 2013-2017 (Table 5.1.2(a)). Among females, however, it was never among the ten leading cancers in the fifty years under study (Table 5.1.2(b)). In 2013-2017, a total of 1,952 cases of myeloid neoplasms were diagnosed, comprising 2.7% of all malignancies. Of these, 1,134 occurred among males (comprising 3.3% of all malignancies among males) and the other 818 occurred among females (2.2% of all malignancies among females). From 1968-1972 to 2013-2017, the ASIR of myeloid neoplasms saw an overall increase for both males and females, from 3.4 to 8.1 and 2.8 to 5.2 per 100,000 population respectively (Figure 9.15.1).

The male-to-female ratio of myeloid neoplasms ranged between 1.2-1.6:1 across the years. Likewise, a general male predominance among myeloid neoplasms had also been observed in the UK and Europe [159] [160]. Among males, the Malays were consistently at a higher risk of developing myeloid neoplasms from 1988-1992 onwards. In 2013-2017, the age-adjusted relative risk was 1.41 (95%CI: 1.25-1.6), which was significantly higher than that of the Chinese, while that of Indians was 0.71 (95%CI: 0.52-0.98) which was significantly lower (Table 9.15.1(a)). Similarly, among females, the Malays were at highest risk of developing myeloid neoplasms, a trend observed from 1978-1982 onwards (Table 9.15.1(b)). In 2013-2017, the age-adjusted relative risk was 1.26 for Malay females (95%CI: 1.09-1.46) and 0.77 (95%CI: 0.57-1.04) for Indian females when compared to their Chinese counterparts. As with other populations, the incidence of myeloid neoplasms was observed to rise sharply with age, peaking after 80 years of age in 2013-2017 (Figure 9.15.2) [159] [160] [161] [162] .

The most common subgroup of myeloid neoplasms was myeloproliferative neoplasms, accounting for about 37.0% of all myeloid neoplasms from 2008-2017, followed by acute myeloid leukaemia (AML) and its precursors, at approximately 30.0% (Table 9.15.2).

Like the ASIR of myeloid neoplasms, the ASMR also rose over the years (Figure 9.15.3, Tables 9.15.3(a) and 9.15.3(b)). From 1968-1972 to 2013-2017, the ASMR of myeloid neoplasms grew from 0.7 to 2.0 per 100,000 population for males; that for females grew from 0.8 to 1.3 per 100,000 population.

The five-year ASRS of myeloid neoplasms exhibited an overall increase for both males and females (Figures 9.15.4(a) and 9.15.4(b)). Among males, the five-year ASRS increased from 3.5% in 1973-1977 to 42.4% in 2013-2017; that for females rose from 5.7% to 47.5% over the same period. However, in the last three five-year periods,

there was little improvement in the survival of patients with myeloid neoplasms. This might be because survival rate is influenced by factors such as age, genomic subtype, and response to treatment; as most patients were elderly with age-related comorbidities, the prognosis of myeloid neoplasms was poorer [159] [161] [162] [163].

Figure 9.15.1: AGE-STANDARDISED INCIDENCE RATE (PER 100,000 POPULATION) FOR MYELOID NEOPLASMS BY GENDER AND FIVE-YEAR PERIOD, 1968-2017

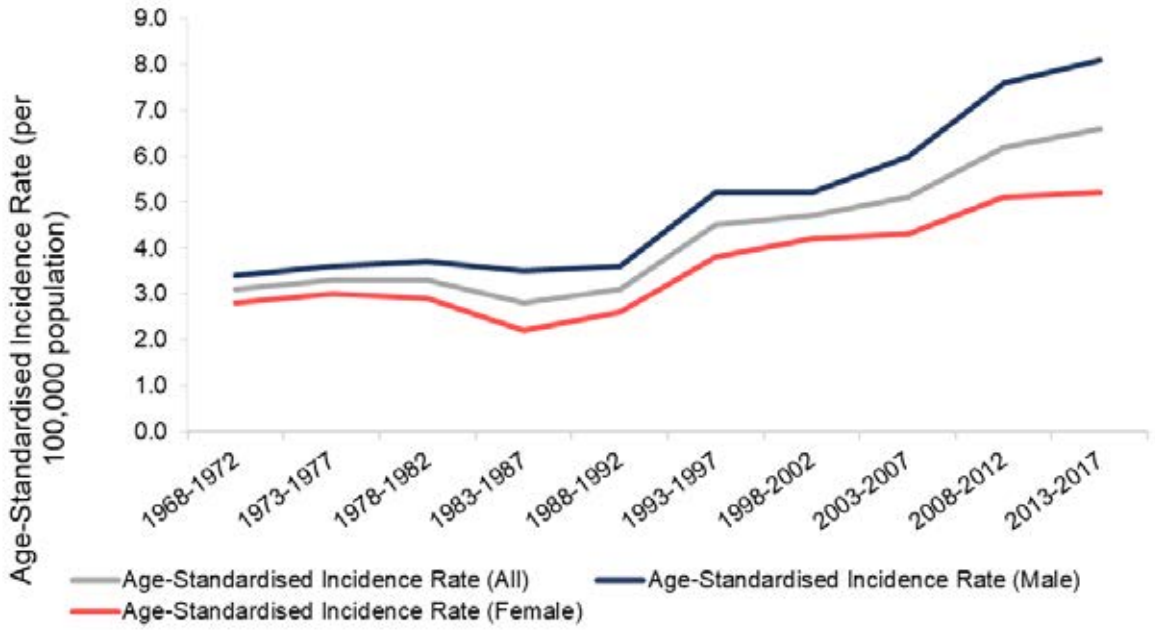


Table 9.15.1(a): INCIDENCE NUMBER AND RATE (PER 100,000 POPULATION) AND RELATIVE RISK FOR MYELOID NEOPLASMS IN MALES BY ETHNICITY AND FIVE-YEAR PERIOD, 1968-2017

Period		1968-1972	1973-1977	1978-1982	1983-1987	1988-1992
All	Number (%)	144 (100.0%)	166 (100.0%)	179 (100.0%)	192 (100.0%)	230 (100.0%)
	CIR	2.8	3.1	3.1	3.1	3.3
	ASIR	3.4	3.6	3.7	3.5	3.6
Chinese	Number (%)	108 (75.0%)	129 (77.7%)	131 (73.2%)	156 (81.3%)	183 (79.6%)
	CIR	2.8	3.1	2.9	3.2	3.4
	ASIR	3.3	3.6	3.4	3.7	3.7
	RR	1.00	1.00	1.00	1.00	1.00
Malay	Number (%)	16 (11.1%)	21 (12.7%)	22 (12.3%)	21 (10.9%)	34 (14.8%)
	CIR	2.1	2.7	2.6	2.3	3.5
	ASIR	3.3	3.0	3.8	2.9	4.2
	RR and 95% CI	0.81 (0.53-1.25)	0.92 (0.69-1.25)	0.99 (0.56-1.74)	0.79 (0.51-1.23)	1.12 (0.76-1.64)
Indian	Number (%)	14 (9.7%)	13 (7.8%)	22 (12.3%)	14 (7.3%)	10 (4.3%)
	CIR	3.3	3.2	5.4	3.1	1.9
	ASIR	3.7	2.6	6.1	2.8	1.6
	RR and 95% CI	1.07 (0.65-1.78)	0.97 (0.55-1.68)	1.68 (1.06-2.66)	0.82 (0.53-1.27)	0.48 (0.25-0.94)
Period		**1993-1997**	**1998-2002**	**2003-2007**	**2008-2012**	**2013-2017**
All	Number (%)	375 (100.0%)	433 (100.0%)	571 (100.0%)	883 (100.0%)	1134 (100.0%)
	CIR	5.0	5.3	6.6	9.5	11.8
	ASIR	5.2	5.2	6.0	7.6	8.1
Chinese	Number (%)	292 (77.9%)	341 (78.8%)	449 (78.6%)	702 (79.5%)	877 (77.3%)
	CIR	5.0	5.5	6.9	10.3	12.4
	ASIR	5.2	5.2	6.0	7.6	7.9
	RR	1.00	1.00	1.00	1.00	1.00
Malay	Number (%)	56 (14.9%)	64 (14.8%)	68 (11.9%)	112 (12.7%)	165 (14.6%)
	CIR	5.2	5.6	5.7	8.9	12.7
	ASIR	6.4	6.7	6.2	9.1	11.2
	RR and 95% CI	1.19 (0.90-1.58)	1.24 (1.05-1.47)	1.06 (0.95-1.19)	1.14 (0.91-1.43)	1.41 (1.25-1.60)
Indian	Number (%)	21 (5.6%)	23 (5.3%)	35 (6.1%)	47 (5.3%)	60 (5.3%)
	CIR	3.6	3.4	4.7	5.3	6.6
	ASIR	3.6	3.2	4.5	5.2	5.2
	RR and 95% CI	0.60 (0.40-0.92)	0.60 (0.41-0.87)	0.77 (0.52-1.13)	0.66 (0.52-0.84)	0.71 (0.52-0.98)

Table 9.15.1(b): INCIDENCE NUMBER AND RATE (PER 100,000 POPULATION) AND RELATIVE RISK FOR MYELOID NEOPLASMS IN FEMALES BY ETHNICITY AND FIVE-YEAR PERIOD, 1968-2017

Period		1968-1972	1973-1977	1978-1982	1983-1987	1988-1992
All	Number (%)	108 (100.0%)	133 (100.0%)	148 (100.0%)	127 (100.0%)	171 (100.0%)
	CIR	2.2	2.6	2.6	2.1	2.5
	ASIR	2.8	3.0	2.9	2.2	2.6
Chinese	Number (%)	92 (85.2%)	112 (84.2%)	119 (80.4%)	102 (80.3%)	130 (76.0%)
	CIR	2.4	2.7	2.7	2.1	2.5
	ASIR	3.0	3.1	2.9	2.1	2.4
	RR	1.00	1.00	1.00	1.00	1.00
Malay	Number (%)	11 (10.2%)	16 (12.0%)	20 (13.5%)	19 (15.0%)	28 (16.4%)
	CIR	1.5	2.1	2.5	2.2	3.0
	ASIR	1.6	3.1	2.9	2.4	3.5
	RR and 95% CI	0.77 (0.40-1.48)	0.92 (0.61-1.38)	1.15 (0.73-1.79)	1.23 (0.87-1.76)	1.39 (1.00-1.93)
Indian	Number (%)	3 (2.8%)	4 (3.0%)	6 (4.1%)	5 (3.9%)	12 (7.0%)
	CIR	1.1	1.4	1.9	1.3	2.7
	ASIR	2.2	2.3	3.5	2.0	3.4
	RR and 95% CI	0.58 (0.19-1.82)	0.62 (0.26-1.49)	0.89 (0.33-2.37)	0.75 (0.20-2.87)	1.29 (0.81-2.07)
Period		**1993-1997**	**1998-2002**	**2003-2007**	**2008-2012**	**2013-2017**
All	Number (%)	297 (100.0%)	383 (100.0%)	454 (100.0%)	673 (100.0%)	818 (100.0%)
	CIR	4.0	4.7	5.2	7.1	8.2
	ASIR	3.8	4.2	4.3	5.1	5.2
Chinese	Number (%)	236 (79.5%)	307 (80.2%)	368 (81.1%)	522 (77.6%)	652 (79.7%)
	CIR	4.0	4.8	5.5	7.4	8.8
	ASIR	3.7	4.1	4.4	4.9	5.1
	RR	1.00	1.00	1.00	1.00	1.00
Malay	Number (%)	42 (14.1%)	51 (13.3%)	58 (12.8%)	89 (13.2%)	106 (13.0%)
	CIR	4.0	4.5	4.8	7.1	8.1
	ASIR	4.7	5.0	4.6	6.2	6.5
	RR and 95% CI	1.30 (1.01-1.67)	1.22 (0.97-1.52)	1.13 (0.87-1.46)	1.30 (1.11-1.51)	1.26 (1.09-1.46)
Indian	Number (%)	13 (4.4%)	21 (5.5%)	17 (3.7%)	46 (6.8%)	41 (5.0%)
	CIR	2.5	3.4	2.4	5.6	4.7
	ASIR	3.7	3.5	2.5	5.1	3.9
	RR and 95% CI	0.82 (0.48-1.40)	0.90 (0.58-1.40)	0.57 (0.34-0.94)	1.09 (0.88-1.36)	0.77 (0.57-1.04)

Figure 9.15.2: AGE-SPECIFIC INCIDENCE RATE (PER 100,000 POPULATION) FOR MYELOID NEOPLASMS BY AGE GROUP, 1968-1972, 1988-1992, 2013-2017

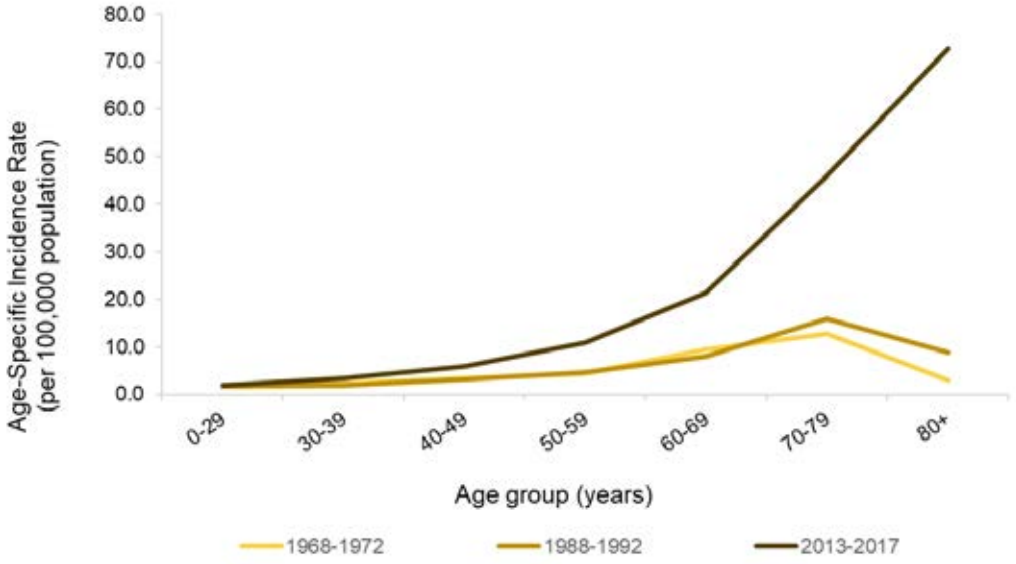


Table 9.15.2: SUBGROUPS OF MYELOID NEOPLASMS, 2008-2017

	2008-2012		2013-2017	
Histology	No.	%	No.	%
Acute leukaemia of ambiguous lineage	35	2.2	48	2.5
Acute Myeloid Leukaemia and related Precursor Neoplasm	510	32.8	565	28.9
Myeloproliferative Neoplasm	549	35.3	753	38.6
Myelodysplastic / Myeloproliferative Neoplasm	93	6.0	103	5.3
Myelodysplastic Syndrome	369	23.7	483	24.7
Total	**1556**	**100**	**1952**	**100**

Figure 9.15.3: AGE-STANDARDISED MORTALITY RATE (PER 100,000 POPULATION) FOR MYELOID NEOPLASMS BY GENDER AND FIVE-YEAR PERIOD, 1968-2017

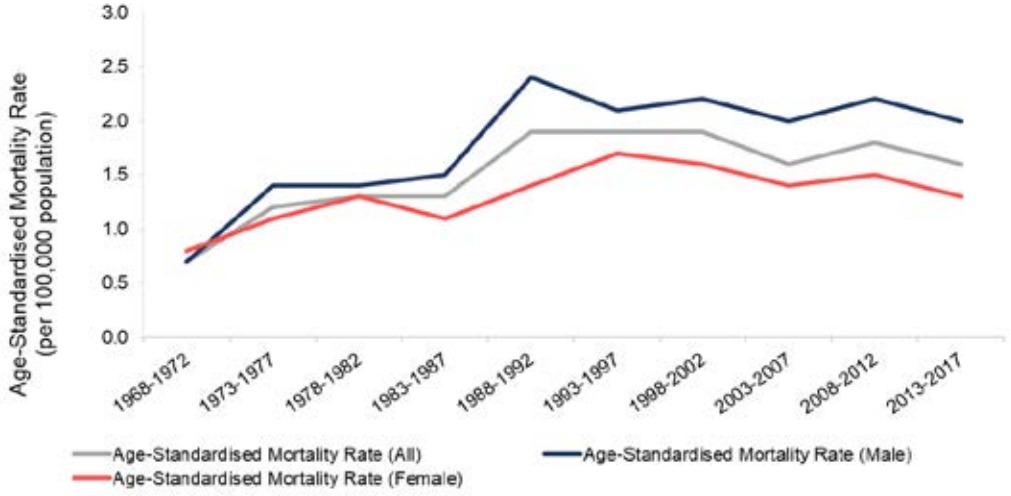


Table 9.15.3(a): MORTALITY NUMBER AND RATE (PER 100,000 POPULATION) FOR MYELOID NEOPLASMS IN MALES BY ETHNICITY AND FIVE-YEAR PERIOD, 1968-2017

Period		1968-1972	1973-1977	1978-1982	1983-1987	1988-1992
All	Number (%)	31 (100.0%)	69 (100.0%)	73 (100.0%)	83 (100.0%)	153 (100.0%)
	CMR	0.6	1.3	1.3	1.3	2.2
	ASMR	0.7	1.4	1.4	1.5	2.4
Chinese	Number (%)	24 (77.4%)	55 (79.7%)	60 (82.2%)	69 (83.1%)	122 (79.7%)
	CMR	0.6	1.3	1.3	1.4	2.3
	ASMR	0.7	1.4	1.5	1.7	2.5
Malay	Number (%)	3 (9.7%)	6 (8.7%)	5 (6.8%)	9 (10.8%)	23 (15.0%)
	CMR	0.4	0.8	0.6	1.0	2.4
	ASMR	1.2	1.1	0.9	1.1	2.8
Indian	Number (%)	3 (9.7%)	6 (8.7%)	6 (8.2%)	4 (4.8%)	6 (3.9%)
	CMR	0.7	1.5	1.5	0.9	1.2
	ASMR	0.5	2.0	1.3	0.9	0.9
Period		**1993-1997**	**1998-2002**	**2003-2007**	**2008-2012**	**2013-2017**
All	Number (%)	153 (100.0%)	178 (100.0%)	184 (100.0%)	260 (100.0%)	282 (100.0%)
	CMR	2.0	2.2	2.1	2.8	2.9
	ASMR	2.1	2.2	2.0	2.2	2.0
Chinese	Number (%)	124 (81.0%)	148 (83.1%)	144 (78.3%)	213 (81.9%)	223 (79.1%)
	CMR	2.1	2.4	2.2	3.1	3.2
	ASMR	2.2	2.3	2.0	2.2	2.0
Malay	Number (%)	20 (13.1%)	25 (14.0%)	21 (11.4%)	27 (10.4%)	39 (13.8%)
	CMR	1.9	2.2	1.7	2.2	3.0
	ASMR	2.3	2.8	2.0	2.5	2.6
Indian	Number (%)	8 (5.2%)	3 (1.7%)	17 (9.2%)	13 (5.0%)	9 (3.2%)
	CMR	1.4	0.4	2.3	1.5	1.0
	ASMR	1.2	0.4	2.2	1.7	0.8

Table 9.15.3(b): MORTALITY NUMBER AND RATE (PER 100,000 POPULATION) FOR MYELOID NEOPLASMS IN FEMALES BY ETHNICITY AND FIVE-YEAR PERIOD, 1968-2017

Period		1968-1972	1973-1977	1978-1982	1983-1987	1988-1992
All	Number (%)	30 (100.0%)	48 (100.0%)	66 (100.0%)	67 (100.0%)	93 (100.0%)
	CMR	0.6	0.9	1.2	1.1	1.4
	ASMR	0.8	1.1	1.3	1.1	1.4
Chinese	Number (%)	24 (80.0%)	43 (89.6%)	53 (80.3%)	55 (82.1%)	72 (77.4%)
	CMR	0.6	1.0	1.2	1.1	1.4
	ASMR	0.7	1.2	1.3	1.1	1.3
Malay	Number (%)	4 (13.3%)	3 (6.3%)	10 (15.2%)	10 (14.9%)	11 (11.8%)
	CMR	0.5	0.4	1.2	1.2	1.2
	ASMR	0.5	0.4	1.4	1.3	1.4
Indian	Number (%)	2 (6.7%)	2 (4.2%)	3 (4.5%)	2 (3.0%)	9 (9.7%)
	CMR	0.7	0.7	0.9	0.5	2.0
	ASMR	1.8	0.6	1.2	0.6	2.7
Period		**1993-1997**	**1998-2002**	**2003-2007**	**2008-2012**	**2013-2017**
All	Number (%)	133 (100.0%)	143 (100.0%)	144 (100.0%)	202 (100.0%)	222 (100.0%)
	CMR	1.8	1.7	1.6	2.1	2.2
	ASMR	1.7	1.6	1.4	1.5	1.3
Chinese	Number (%)	108 (81.2%)	117 (81.8%)	121 (84.0%)	157 (77.7%)	168 (75.7%)
	CMR	1.9	1.8	1.8	2.2	2.3
	ASMR	1.7	1.6	1.4	1.4	1.2
Malay	Number (%)	17 (12.8%)	17 (11.9%)	17 (11.8%)	29 (14.4%)	37 (16.7%)
	CMR	1.6	1.5	1.4	2.3	2.8
	ASMR	1.8	1.9	1.5	2.1	2.1
Indian	Number (%)	7 (5.3%)	7 (4.9%)	4 (2.8%)	11 (5.4%)	13 (5.9%)
	CMR	1.3	1.1	0.6	1.3	1.5
	ASMR	1.5	1.2	0.6	1.3	1.2

Figure 9.15.4(a): TRENDS IN AGE-STANDARDISED INCIDENCE RATE (PER 100,000 POPULATION), AGE-STANDARDISED MORTALITY RATE (PER 100,000 POPULATION), AND FIVE-YEAR AGE-STANDARDISED RELATIVE SURVIVAL RATE (%) FOR MYELOID NEOPLASMS IN MALES BY FIVE-YEAR PERIOD, 1968-2017

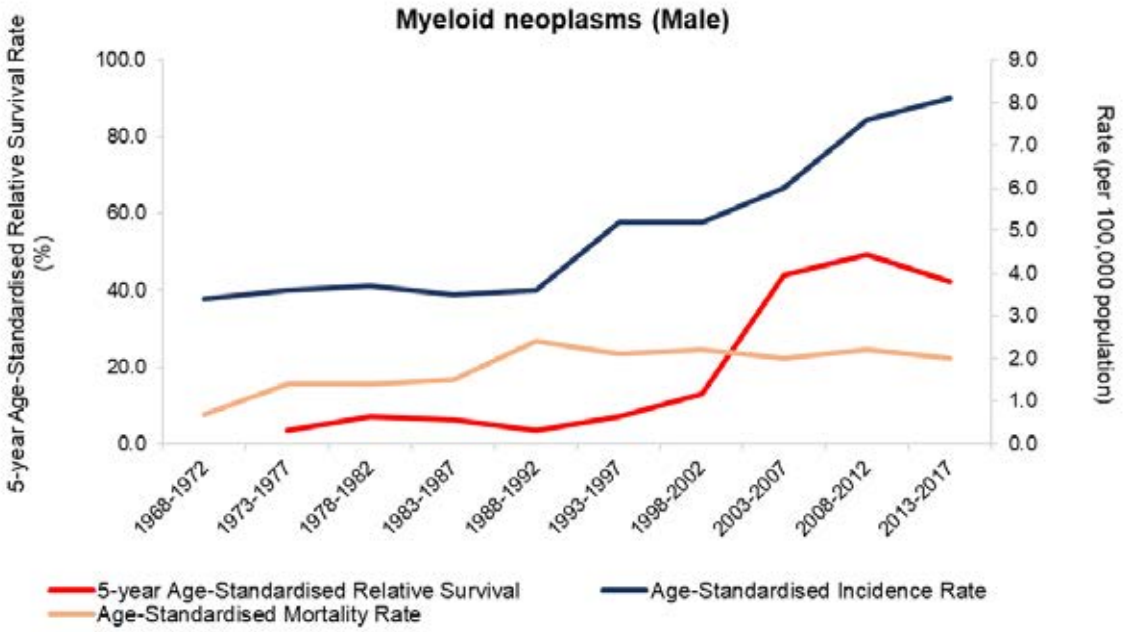
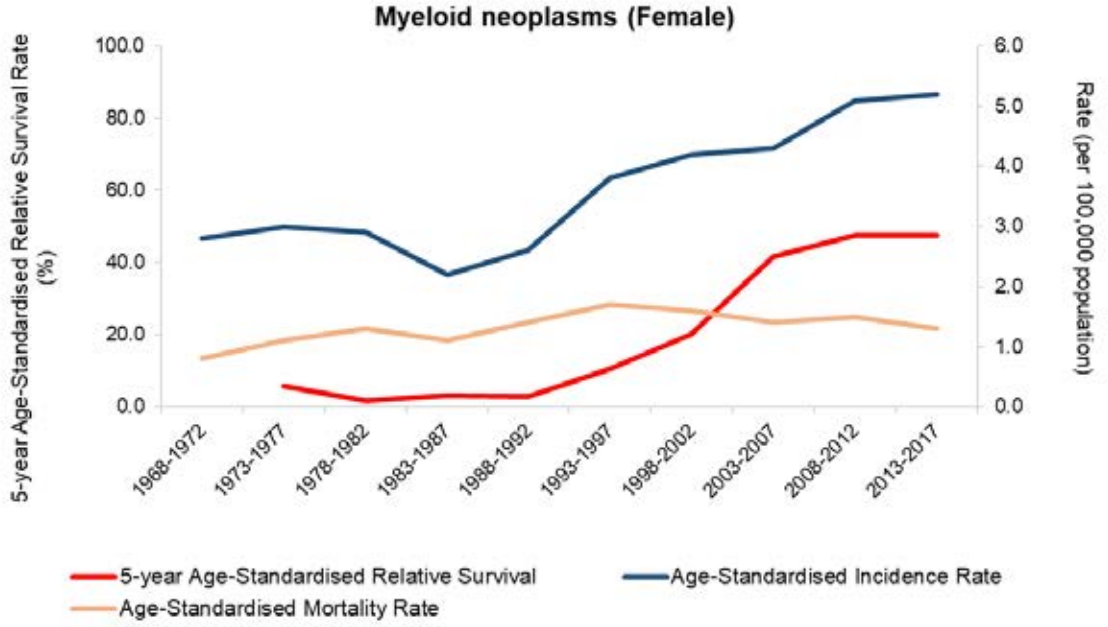
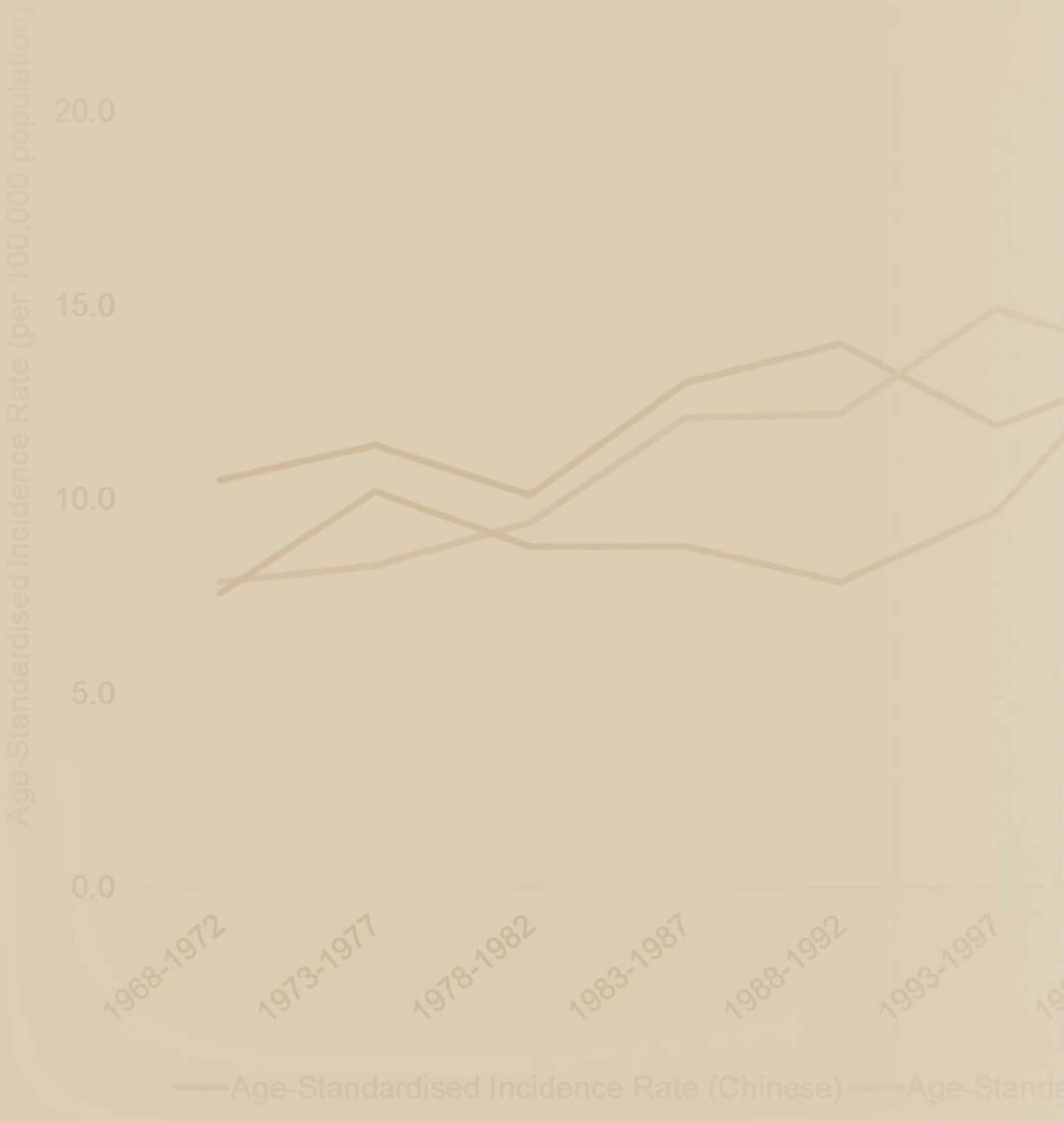


Figure 9.15.4(b): TRENDS IN AGE-STANDARDISED INCIDENCE RATE (PER 100,000 POPULATION), AGE-STANDARDISED MORTALITY RATE (PER 100,000 POPULATION), AND FIVE-YEAR AGE-STANDARDISED RELATIVE SURVIVAL RATE (%) FOR MYELOID NEOPLASMS IN FEMALES BY FIVE-YEAR PERIOD, 1968-2017




Age-Standardised Incidence Rate (per 100,000 population)
20.0
15.0
10.0
5.0
0.0
1968-1972
1973-1977
1978-1982
1983-1987
1988-1992
1993-1997
Age-Standardised Incidence Rate (Chinese)
Age-Standardised Incidence Rate (Indian)

CHAPTER 10

CHILDHOOD CANCERS, 1968-2017

10.1 INCIDENCE OF CHILDHOOD CANCER BY GENDER AND ETHNICITY, 1968-2017

10.1.1 INCIDENCE OF CHILDHOOD CANCER BY GENDER, 1968-2017

The International Classification of Childhood Cancer, 3rd edition (ICCC-3) is the international standard for reporting incidence of cancers occurring in individuals aged 19 years and below. This classification system combines the morphology and topography codes into twelve main diagnostic groups, and emphasizes that the classification of tumours in children should be based on morphology, rather than on the primary site of origin as it is with adults [164].

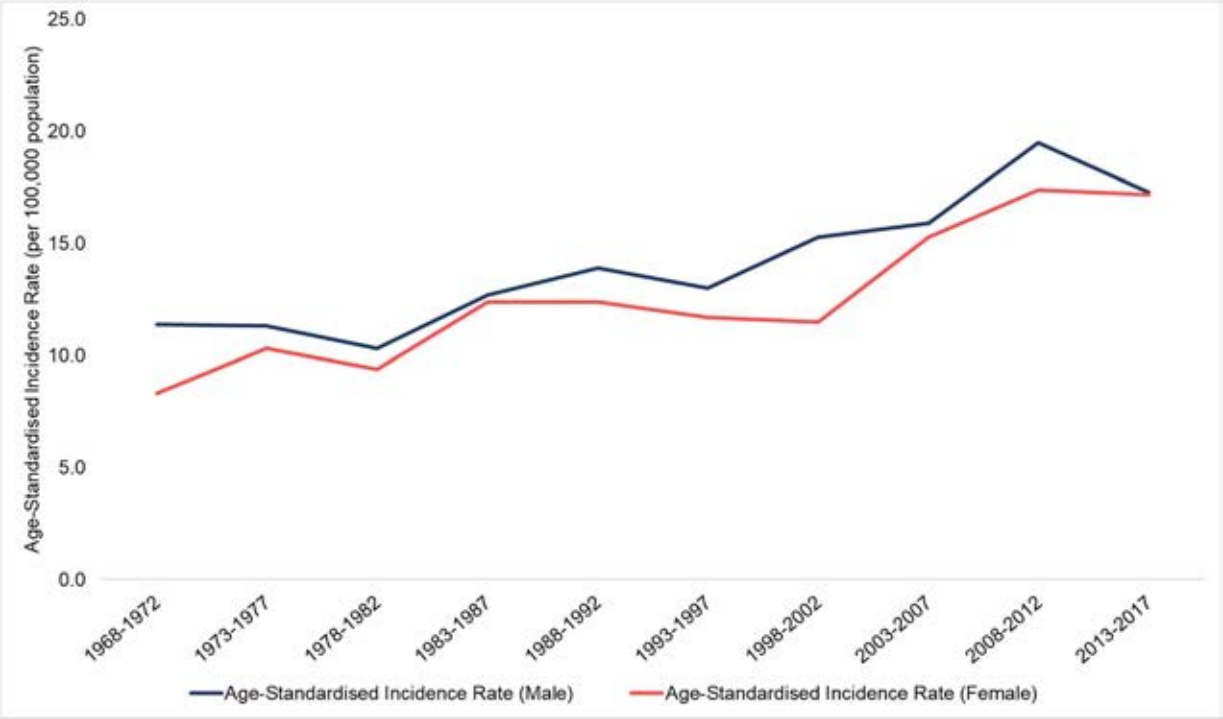
The incidence numbers and rates of childhood cancer broken down by gender for every five-year period from 1968-2017 are shown in Table 10.1.1 and Figure 10.1.1. The number of childhood cancers diagnosed rose from 491 in 1968-1972 to 720 in 2013-2017. In terms of ASIR, it had almost doubled during this period, increasing from 9.9 to 17.3 per 100,000 population. A similar pattern was observed for both genders - the ASIR for males increased from 11.4 to 17.3 per 100,000 population, while that for females rose from 8.3 to 17.2 per 100,000 population.

It is noteworthy that the gender gap in childhood cancer narrowed over the years; in 1968-1972, there were about 1.5 times as many males diagnosed with childhood cancer as females but by 2013-2017 the numbers of males and females with childhood cancer were approximately equal.

Table 10.1.1 INCIDENCE NUMBER AND RATE (PER 100,000 POPULATION) FOR CHILDHOOD CANCER BY GENDER AND FIVE-YEAR PERIOD, 1968-2017

Period	Gender	Number	%	CIR	ASIR
1968-1972	Male	295	60.1	11.2	11.4
	Female	196	39.9	7.9	8.3
	Total	491	100	9.6	9.9
1973-1977	Male	273	53.8	11.1	11.3
	Female	234	46.2	10.1	10.3
	Total	507	100	10.6	10.8
1978-1982	Male	240	53.0	10.3	10.3
	Female	213	47.0	9.8	9.4
	Total	453	100	10.1	9.9
1983-1987	Male	270	51.7	12.4	12.7
	Female	252	48.3	12.4	12.4
	Total	522	100	12.4	12.5
1988-1992	Male	304	54.5	13.8	13.9
	Female	254	45.5	12.4	12.4
	Total	558	100	13.2	13.2
1993-1997	Male	294	54.1	12.8	13.0
	Female	249	45.9	11.6	11.7
	Total	543	100	12.2	12.3
1998-2002	Male	353	58.3	14.7	15.3
	Female	252	41.7	11.2	11.5
	Total	605	100	13.0	13.5
2003-2007	Male	363	51.6	15.1	15.9
	Female	340	48.4	15.0	15.3
	Total	703	100	15.1	15.6
2008-2012	Male	439	53.5	18.8	19.5
	Female	381	46.5	17.1	17.4
	Total	820	100	18.0	18.5
2013-2017	Male	364	50.6	16.8	17.3
	Female	356	49.4	17.2	17.2
	Total	720	100	17.0	17.3

Figure 10.1.1: AGE-STANDARDISED INCIDENCE RATE (PER 100,000 POPULATION) FOR CHILDHOOD CANCER BY GENDER AND FIVE-YEAR PERIOD, 1968-2017



10.1.2 INCIDENCE OF CHILDHOOD CANCER BY ETHNICITY, 1968-2017

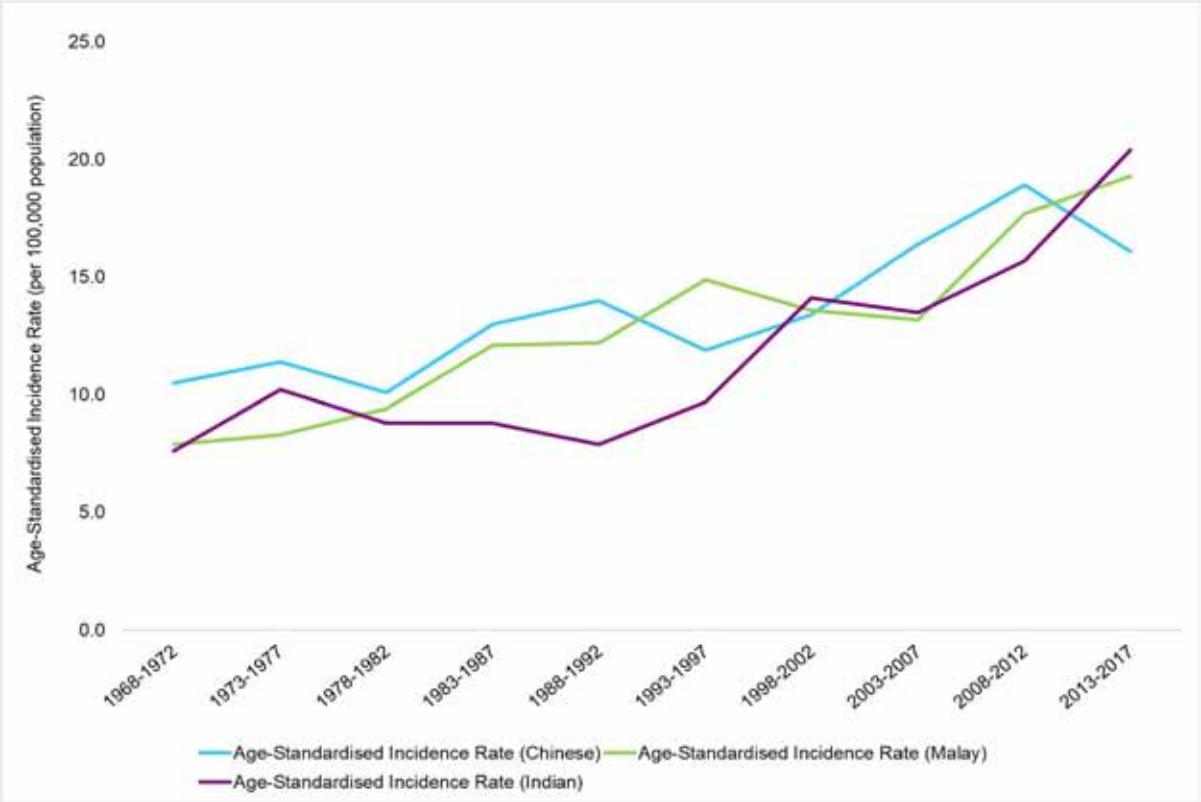
As with the increases in the incidence rates of childhood cancer observed in males and females aged 19 years and below since 1968-1972, the incidence of childhood cancer also increased in all three major ethnic groups, particularly for the Malays and Indians (Table 10.1.2, Figure 10.1.2). In 1968-1972, the Chinese had the highest ASIR of childhood cancer, at 10.5 per 100,000 population, but by 2013-2017, the incidence of childhood cancer was the lowest in the Chinese at 16.1 per 100,000 population. In contrast, the ASIR of childhood cancer in the Malays and Indians were each about 8.0 per 100,000 population in 1968-1972 but by 2013-2017, this figure had jumped to about 20.0 per 100,000 population for each group, surpassing that of the Chinese.

Correspondingly, the proportion of Chinese among the cases of childhood cancer decreased from 80.7% in 1968-1972 to 63.9% in 2013-2017, while that of the Malays and Indians increased from 13.2% to 19.9% and 5.5% to 12.2% respectively.

Table 10.1.2 INCIDENCE NUMBER AND RATE (PER 100,000 POPULATION) FOR CHILDHOOD CANCER BY ETHNICITY AND FIVE-YEAR PERIOD, 1968-2017

Period	Ethnic group	Number	%	CIR	ASIR
1968-1972	Chinese	396	80.7	10.2	10.5
	Malay	65	13.2	7.5	7.9
	Indian	27	5.5	8.0	7.6
	Total	491	100	9.6	9.9
1973-1977	Chinese	406	80.1	11.1	11.4
	Malay	65	12.8	8.1	8.3
	Indian	29	5.7	9.7	10.2
	Total	507	100	10.6	10.8
1978-1982	Chinese	350	77.3	10.2	10.1
	Malay	75	16.6	10.0	9.4
	Indian	25	5.5	9.0	8.8
	Total	453	100	10.1	9.9
1983-1987	Chinese	406	77.8	12.7	13.0
	Malay	86	16.5	12.4	12.1
	Indian	24	4.6	8.7	8.8
	Total	522	100	12.4	12.5
1988-1992	Chinese	440	78.9	13.8	14.0
	Malay	88	15.8	12.4	12.2
	Indian	24	4.3	8.1	7.9
	Total	558	100	13.2	13.2
1993-1997	Chinese	382	70.3	11.8	11.9
	Malay	118	21.7	14.9	14.9
	Indian	33	6.1	9.6	9.7
	Total	543	100	12.2	12.3
1998-2002	Chinese	427	70.6	12.9	13.4
	Malay	115	19.0	13.3	13.6
	Indian	54	8.9	13.4	14.1
	Total	605	100	13.0	13.5
2003-2007	Chinese	511	72.7	15.8	16.4
	Malay	114	16.2	13.2	13.2
	Indian	59	8.4	13.2	13.5
	Total	703	100	15.1	15.6
2008-2012	Chinese	575	70.1	18.5	18.9
	Malay	145	17.7	18.0	17.7
	Indian	71	8.7	14.8	15.7
	Total	820	100	18.0	18.5
2013-2017	Chinese	460	63.9	16.0	16.1
	Malay	143	19.9	19.7	19.3
	Indian	88	12.2	19.2	20.4
	Total	720	100	17.0	17.3

Figure 10.1.2: AGE-STANDARDISED INCIDENCE RATE (PER 100,000 POPULATION) FOR CHILDHOOD CANCER BY ETHNICITY AND FIVE-YEAR PERIOD, 1968-2017



10.2 INCIDENCE OF CHILDHOOD CANCER BY ICCC-3 GROUPS, 2008-2017

The International Classification for Childhood Cancer, 3rd Edition (ICCC-3) was updated in 2008 to include the haematolymphoid codes based on WHO Classification of Tumours of Haematopoietic and Lymphoid Tissues (2008) [164]. Using this classification, a total of 1,400 cases of childhood cancer were diagnosed in the period 2008-2017 (Table 10.2).

For both 2008-2012 and 2013-2017, leukaemias were the most common type of childhood cancer, with lymphoid leukaemias being the majority sub-type, followed by myeloid leukaemias. Other common types of cancer in childhood included germ cell tumours, lymphomas, and tumours of the central nervous system (CNS). Children aged four years and below accounted for the highest proportion of cases of leukaemias and tumours of the CNS among the young. Those aged 15-19 years accounted for the highest proportion of cases for lymphomas and germ cell tumours.

Table 10.2 INCIDENCE OF CHILDHOOD CANCER BY ICCC-3 GROUP, 2008-2017

ICCC group	ICCC description	2008-2012					2013-2017				
		0-4y	5-9y	10-14y	15-19y	TOTAL	0-4y	5-9y	10-14y	15-19y	TOTAL
I.	**Leukaemias, myeloproliferative diseases, and myeloplastic diseases**										
(a)	Lymphoid leukaemias	70	39	24	14	147	59	33	20	17	129
(b)	Acute myeloid leukaemias	8	6	11	15	40	17	3	11	8	39
(c)	Chronic myeloproliferative diseases	0	5	2	5	12	0	0	5	5	10
(d)	Myelodysplastic syndrome and other myeloproliferative diseases	6	0	1	1	8	2	0	1	0	3
(e)	Unspecified and other specified leukaemias	4	1	2	3	10	2	0	1	2	5
		88	51	40	38	**217**	80	36	38	32	**186**
II.	**Lymphomas and reticuloendothelial neoplasms**										
(a)	Hodgkin lymphomas	0	0	5	27	32	0	1	3	36	40
(b)	Non-Hodgkin lymphomas (except Burkitt lymphoma)	2	5	12	11	30	7	5	8	19	39
(c)	Burkitt lymphoma	4	0	3	2	9	1	2	8	3	14
(d)	Miscellaneous lymphoreticular neoplasms	1	0	1	0	2	0	0	0	0	0
(e)	Unspecified lymphomas	0	0	0	1	1	0	0	0	1	1
		7	5	21	41	**74**	8	8	19	59	**94**
III.	**CNS and miscellaneous intracranial and intraspinal neoplasms**										
(a)	Ependymomas and choroid plexus tumour	7	0	2	3	12	4	1	0	1	6
(b)	Astrocytomas	8	9	11	9	37	6	9	5	9	29
(c)	Intracranial and intraspinal embryonal tumours	9	7	5	2	23	12	7	8	2	29
(d)	Other gliomas	3	5	2	4	14	6	1	2	1	10
(e)	Other specified intracranial and intraspinal neoplasms	4	2	0	6	12	3	2	2	0	7
(f)	Unspecified intracranial and intraspinal neoplasms	0	0	0	0	0	1	0	0	0	1
		31	23	20	24	**98**	32	20	17	13	**82**
IV.	**Neuroblastoma and other peripheral nervous cell tumours**										
(a)	Neuroblastoma and ganglioneuroblastoma	29	3	1	1	34	17	1	3	1	22
(b)	Other peripheral nervous cell tumours	0	0	0	1	1	1	1	0	2	4
		29	3	1	2	**35**	18	2	3	3	**26**
V.	**Retinoblastoma**	18	1	0	0	19	9	1	0	0	10
		18	1	0	0	**19**	9	1	0	0	**10**
VI.	**Renal tumours**										
(a)	Nephroblastoma and other non-epithelial renal tumours	6	1	1	0	8	11	3	0	0	14
(b)	Renal carcinomas	0	0	0	2	2	1	0	0	1	2
		6	1	1	2	**10**	12	3	0	1	**16**

ICCC group	ICCC description	2008-2012					2013-2017				
		0-4y	5-9y	10-14y	15-19y	TOTAL	0-4y	5-9y	10-14y	15-19y	TOTAL
VII.	**Hepatic tumours**										
(a)	Hepatoblastoma	11	0	0	0	11	8	0	0	0	8
(b)	Hepatic carcinomas	0	1	1	0	2	0	0	1	0	1
		11	1	1	0	**13**	8	0	1	0	**9**
VIII.	**Malignant bone tumours**										
(a)	Osteosarcomas	0	5	13	13	31	0	3	13	13	29
(b)	Chondrosarcomas	0	0	1	3	4	0	0	3	0	3
(c)	Ewing tumour and related sarcomas of bone	1	0	1	2	4	0	0	4	0	4
(d)	Other specified malignant bone tumours	0	1	3	10	14	0	0	0	7	7
		1	6	18	28	**53**	0	3	20	20	**43**
IX.	**Soft tissue and other extraosseous sarcomas**										
(a)	Rhabdomyosarcomas	10	2	6	2	20	4	1	2	4	11
(b)	Fibrosarcomas, peripheral nerve sheath tumours, and other fibrous neoplasms	1	0	3	7	11	2	1	2	4	9
(c)	Other specified soft tissue sarcomas	2	1	5	19	27	1	4	8	11	24
(d)	Unspecified soft tissue sarcomas	0	0	1	2	3	0	0	1	1	2
		13	3	15	30	**61**	7	6	13	20	**46**
X.	**Germ cell tumours, trophoblastic tumours, and neoplasms of gonads**										
(a)	Intracranial and intraspinal germ cell tumours	4	7	11	6	28	0	1	4	4	9
(b)	Malignant extracranial and extragonadal germ cell tumours	3	0	4	4	11	3	0	2	7	12
(c)	Malignant gonadal germ cell tumours	5	4	11	25	45	6	2	8	21	37
(d)	Gonadal carcinomas	0	0	2	23	25	0	0	0	9	9
(e)	Other and unspecified malignant gonadal tumours	0	0	2	5	7	1	1	1	1	4
		12	11	30	63	**116**	10	4	15	42	**71**
XI.	**Other malignant epithelial neoplasms and malignant melanomas**										
(a)	Thyroid carcinomas	0	0	0	0	0	0	1	1	0	2
(b)	Nasopharyngeal carcinomas	1	0	3	26	30	0	2	2	23	27
(c)	Salivary gland carcinomas	0	0	0	1	1	0	0	0	1	1
(d)	Carcinomas of other sites	0	0	5	17	22	0	2	5	22	29
		1	0	8	44	**53**	0	5	8	46	**59**
XII.	**Other and unspecified malignant neoplasms**										
(a)	Lung-pleuropulmonary blastomas	2	1	0	2	5	1	0	1	1	3
(b)	Peritoneum – Epithelioid Mesothelioma	0	0	1	0	1	0	0	0	0	0
		2	1	1	2	**6**	1	0	1	1	**3**
	TOTAL	219	106	156	274	**755**	185	88	135	237	**645**

10.3 MORTALITY OF CHILDHOOD CANCER BY GENDER AND ETHNICITY, 1968-2017

10.3.1 MORTALITY OF CHILDHOOD CANCER BY GENDER, 1968-2017

The number of deaths from childhood cancer remained small throughout the years. In fact, it even decreased by more than half over time, from 190 deaths in 1968-1972 to 82 in 2013-2017, and the CMR and ASMR had correspondingly declined from 3.7 to 1.9 and 3.8 to 1.9 per 100,000 population respectively (Table 10.3.1, Figure 10.3.1). Although there were some fluctuations for mortality rates during this period, in part due to the small number, there was little change overall in terms of the gender breakdown in 1968-1972 compared to 2013-2017 with males accounting for approximately two-thirds of all deaths from childhood cancer.

Table 10.3.1 MORTALITY NUMBER AND RATE (PER 100,000 POPULATION) FOR CHILDHOOD CANCER BY GENDER AND FIVE-YEAR PERIOD, 1968-2017

Period	Gender	Number	%	CMR	ASMR
1968-1972	Male	120	63.2	4.6	4.6
	Female	70	36.8	2.8	2.9
	Total	190	100.0	3.7	3.8
1973-1977	Male	142	60.2	5.8	5.6
	Female	94	39.8	4.0	4.1
	Total	236	100.0	4.9	4.9
1978-1982	Male	105	56.5	4.5	4.4
	Female	81	43.5	3.7	3.5
	Total	186	100	4.1	4.0
1983-1987	Male	110	53.4	5.0	5.0
	Female	96	46.6	4.7	4.7
	Total	206	100	4.9	4.8
1988-1992	Male	131	58.0	6.0	5.9
	Female	95	42.0	4.6	4.6
	Total	226	100	5.3	5.3
1993-1997	Male	103	59.2	4.5	4.5
	Female	71	40.8	3.3	3.3
	Total	174	100	3.9	3.9
1998-2002	Male	77	52.0	3.2	3.3
	Female	71	48.0	3.2	3.2
	Total	148	100	3.2	3.2
2003-2007	Male	73	57.0	3.0	2.9
	Female	55	43.0	2.4	2.3
	Total	128	100.0	2.7	2.6
2008-2012	Male	56	56.6	2.4	2.3
	Female	43	43.4	1.9	1.8
	Total	99	100	2.2	2.1
2013-2017	Male	53	64.6	2.5	2.4
	Female	29	35.4	1.4	1.3
	Total	82	100	1.9	1.9

Figure 10.3.1: AGE-STANDARDISED MORTALITY RATE (PER 100,000 POPULATION) FOR CHILDHOOD CANCER BY GENDER AND FIVE-YEAR PERIOD, 1968-2017

10.3.2 MORTALITY OF CHILDHOOD CANCER BY ETHNICITY, 1968-2017

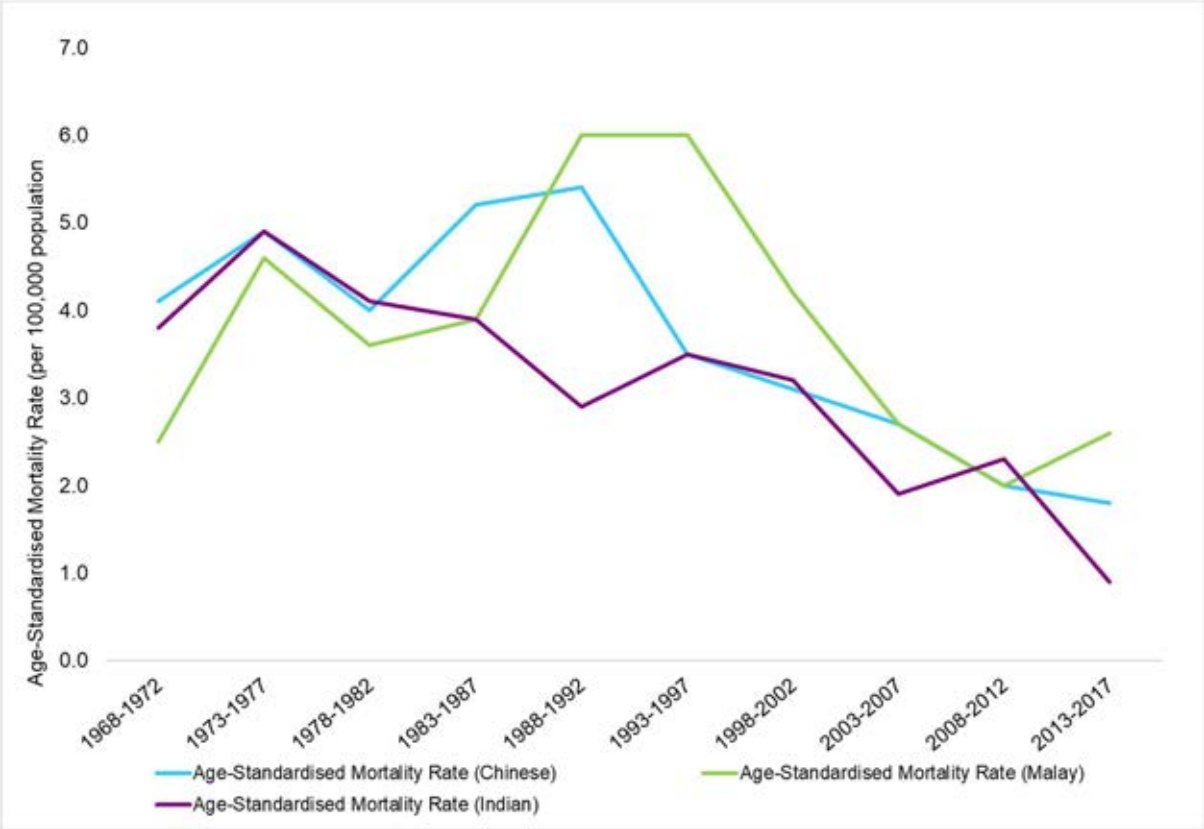
The mortality rates of childhood cancer fell over the years for the Chinese and Indians, but there was little overall change in childhood cancer mortality rates for the Malays (Table 10.3.2, Figure 10.3.2). The ASMR for the Chinese fell from 4.1 to 1.8 per 100,000 population between 1968-1972 and 2013-2017, while for the Indians, it fell from 3.8 to 0.9 per 100,000 during this period. Among the Malays, the ASMR remained about the same for 1968-1972 compared to 2013-2017.

Correspondingly, the proportions of Chinese and Indians among childhood cancer deaths also fell over the years, from 81.6% in 1968-1972 to 68.3% in 2013-2017 for the Chinese and 6.8% to 3.7% for the Indians during the same period. As for the Malays, while they accounted for 11.1% of childhood cancer deaths in 1968-1972, the proportion rose to 24.4% in 2013-2017. However, the fluctuations in the ethnic trends observed across the years could be due to the small numbers and should therefore be interpreted with caution.

Table 10.3.2 MORTALITY NUMBER AND RATE (PER 100,000 POPULATION) FOR CHILDHOOD CANCER BY ETHNICITY AND FIVE-YEAR PERIOD, 1968-2017

Period	Ethnic group	Number	%	CMR	ASMR
1968-1972	Chinese	155	81.6	4.0	4.1
	Malay	21	11.1	2.4	2.5
	Indian	13	6.8	3.9	3.8
	Total	190	100	3.7	3.8
1973-1977	Chinese	179	75.8	4.9	4.9
	Malay	38	16.1	4.7	4.6
	Indian	16	6.8	5.3	4.9
	Total	236	100	4.9	4.9
1978-1982	Chinese	140	75.3	4.1	4.0
	Malay	32	17.2	4.3	3.6
	Indian	11	5.9	4.0	4.1
	Total	186	100	4.1	4.0
1983-1987	Chinese	166	80.6	5.2	5.2
	Malay	28	13.6	4.0	3.9
	Indian	11	5.3	4.0	3.9
	Total	206	100	4.9	4.8
1988-1992	Chinese	173	76.5	5.4	5.4
	Malay	43	19.0	6.0	6.0
	Indian	9	4.0	3.0	2.9
	Total	226	100	5.3	5.3
1993-1997	Chinese	113	64.9	3.5	3.5
	Malay	47	27.0	5.9	6.0
	Indian	12	6.9	3.5	3.5
	Total	174	100	3.9	3.9
1998-2002	Chinese	99	66.9	3.0	3.1
	Malay	36	24.3	4.2	4.2
	Indian	13	8.8	3.2	3.2
	Total	148	100	3.2	3.2
2003-2007	Chinese	94	73.4	2.9	2.7
	Malay	24	18.8	2.8	2.7
	Indian	9	7.0	2.0	1.9
	Total	128	100	2.7	2.6
2008-2012	Chinese	68	68.7	2.2	2.0
	Malay	17	17.2	2.1	2.0
	Indian	11	11.1	2.3	2.3
	Total	99	100	2.2	2.1
2013-2017	Chinese	56	68.3	1.9	1.8
	Malay	20	24.4	2.8	2.6
	Indian	3	3.7	0.7	0.9
	Total	82	100	1.9	1.9

Figure 10.3.2: AGE-STANDARDISED MORTALITY RATE (PER 100,000 POPULATION) FOR CHILDHOOD CANCER BY ETHNICITY AND FIVE-YEAR PERIOD, 1968-2017



While childhood cancer mortality by gender and ethnicity has been shown, childhood cancer mortality with breakdown by ICCC group has not been reflected here as the numbers in the cells for many of the sub-groups become very small and comparisons will not be meaningful.

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