UNDERSTANDING THE ROLE OF CHRONIC DISEASE AND PRIVATE HEALTH INSURANCE IN DETERMINING HEALTHCARE-SEEKING BEHAVIOUR IN AUSTRALIA: AN APPLIED MICROECONOMIC EVALUATION

A Thesis submitted by

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Abstract

Sound health is desirable for all and health is an essential element of human development and quality of life. There are numerous determinants (both external and internal) that influence a person's health and healthcare utilisation or healthcare-seeking behaviour. Many of these determinants, such as income, education, age, gender, chronic diseases and location, are comparable across the global population. However, how the determinants interact and induce utilisation of healthcare services is distinctive to a specific community and the environment (health system and policies) they reside in. The healthcare system of many countries aims to ensure universal and equal access to healthcare for all. Accordingly, developed countries such as Australia provide publicly funded healthcare services for all residents. Nevertheless, past studies have documented unequal access to and use of healthcare (patients delaying or relinquishing necessary healthcare) resulting in avoidable morbidity and mortality.

Disparities in healthcare utilisation are the consequence of a complex range of individual, demographic and socioeconomic elements. There is a paucity of evidence on whether, for example, being male or female, being diagnosed with cancer or having private health insurance coverage significantly influences the pattern of healthcare utilisation among Australian patients. Hence, the objective of this research was to investigate the care-seeking behaviour or healthcare usage of patients with cancer, and of patients with private health insurance in Australia. The theoretical framework of the thesis is linked with the 'theory of care-seeking behaviour' developed by Lauver (1992), who argued that the probability of getting involved in health behaviour is determined by psychological variables (e.g. expectations, habits and norms), clinical variables (e.g. chronic diseases) and the surrounding environment (e.g. health system, health insurance). The results of this study confirm the validity of the theory for Australia.

This thesis is a PhD by publication and includes one systematic literature review and three cross-sectional studies using data from the Household, Income and Labour Dynamics Australia in (HILDA) survey which is collected annually and is nationally representative. This was supplemented by data from the Australian Bureau of Statistics. Several key findings emerged from the statistical analysis.

This thesis is an accumulation of four research articles. These articles are cohesive, as the key objective of all these papers were to analyse and understand healthcare utilisation or care-seeking behaviour of patients in Australia.

The purpose of Paper 1 was to assess the factors that are associated with healthcare utilisation in Australian cancer patients based on their demographic, geographic and socioeconomic backgrounds. The study concluded that demographic and sociocultural factors such as advancing age, gender, low income, low education status, rurality, lacking private health insurance, increased psychological distress and less access to specialist care were all associated with lower healthcare utilisation among cancer patients. Models of care such as general practitioner-led cancer care are preferred by younger individuals with cancer. Yet, accessing specialist care is associated with lower rates of hospitalisation. Higher levels of psychological distress increase hospital length of stay.

The objective of Paper 2 was to conduct a systematic literature review to examine gender differences in healthcare utilisation of lung cancer patients. A total of 42 studies met the eligibility criteria from 1356 potential studies. In these studies, the most commonly measured healthcare practice was surgery (number of studies =19), followed by chemotherapy (number of studies =13). All studies were from developed countries and had a higher percentage of male participants. Substantial evidence of heterogeneity in the use of treatments by gender was found. In relation to diagnosis interval and stage of cancer diagnosis, studies suggested that women had longer diagnostic intervals; nonetheless, they often get diagnosed at an earlier stage. Furthermore, women had a higher probability of using inpatient cancer-care services and surgical treatments. Conversely, men had more significant risks of readmission after surgery (number of studies =2) and longer length of stay (number of studies =2). Lastly, there were no significant gender differences in the odds of receiving chemotherapy and radiation therapy.

Paper 3 aimed to examine the healthcare-seeking (hospital, primary and preventive care) and healthcare utilisation behaviour of patients with private health insurance in Australia. The findings of the study indicated that patients with private health insurance had a higher number of hospital nights' stay despite having a lower number of hospital admissions compared with those without private cover. Significant

disparities were identified in preventive and specialist care use between patients with cover and without cover. No significant variations were observed in healthcare utilisation for patients before and after dropping their private health cover. Finally, one in four patients selected to use public hospitals over private hospitals despite holding private health insurance cover. Those insured and coming from lower socioeconomic backgrounds (e.g. lower income and education level) and those who are younger and without long-term health conditions have a higher probability of selecting public rather than private care. It is beyond the scope of this thesis to estimate the reason for this finding; however, recent studies and reports have indicated that a majority of private patients view their out-of-pocket health expenditure as too high, and the probability of paying out-of-pocket expenditure at the hospital is much higher for private patients compared to public patients.

The objective of Paper 4 was to investigate the determinants of private health insurance demand and then estimate the effect of income inequality on the private health insurance coverage rate. The previous studies included in this thesis indicated that private health insurance plays an important role in determining healthcare use (e.g. specialist care, health screening, and private hospital care) in Australia. The results of the paper showed that regions with higher income inequality have a higher percentage of the population with private health cover. The increasing wealth of the top 25% of income earners has a significant and positive relationship with private health insurance demand. Moreover, higher self-assessed health status, higher levels of education, a greater proportion of Australian citizenship and a higher proportion of the population over the age of 65, significantly increase the private health insurance coverage rate in a region. A substantial disparity was observed in private health insurance coverage within and across states in Australia.

Keywords: Care-seeking behaviour; choice of care; healthcare utilization; primary preventive care; specialist care; hospital admission; gender difference; cancer; lung cancer; systematic review; private health insurance; public hospital; private hospital; income inequality; income share; regions; logistic regression; instrumental variable approach; disaggregate data; endogeneity; HILDA; Australia.

Certification of Thesis

This Thesis is the work of Rezwanul Hasan Rana except where otherwise acknowledged, with the majority of the authorship of the papers presented as a Thesis by Publication undertaken by the student. The work is original and has not previously been submitted for any other award, except where acknowledged.

Principal Supervisor: **Professor Khorshed Alam**

Associate Supervisor: **Professor Jeff Gow**

Student and supervisors signatures of endorsement are held at the University

<center>**Statement of Contribution**</center>

The following detail is the agreed share of contribution for candidate and co-authors in the presented publications in this thesis:

Article I:

Rana, R.H., Alam, K. Gow, J. and Ralph N**.,** 2019. Predictors of healthcare use in Australian cancer patients, *Cancer Management and Research,* 11, pp. 6941-6957. DOI: https://doi.org/10.2147/CMAR.S193615

The overall contribution of ***Rezwanul Hasan Rana*** was 70% to the concept development, data collection, statistical analysis and revising the final submission. ***Khorshed Alam*** contributed 10%, assisted in designing the study, supervised data analysis and the writing of the manuscript. ***Jeff Gow*** contributed 10%, updated the research design and reviewed the article. ***Nicholas Ralph*** contributed 10%, assisted in writing discussion and policy implications of the study.

Article II:

Rana, R.H., Alam, F., Alam, K. and Gow, J**.** 2019. Gender-specific differences in care-seeking behaviour among lung cancer patients: a systematic review, *Journal of Cancer Research and Clinical Oncology* **(under review).**

The overall contribution of ***Rezwanul Hasan Rana*** was 65% to the concept development, data collection, review of the articles and deciding the eligibility for inclusion drafting the paper. ***Fariha Alam*** contributed 15%, assisted in review of the articles and deciding the eligibility for inclusion. ***Khorshed Alam*** contributed 10%, assisted in designing the study, verified the extraction of data form the selected studies and the writing of the manuscript. ***Jeff Gow*** contributed 10%, updated the research design and reviewed the article.

Article III:

Rana, R.H., Alam, K. and Gow, J. 2019. Selection of private or public hospital care: examining the care-seeking behaviour of patients with private health insurance, *BMC Health Services Research* **(under second review).**

The overall contribution of ***Rezwanul Hasan Rana*** was 75% to the concept development, review of the literature, data collection, statistical analysis and preparing the final draft. ***Khorshed Alam*** contributed 15% by assisting in designing the study,

supervised data analysis and the writing of the manuscript. *Jeff Gow* contributed 10% by updating the research design and reviewed the article.

Article IV:

Rana, R.H., Alam, K. and Gow, J**.** 2019. The impact of income inequality on private health insurance coverage: A comparison between different regions of Australia, *Rural and Remote Health* **(under review)**.

The overall contribution of *Rezwanul Hasan Rana* was 75% to the concept development, review of the literature, data collection, statistical analysis and preparing the final draft. *Khorshed Alam* contributed 15% by assisting in designing the study, supervised data analysis and the writing of the manuscript. *Jeff Gow* contributed 10% by updating the research design and reviewed the article.

Acknowledgements

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Abbreviations

ABS	Australian Bureau of Statistics
AIHW	Australian Institute of Health and Welfare
ANOVA	Analysis of Variance
ASGS	Australian Statistical Geographic Standard
ASCO	American Society of Clinical Oncology
ACSQH	Australian Commission on Safety and Quality in Healthcare
ATO	Australian Tax Office
BMI	Body Mass Index
BOA	Born Outside of Australia
CI	Confidence Interval
CPI	Consumer Price Index
CUE	Continuous-Updating Estimator
DSS	Department of Social Services
EGMM	Efficient Generalised Method Of Moments
EU	Expected Utility
GDP	Gross Domestic Product
GIS	Geographic Information System
GP	General Practitioners
HILDA	Household, Income and Labour Dynamics in Australia
iHEA	International Health Economics Association
IV	Instrumental Variable
LM	Lagrange Multipliers

MBS	Medicare Benefit Schedule
MLS	Medicare Levy Surcharge
NICE	National Institute for Clinical Excellence
NSCLC	Non-Small Cell Lung Cancer
OECD	Organisation for Economic Co-operation and Development
OLS	Ordinary Least Square
OSHC	Overseas Student Health Cover
PHI	Private Health Insurance
Pr	Probability
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analysis
PROSPERO	Prospective Register of Systematic Reviews
SA3	Statistical Area 3 (in ABS data)
SCLC	Small Cell Lung Cancer
STROBE	Strengthening the Reporting of Observational Studies in Epidemiology
VIF	Variance Inflation Factor
2SLS	Two-stage Least Squares

List of published and under-review papers included in the thesis

Rana, R.H., Alam, K. Gow, J. and Ralph N., 2019. Predictors of healthcare use in Australian cancer patients, *Cancer Management and Research,* 11, p.6941-6957

The purpose of this study was to measure healthcare utilisation in Australian cancer patients based on their demographics, geographic and socioeconomic backgrounds.

Gender-specific differences in care-seeking behaviour among lung cancer patients: a systematic review (under-review in *Journal of Cancer Research and Clinical Oncology*)

This systematic literature review examined gender differences in healthcare utilisation of lung cancer patients. The aim was to synthesise evidence to assess whether men and women utilise cancer treatments differently.

Selection of private or public hospital care: examining the care-seeking behaviour of patients with private health insurance (under-review in *BMC Health Services Research* Journal)

This study aimed to examine the healthcare-seeking (hospital, primary and preventive care) and healthcare utilisation behaviour of patients with private health insurance (private health insurance) in Australia.

The impact of income inequality on private health insurance coverage: a comparison between different regions of Australia (under-review in *Rural and Remote Health* Journal)

The two aims of this Australian study were to investigate the determinants of PHI demand and then estimate the effect of income inequality on the PHI coverage rate.

List of published papers during the PhD programme (not included in the thesis)

Rana, R.H., Alam, K. and Gow, J., 2018. Health expenditure, child and maternal mortality nexus: a comparative global analysis. *BMC International Health and Human Rights*, *18*, p.29. DOI: https://doi.org/10.1186/s12914-018-0167-1.

Rana, R.H., Alam, K. and Gow, J., 2018. Development of a richer measure of health outcomes incorporating the impacts of income inequality, ethnic diversity, and ICT development on health. *Globalization and Health*, *14*, p.72. DOI: https://doi.org/10.1186/s12992-018-0385-2.

Rana, R.H., Alam, K. and Gow, J., 2019. The impact of immigration on public and out-of-pocket health expenditure in OECD countries. *Journal of International Migration and Integration*, *20*, p.1-24. DOI: 10.1007/s12134-019-00667-y.

Rana, R.H., Alam, K. and Gow, J., 2019. Health expenditure and gross domestic product: causality analysis by income level. *International Journal of Health Economics and Management*, *19*, p. 1-23. DOI**:** https://doi.org/10.1007/s10754-019-09270-1.

Rana, R.H., Alam, K. and Gow, J., 2019. Health outcome and expenditure in low-income countries: does increasing diffusion of information and communication technology matter? *Information Technology for Development*, pp.1-19. DOI: https://doi.org/10.1080/02681102.2019.1678455.

CHAPTER 1

1.0 Introduction

1.1 Background

Research related to healthcare-seeking behaviour is concerned with the actions of individuals when they experience health problems (falling health stock or status). It is well-documented that people respond differently when trying to satisfy their healthcare needs. This is true despite two individuals having similar healthcare needs and facing an identical healthcare environment. Previous literature has either estimated the process (e.g. illness response) of care-seeking behaviour or the 'endpoint' which is healthcare utilisation (Tipping & Segall 1995) to understand the healthcare-seeking behaviour. Healthcare is a general term used to define services that improve the health of the general population, including identifying symptoms of diseases and their cure potentials. Likewise, healthcare utilisation is the measurement or account of the usage of care services by individuals to fulfil their healthcare needs to maintain desired heath status or stock. In mapping out the determinants of healthcare utilisation in the literature, several socioeconomic, demographic, geographic, cultural and organisational factors have been identified (Anderson 1973; Babitsch et al. 2012).

The primary goal of a modern healthcare system and health policymakers (globally) is to ensure timely receipt of appropriate healthcare services by individuals with medical conditions. Timely utilisation of treatment reduces mortality rate and the economic burden of illness. Hence, variations in healthcare utilisation are important considerations in epidemiological research. Furthermore, understanding the pattern of healthcare utilisation of patients in a health system serves many purposes. First, it is useful when comparing treatment received by patient characteristics across different healthcare settings. Second, it helps to associate patient care usage with health services provider characteristics. Third, it can be used to understand the healthcare utilisation of various population subgroups and to explain who is using which healthcare services and why. Fourth, it provides information about the quality, cost and appropriateness of treatments received. Empirical studies have emphasised that assessing healthcare utilisation data promotes equity in access to care, disease intervention and survival rate (Dubayova et al. 2010), curbs healthcare avoidance and delays in seeking necessary healthcare (Byrne 2008; Cornally

& McCarthy 2011) and facilitates developing patient-centred interventions (Lauver et al. 2002).

Moreover, Donabedian (1972) concluded that healthcare utilisation is the benchmark for measuring access to care. Hence, analysis of healthcare utilisation or demand for health services provides vital information when forecasting future healthcare needs and associated expenditure and to identify areas that require further attention. Policymakers can apply the information to design effective healthcare activities and management programmes to improve the health of the population. As a result, understanding patient's healthcare use or demand for healthcare services is not only crucial for countries with poor health status (often least developed countries) but also for developed countries that perform well (in terms of health services and outcomes) by international standards.

1.2 Australian healthcare system in brief

The study setting of this thesis is Australia, a developed country that has a sound and relatively sophisticated healthcare system which ranks very high internationally and also among the Organisation for Economic Co-operation and Development (OECD) countries (Dixit & Sambasivan 2018; Hall 2015). The population of Australia enjoys higher life expectancy, lower infant mortality and fewer disability-adjusted life years compared to the OCED country average while the share of national healthcare expenditure to gross domestic product (GDP) is at the median among OECD countries (Anderson 1973; AIHW 2014). According to the OECD (2019) health statistics, the residents of Australia have a higher average number of doctor consultations and a lower average length of stay at hospitals and fewer waiting days for elective surgeries compared to the average of OECD countries. For instance, the median waiting days for Cataract surgery, Coronary bypass and Hip replacement in Australia were 85 days, 13 days and 110 days, respectively, compared to the OECD average of 103 days, 22 days and 128 days. Hence, if health status and use of healthcare services are principal indicators of the performance of a healthcare system, Australia's health sector is doing more than an efficient job in comparison to other OECD countries.

The federal, state and territory governments of Australia share the responsibility to finance, develop and implement policies, and regulate and monitor the healthcare system.

The health system is a multi-layered network of public and private service providers and supporting mechanisms (AIHW 2014). Healthcare is provided through general practitioners (GPs) (primary care services), medical specialists, allied health workers, hospitals, nurses and other health professionals.

The universal tax-funded public health insurance programme in Australia is called 'Medicare'. It has three major parts: medical services, public hospitals and medicines. It covers the expenses of public hospital services (free treatment for patients in public hospitals) and visits to doctors (payment of benefits or rebates for using selected professional healthcare services through the 'Medicare Benefits Schedule') (Calder et al. 2019). In addition, the 'Pharmaceutical Benefits Scheme' provides subsidies for a variety of prescription medicines. Hence, the fundamental structure of the hospital and medical services has been established in a way to provide essential healthcare services to all Australians without experiencing financial hardship (Van Doorslaer et al. 2008).

The Australian healthcare system is often called a hybrid model because, in addition to Medicare, people can also purchase private health insurance (PHI) to gain access to both public and private hospitals as private patients (Willis & Parry 2016) and extra coverage of services (e.g. dental care, physiotherapy) not covered by Medicare (Cheng 2014). Australian health policy encourages private health cover (through tax incentives or monetary rebates on premiums) so that private hospital care can complement (sometimes duplicate) the services provided by the public hospitals. The aim is to reduce public healthcare expenditure, improve access and quality of the public health sector and better utilisation of public resources (Ellis & Savage 2008). Hence, promoting PHI is a pivotal mechanism to manage the rising burden of healthcare demand for the rapidly ageing population of Australia. Moreover, PHI also provides patients with more options regarding their choice of doctors and type of services and reduced waiting times (Eldridge, Onur & Velamuri 2017). Nonetheless, the policy of subsidising private health insurance through the tax system is a contentious issue, and some argue that it creates inequality in access to care (Colombo & Tapay 2004).

Healthcare in Australia is funded using a mixture of public and private sources of financing (Cheng 2014). Eventually, all healthcare spending is financed by households

through taxation, out-of-pocket expenditure or private health insurance premiums (Duckett & Willcox 2015). Figure 1.1 provides a basic health funding flowchart of the Australian health sector. It is important to note that some households contribute more than others, and some utilise healthcare services more than they contribute. Hence, the health financing mechanism is redistributive and focused on shifting income from the affluent to the deprived. Figures 1.2, 1.3, and 1.4 represent a state-wise and year-wise comparison for a number of public and private hospitals as well as the total amounts of funding from all sources.
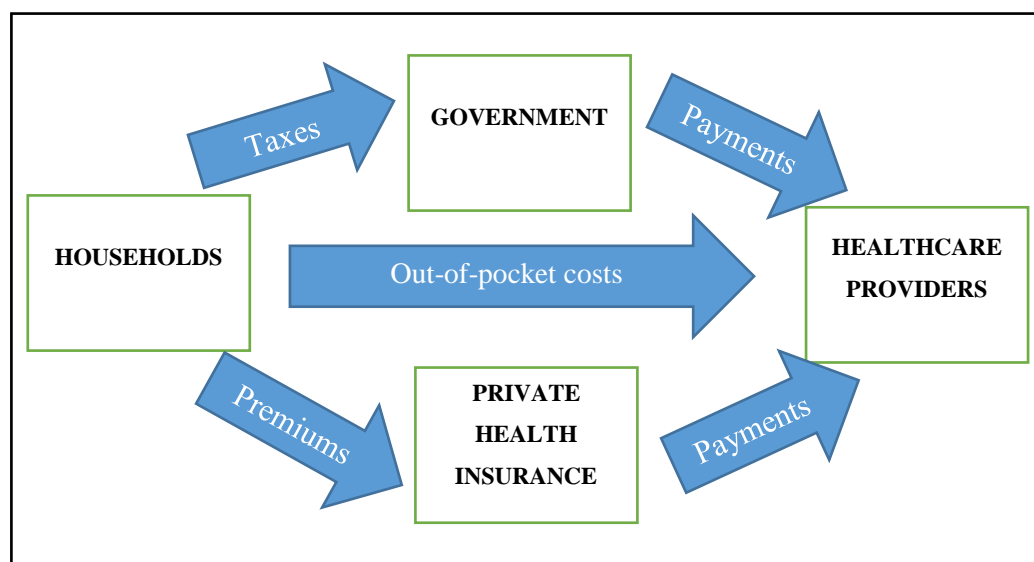
Figure 1.1 Flow of health funding in Australian health sector. Source: Duckett and Willcox (2015)

1.3 Defining the key terminologies related to the Australian healthcare system

General practitioners: A qualified doctor who is a specialist in general practice (GP) with the abilities and experiences to diagnose, treat and prescribe medication along with coordinating sophisticated medical care to treat complex health conditions.

Specialists: A patient can use the services of a specialist after being referred by the GP. A specialist has undertaken advanced training and has comprehensive knowledge in a specialised field.

Allied health provider: Allied health providers offer services such as physiotherapy and psychology, and complementing traditional treatments.

Medicare: The universal healthcare system of Australia. The eligibility criteria to access healthcare under Medicare include being a citizen of Australia and New Zealand, or permanent residents of Australia. There is also Medicare Benefits Schedule (MBS) which offers a range of medical services that are subsidised by Medicare. According to Ellis and Savage (2008, p. 261), all outpatient medical services and a large proportion of in-patient services are provided by private practitioners paid by fee-for-service with a fixed rate of reimbursement from the government via Medicare. In public hospitals, specialists treating public patients are either salaried or are private practitioners paid on a sessional basis who also work in private hospitals, and both may also treat private patients in public hospitals. Medicare also subsidises drugs listed on the Pharmaceutical Benefits Scheme (PBS).

Private health insurance: In June 2018, 45.1% of the population had private insurance hospital treatment cover, and 54.3% of the population held some form of general treatment cover, down from 47% and 56% respectively, in 2015 (Australian Prudential Regulation Authority 2018). Insurance types offered by PHI in Australia include hospital cover, general treatment cover (ancillary or extras cover) and ambulance cover (if not provided by the state). Some certain services are not allowed to be covered by PHI (Australian Institute of Health and Welfare 2017). Private insurance coverage is limited to treatments in public or private hospitals. It covers the portion of the treatment fees charged for private in-patients care and various extra services such as dental care and allied health services (not covered by Medicare) (Ellis & Savage 2008). These extra services can be purchased separately. Patients with PHI (depending on the type of coverage or policy) can choose to use public hospital care as public patients (the treatment cost will be paid through Medicare) and public or private hospital care as private patients (the treatment cost will be paid by the private insurer). Being a public patient does not incur additional out-of-pocket costs; however, patients using private care might have to pay the out-of-pocket costs that are not covered by the health insurer.

Overseas Student Health Cover (OSHC): Health insurance (sold by private health insurance companies) is a visa requirement for international students and it ensures access

to affordable healthcare and medical treatments for students and their dependents while they are studying and staying in Australia.

Public and private hospitals: Public hospitals provide free health care to Australians based on the hospital care policies applied and funded, by each state. On the other hand, private hospitals are owned and operated by private and non-profit organisations. Private hospitals are funded through the fees charged directly to patients. The payments incurred can be an out-of-pocket cost for the patients or otherwise paid by the private health insurance (when a patient has PHI cover). If the cost of the treatments (at private hospitals) are not fully covered by PHI, the additional payments would be out-of-pocket costs. The key benefits of the private healthcare system in Australia are: (1) greater choice of medical practitioners (e.g. specialists); (2) shorter waiting times for elective surgeries; (3) choice of better amenities at the hospital (e.g. private rooms); and (4) cover for many types of allied health services that are often not covered by Medicare (Buchmueller et al. 2013).

Number of Public and Private Hospitals 2017-18
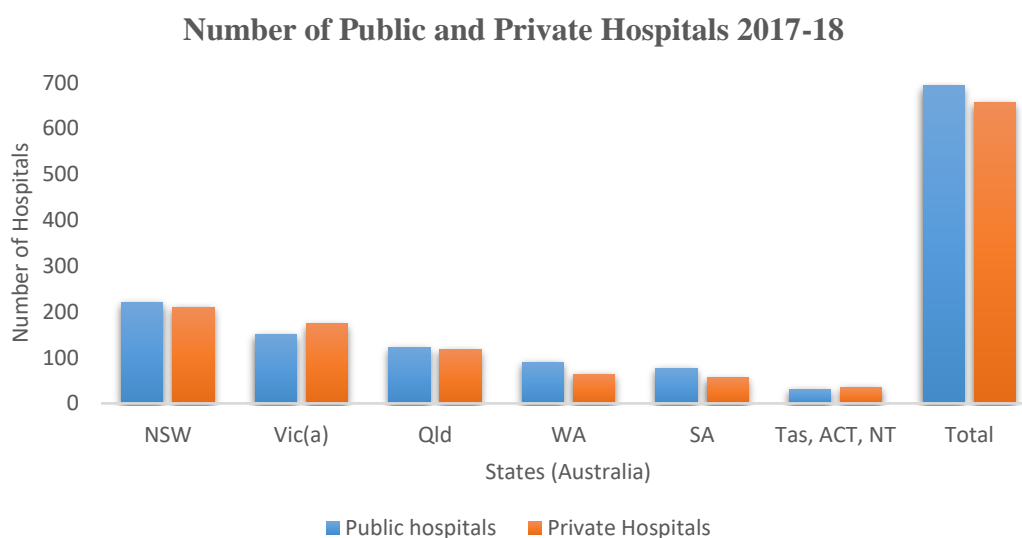
Figure 1.2 State-wise comparison between number of public and private hospitals (source: AIHW 2019)

Number of Public and Private Hospitals 2012-2017
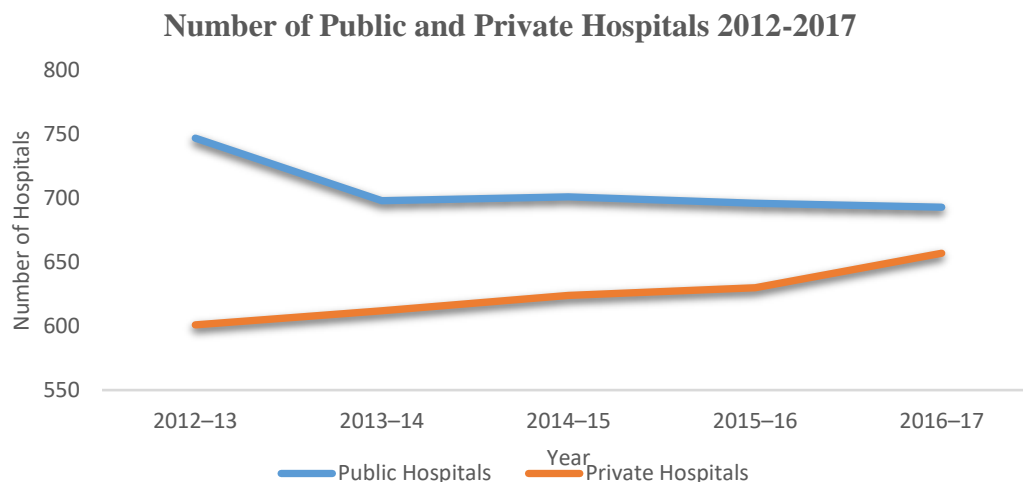
Figure 1.3 Year-wise comparison between number of public and private hospitals (source: AIHW 2019)

Co-payment: This is the additional cost for accessing GP or specialist services when the doctor's fees are higher than the amount covered by the Medicare, PHI or OSHC. This is the out-of-pocket cost which is not refunded by Medicare or private health insurers.

Health system financing: According to the Australian Institute of Health and Welfare (2018) the health system in Australia is typically financed by public funds, with a substantial mix of both public and private insurance arrangements. In 2016-17, 68.7% of total health expenditures were publicly funded (41.3% by the Australian government, 27.4% by state and territory governments). The sources of non-public funding include: individuals (16.5%), private health insurers (8.8%), and accident compensation schemes (6.0 %) (Australian Institute of Health and Welfare 2018).

Total funding (all sources) for Public and Private Hospitals 2012-2017
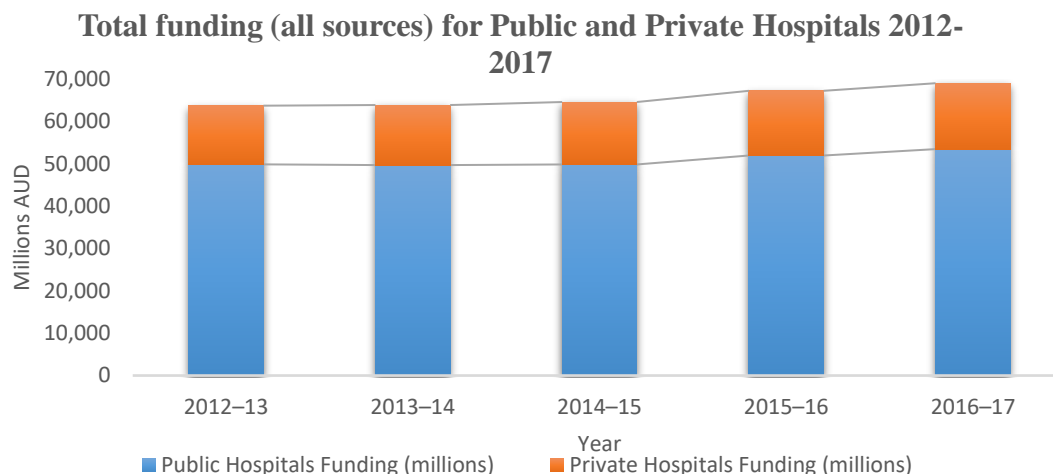
Figure 1.4 Year-wise comparison between total amount of funding for public and private hospitals (source: AIHW 2019)

Community rating: The PHI of Australia relies on a system of community rating. Hence, everyone pays similar premiums for the health cover as long as the coverage is identical. For instance, a 20 year-old single and healthy male will pay the same premium as a 60 years-old single and unwell male. The system is designed to maintain fairness in the PHI system.

1.3.1 The issue with PHI in Australia

A recent study conducted by Private Health Care Australia (2017) highlighted the fact that healthcare expenditure has increased at a rate much higher than the Consumer Price Index (CPI) over the last decade, which has led to higher premiums for PHI and therefore, greater pressure on household expenses. The study also mentioned that in 2014-2015, health system input costs (hospital accommodation costs of 7.6%, medical specialist gap costs of 7.1%, medical device costs of 9% and allied health costs of 6.3%) rose by close to 8%, while household incomes rose by just 1.8%. Seventy-two percent of the patients with PHI stated that their premium is excessive, while 48% mentioned that their out-of-pocket cost for specialist care is too high (Private Health Care Australia 2017, p. 15). These findings may explain the reduction of insured Australian (hospital only and combined cover) from 46.8% in 2016 to 45.1% in 2018 (Australian Competition and Consumer Commission 2018).

1.4 Statement of the problem or significance of the study

Like all other developed countries, the health sector of Australia is experiencing major demographic, technological and economic challenges. Moreover, although considerable development has been made within the health system over the past years, improvements have not been experienced equally by all in the communities of Australia (Calder et al. 2019). Macri (2016) stated that several subgroups of the population in Australia experience significantly worse health than the general population, and addressing this issue is a fundamental challenge for policymakers. Several contemporary studies have identified inequalities in the access and utilisation of healthcare services in Australia. The ACSQH (2015) mapped significant variations in healthcare use by location (urban vs rural) and age. Others have found differences in healthcare utilisation based on socioeconomic status and people living with disabilities (Fisher et al. 2016), between different races (Bastos et al. 2018), by gender (Turrell et al. 2006), by chronic diseases status and private health insurance status (Reeve et al. 2018).

In addition, despite having universal health coverage, there is also evidence of individuals forgoing recommended care due to costs being incurring through the imposition of the co-payment by providers. Duckett and Willcox (2015) indicated that 14% of Australians did not see a doctor when sick, and 8% did not fill prescriptions or skipped doses because of the unaffordable costs. According to Osborn and Schoen (2013), 8% of Australians faced a severe problem in paying medical bills, 18% waited two months or more for a specialist doctor appointment, and 43% of Australians think that the health system needs fundamental changes. Responding to these unwarranted (factors other than needs or preferences) variations in access to and utilisation of care is one of the biggest challenges to the Australian healthcare system.

Designing appropriate interventions to trigger fundamental changes in the healthcare system to lessen the aforementioned problems is a trying and time-consuming task. Nonetheless, understanding the pattern of healthcare utilisation of patients from different socioeconomic, demographic and geographic backgrounds in Australia is important in trying to obtain better outcomes. The literature shows a close association between healthcare utilisation and the supply and accessibility of healthcare services (Fisher et al.

2000; Srivastava 2014). Previous empirical studies have outlined several key factors that influence the variation in healthcare use. Some variations (warranted) are expected due to differences in disease prevalence and severity, patient preferences or clinical responsiveness. However, much attention is needed to understand the unwarranted variations (which advocate the dynamics), other than patient needs or preferences, which are steering treatment decisions. Therefore, studies included in this thesis examined the socioeconomic, demographic and geographic factors that influence a patient's decision to utilise healthcare services in Australia.

1.5 Key determinants of healthcare utilisation (review of the literature)

Healthcare utilisation occurs at the moment in the health system when a patient's healthcare needs are attended to by a medical professional. Even in a well-functioning healthcare system in a developed country such as Australia, there is sometimes a lack of required healthcare utilisation from subgroups of the population. Several theories and behavioural models have been developed to explain the predictors of healthcare utilisation. For example, the 'Health Belief Model' developed by Hochbaum et al. (1952), the 'Behavioural Model of Health Services Use' by Andersen (1968), the 'Theory of Planned Behaviour' by Ajzen and Fishbein (1980), 'Trans-theoretical Model' by Prochaska et al. (1992), and the 'Theory of Care-Seeking Behaviour' proposed by Lauver (1992). These models used both internal (e.g. attitude, perceived benefit, self-efficacy, health belief) and external (e.g. clinical, socioeconomic, organisational) factors to explain the healthcare utilisation decision of individuals with illness (Babitsch, Gohl & von Lengerke 2012; Lawal et al. 2017).

Empirical studies have identified various need related factors that explain the unequal utilisation of medical care. The most frequently researched aspects were age, gender, education status, race/ethnicity and marital status (called predisposing factors) along with some enabling factors such as income, private health insurance and availability of healthcare facilities (Babitsch et al. 2012).

1.5.1 Age

The relationship between a patient's age and utilisation of healthcare services is well-documented in the literature (Nabalamba & Millar 2007; Thode et al. 2005). Importantly, the direction of the relationship often varies significantly based on patient characteristics and the type of healthcare services examined. For example, younger patients showing a higher odds of using specialist consultations compared to older patients, who had higher odds of using hospital care (Blackwell et al. 2009; Harris et al. 2016; Nabalamba & Millar 2007).

1.5.2 Gender

A myriad of studies have concluded that women have a higher probability of GP visits and faster response to chronic disease symptoms than men. Hence, women are getting diagnosed at an earlier stage (Blackwell et al. 2009; Parslow et al. 2002), especially in developed countries (DeCola 2012). However, the findings (gender and healthcare utilisation nexus) might differ for women with specific ethnicities (Harris et al. 2016) or from lower socioeconomic backgrounds or lower-income countries (Roy & Chaudhuri 2008).

1.5.3 Ethnicity/race/nativity

Inequality in healthcare utilisation based on ethnicity and race were frequently reported in numerous studies (Andersen et al. 2002; Bastos et al. 2018; McKercher et al. 2017; Nabalamba & Millar 2007). Most of these studies concluded that there were significant differences. Moore et al. (2013) indicated that perception and mistrust of the health system along with anticipation and prior experience of discrimination might be associated with lower healthcare utilisation among some racial and ethnic subgroups.

1.5.4 Education

Literature investigating the link between education and healthcare utilisation often associates higher education with more visits to specialist care (Blackwell et al. 2009; Chen, Kazanjian & Wong 2008). Others have concluded that people from relatively lower

education background had more likelihood of not accessing necessary healthcare (Steele et al. 2007).

1.5.5 Location (urban/rural)

Place of residence is also a key determinant of healthcare utilisation. Residing in urban areas increases the probability of regular contact with doctors significantly (Thode et al. 2005), in particular for patients with chronic diseases. Smith (2012) found that rural and remote cancer patients face severe barriers to accessing and utilising needed care. Fox and Boyce (2014) and Leung, Martin and McLaughlin (2016) reported that delays in cancer diagnosis are associated with rurality. Others associated remoteness with lower utilisation of primary health care (McGrail & Humphreys 2015), preventive care services (Liu et al. 2016) and mental health care (Johnston 2015).

1.5.6 Marital status

Several studies have investigated the link between marital status and healthcare utilisation and the results are contradictory. Insaf, Jurkowski and Alomar (2010) concluded that unmarried women were likelier to delay care than married women in the USA and Parslow et al. (2002) found that married women had a higher probability of visiting a health practitioner in Australia. Others demonstrated that widowed and divorced people suffer from poor health status and use healthcare more (frequently hospitalised) than married patients (Joung, Van der Meer & Mackenbach 1995). On the contrary, marital status is also related to the utilisation of higher-quality hospitals and shorter length of stay (Iwashyna & Christakis 2003).

1.5.7 Income level or financial condition

Associations between income level and healthcare utilisation varies in empirical studies, based on types of healthcare utilisation measured. Van Doorslaer et al. (2008) concluded that higher income is significantly related to specialist care visits, whilst on the contrary, lower-income households are significantly more likely to make GP visits. Parslow et al. (2002) found that individuals who suffered from a financial problem in the last twelve months had higher GP visits. Recent studies showed that abstention or delay in seeking or using healthcare is associated with lower socioeconomic status in Australia (Van

Doorslaer et al. 2008; Buchmueller et al. 2013). Moreover, Schoen et al. (2000) reported that patients below the average income level had lower utilisation of care and were more unlikely to fill a prescription, due to cost. The Australian Bureau of Statistics (2019) in the 'Patient Experience Survey (2017-18)' concluded that people living in areas of most socioeconomically disadvantage had a higher probability of not receiving appropriate specialist care, twice as likely to have delayed or avoided getting prescribed medication or visiting a dentist due to cost (AIHW 2017). In another Australian study, it was concluded that participants from lower socioeconomic backgrounds reported lower follow-up diagnostic assessment rates and a longer median time between a positive screen and assessment, despite having a higher screening positivity rate (AIHW 2018b).

1.5.8 Health insurance status

Numerous empirical studies have found that having private health insurance increases the probability of accessing specialist care (Jones, Koolman & Van Doorslaer 2006) and reduced delay in seeking care (Parslow et al. 2002; Insaf et al. 2010) but a lower number of GP visits (Buchmueller et al. 2013). One of the key benefits of having private health insurance is timely access to elective hospital care (Buchmueller et al. 2013). However, some research argues that private health insurance creates inequality in healthcare access and utilisation (Jones et al. 2006) as high-income earners are most likely to purchase private health cover and experience shorter hospital waiting times, particularly for surgery.

1.5.9 Chronic disease condition

A number of empirical literature investigated whether chronic disease conditions significantly affect healthcare utilisation patterns. These studies looked into several chronic diseases such as diabetes, hypertension, heart disease, cancer, stroke, asthma, psychological distress and arthritis (Ani et al. 2008; Hammond et al. 2010; Huber et al. 2013; Insaf et al. 2010; Langton et al. 2016; Parslow et al. 2002). All of these studies concluded that chronic disease conditions significantly impact a patient's healthcare utilisation in both low-income and high-income countries, irrespective of the state of the healthcare system.

1.6 Gap in the literature

Past empirical studies were instrumental in developing the care-seeking behaviour model and examining the key determinants of healthcare utilisation in developed countries. However, some critical questions warrant further investigation. For example, it is well established in the literature that factors such as age, income, education, area of residence, chronic disease and private health insurance status are primary determinants of healthcare utilisation globally. Having said that, to develop an efficient and well-functioning healthcare system it is essential to realise, to what extent healthcare utilisation of an individual with a chronic disease (e.g. cancer) differs if they are from a high-income household compared to low-income, have a higher education level compared to being lesser-educated, at younger age compared to older age, lives in urban areas rather than rural areas and have access to private health insurance compared to no access. In addition, it is also important to understand whether problems such as psychological distress or financial distress impacts the healthcare utilisation decision of patients with chronic diseases. Finally, past studies also did not pay sufficient attention as to what extent gender characteristics of cancer patients influence the utilisation of healthcare services.

Previous studies investigating the variation in healthcare utilisation of cancer patients often focused on a single state (Cramb et al. 2017; Maxwell et al. 2014) or a particular type of cancer (Doran et al. 2015; Gordon et al. 2018). Others have concentrated on specific geographical areas with small subpopulations (Heath et al. 2006; Thaker et al. 2013). Several other significant studies have examined differences in cancer incidence and mortality among populations of diverse socioeconomic and demographic backgrounds (Anikeeva et al. 2012; Koh, Do & Barton 2008). However, no study has yet examined the healthcare utilisation pattern of cancer households in Australia based on their socioeconomic, demographic, and geographic status. Besides, the extent to which healthcare utilisation varies between cancer households and non-affected households is unknown.

Knowing that each health system and settings are different, it is essential to understand these issues with country-specific data. Australia has a health system which is unique, within developed or OECD countries. The government of Australia encourages its

residents to purchase private health insurance despite offering universal healthcare for all through Medicare. According to AIHW (2018a), in the financial year 2015–16, the Australian government spent $5.7 billion on the private health insurance rebate, which is an income-tested rebate to assist households to purchase private health insurance. It is of interest to examine whether there are heterogeneities in the healthcare utilisation of patients with private health insurance based on their socioeconomic, demographic and geographic characteristics. Previous studies related to private health insurance in Australia mainly focused on the factors determining the decision to buy private health insurance (Barros & Siciliani 2012; Buchmueller et al. 2013), the adverse selection problem (Barrett & Conlon 2003) and the impact of private health insurance on hospital care (Eldridge et al. 2017) and other medical treatments utilisation (Srivastava et al. 2017). Others have argued for (Buchmueller et al. 2013; Eldridge et al. 2017) and against (Frech III & Hopkins 2004; Podger 2016) the government policy of providing private health insurance rebates. Little is known regarding the degree of heterogeneity between the hospital and preventive care-seeking attitudes of patients with or without private health insurance cover. Moreover, it is still unclear what socioeconomic, geographic and demographic characteristics influence patients with private health insurance cover to access public hospitals as a public patient despite paying for and having the availability of private hospital care.

Finally, studies investigating the determinants of purchasing private health cover in Australia often argue that it is pro-rich, and it fosters unequal access to care. It is already known that income inequality impacts access to and utilisation of healthcare. Hence, an interesting question arises: does an unequal distribution of income also impact the decision to buy private health insurance in Australia? No previous studies have investigated how an unequal distribution of income in a region or an individual's position in the income distribution might impact the probability of purchasing private health cover and subsequently, healthcare use.

1.7 Research objectives and questions

The primary aim of this study is to investigate the care-seeking behaviour or healthcare utilisation of Australian patients based on their socioeconomic, demographic, and

geographic characteristics. In particular, this study explores the role of one particular disease (cancer) and private health insurance cover. In summary, the primary objectives of this thesis are to:

1. investigate the healthcare utilisation of Australian cancer patients.

2. conduct a systematic review to examine the gender differences in healthcare utilisation of lung cancer patients.

3. assess the factors associated with healthcare utilisation of patients with private health insurance in Australia.

4. study whether income inequality has an impact on variations in the private health insurance coverage rate across the regions of Australia.

To understand the determinants of the decisions to utilise healthcare, this study tested the following research questions:

Study 1:

1. What are the demographic, health-related and socioeconomic factors associated with healthcare utilisation of Australian cancer patients?

Study 2:

2. Whether there are gender-specific differences in healthcare-seeking and utilisation behaviour for lung cancer treatments, including the stage of diagnosis?

Study 3:

3. To what extent do the hospital care-seeking attitudes and use of secondary preventive and specialist care vary between public and patients with private health insurance cover?
4. What factors influence the choice of the type of hospital care (public vs private) among patients with private health insurance cover?
5. Does healthcare use differ significantly for a cohort of individuals before and after dropping private health insurance?
Study 4:

6. Is there a possibility that income inequality has a negative effect on private health insurance take-up rate and access to private healthcare?

1.8 Scope of the study

To analyse the aforementioned research questions, this study conducted three cross-sectional studies and one systematic literature review. Research papers 1 and 3 used data from the Household, Income, and Labour Dynamics in Australia (HILDA) survey. In the survey, respondents with cancer were identified with the following question: have you been diagnosed with any type of cancer? On the other hand, respondents with private health insurance cover were identified with the following question: apart from Medicare, are you currently covered by private health insurance?

Due to the unavailability of data in the survey, this study could not specify what type of cancer the respondents had. However, the survey data indicated that 94% of the respondents (diagnosed with cancer) were undergoing treatment for cancer in the previous 12 months before the survey. On the contrary, the survey provided detail information about what type (hospital only, ancillary care only or both) of private health cover respondents have purchased.

In terms of analysis of care-seeking decisions, this thesis focused on the utilisation, non-use and variation in utilisation of healthcare, rather than focusing on delay in seeking care. Healthcare utilisation was measured using the following variables; the number of doctor visits, specialist doctor visits (yes or no), visits to a mental health professional (yes or no) and the number of hospital admissions, and the number of nights in hospitals in the last 12 months before the survey. Additional measures such as hospital overnight admission type for patients with private health insurance included; i) public patient in a public hospital, ii) private patient in a public hospital and iii) private patient in the private hospital were also used. Finally, health screening (e.g. breast screening, prostate check, blood pressure test) were used to understand healthcare utilisation related to diagnosis pattern.

This study only measured the external (unwarranted) factors that influence the decision to use healthcare rather than intrinsic factors such as health beliefs, perceived benefit or mistrust or self-efficacy.

Lastly, due to the cross-sectional nature of the data, this study did not look into any reverse or simultaneous causality and did not attempt to estimate any causal relationship between the variables.

1.9 Conceptual framework

Among all the health behaviour theories, the 'Theory of Care-seeking Behaviour' (Lauver 1992) is most useful in developing a framework for understanding the psychosocial, clinical and facilitating factors that impact the care-seeking decisions of a patient (Byrne 2008). This study tested the validity of the theory for the Australian healthcare system while using cancer as a clinical factor and private health insurance as a facilitating factor. The aim is to investigate whether clinical and institutional factors impact the healthcare utilisation decision. Besides, several socioeconomic, demographic and geographic factors were also used in the analysis. Therefore, the interaction effects of clinical condition with other factors and the interaction effects of the facilitating condition with other factors were also examined. For example, the results of this study include, whether cancer patients' healthcare utilisation fluctuates significantly based on income, age, education, gender, marital status, private health insurance cover, rurality, psychological distress level and access to specialist care in Australia. Furthermore, along with analysing the PHI cover and healthcare use nexus, this study also looked into whether there are inequalities in healthcare utilisation behaviour between less affluent and higher-income households, younger and older patients, educated and relatively less educated households, men and women, households in urban areas and those in rural areas, for patients with PHI cover in Australia.

Finally, cancer has been chosen as a clinical factor because it is one of the deadliest diseases in Australia, with around 50,000 cancer-related deaths in 2017, and studies have observed socioeconomic disparities in cancer mortality in Australia. On the other hand, past studies showed that PHI holders have better access and utilisation of healthcare; however, it is also essential to identify healthcare disparities between patients with PHI based on other key factors, in a country that provides universal healthcare for all.

Figure 1.5 provides a basic description of the conceptual framework of this study. According to the health behaviour theories, healthcare utilisation is subject to the

perceived need for care and health expectations. Furthermore, a person's current health status directly influences his/her need for healthcare utilisation. As discussed in the previous sections, many factors influence an individual's health and subsequently, healthcare utilisation. Figure 1.5 outlines these factors as the health services-related factors, socioeconomic and demographic factors, lifestyle and psychological factors and lastly, biological and environmental factors. Lifestyle and biological factors influence the probability of chronic diseases incidence and chronic disease such as cancer (clinical factor) directly affects the health status and hence, impacts healthcare utilisation. On the other hand, a person's health status, surrounding health service-related factors and his/her socioeconomic characteristics might determine the purchasing decision of PHI. Furthermore, access to private health insurance (facilitating factor) increases access to necessary care, hence might influence overall healthcare utilisation. Finally, it assumes that the appropriate use of needed healthcare has a positive influence on health status.
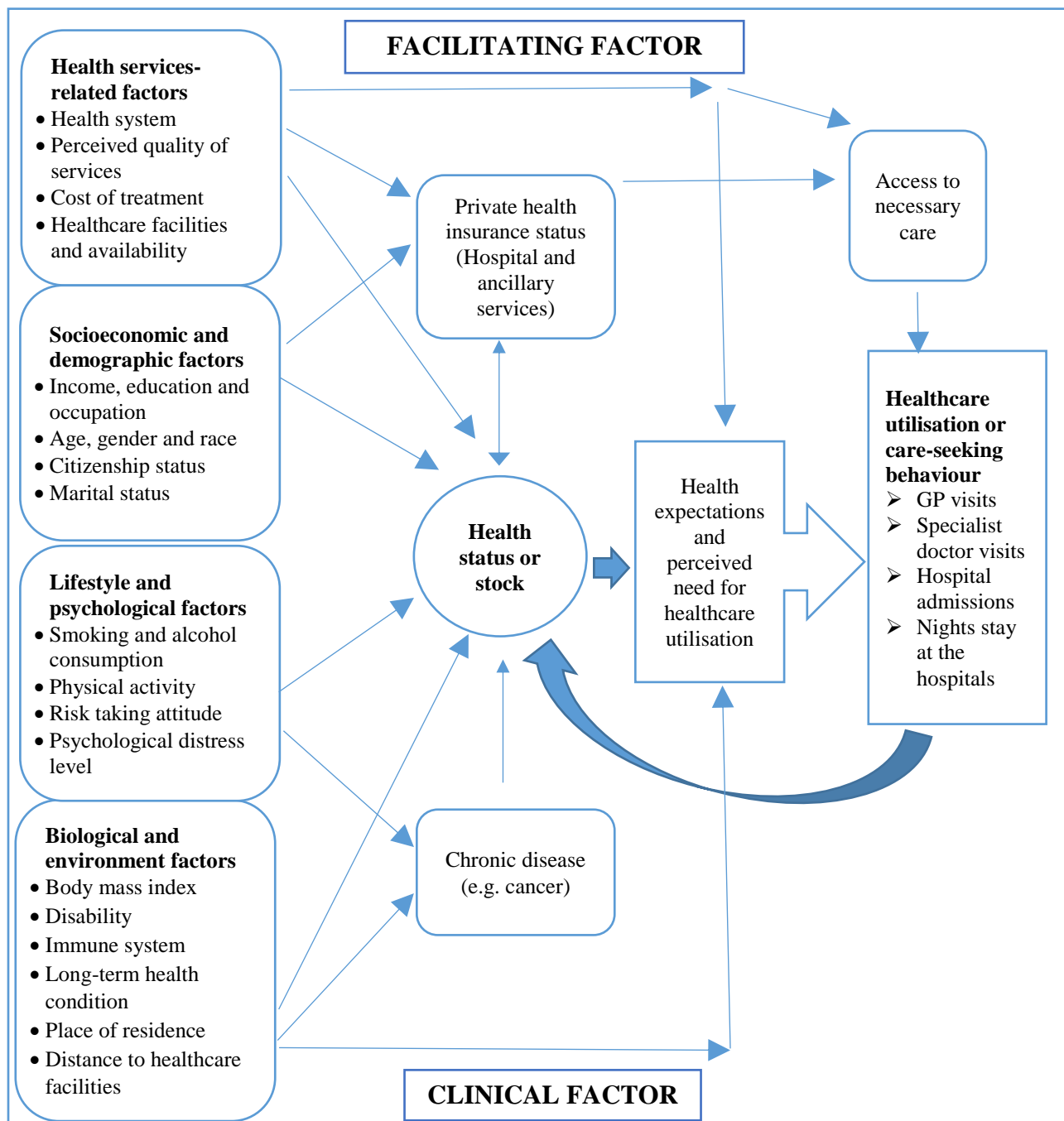
Figure 1.5 Conceptual framework for explaining the determinants of healthcare utilisation

1.10 Structure of the thesis

Chapter one describes the background of the study, the statement of the problem, the gap in the literature the thesis addresses, research objectives and questions, scope and the conceptual framework of the study.

Chapter two consists of research paper one which looked into the first research question. The title of the cross-sectional study using HILDA data is *"Predictors of healthcare utilisation in Australian cancer patients"*. This is a published article in the 'Cancer Management and Research' journal.

Chapter three contains the sole systematic literature review of this thesis. This paper deals with the second research question of this thesis. The title of the article is *"Gender-specific differences in care-seeking behaviour among lung cancer patients: a systematic review"*. This article is currently under-review in the '*Journal of Cancer Research and Clinical Oncology*.

Chapter four contains research paper three, with the title *"Selection of private or public hospital care: examining the care-seeking behaviour of patients with private health insurance"*. This cross-sectional study using HILDA data is currently under-review in the '*BMC Health Services Research*' journal. This study was also presented in the recently held International Health Economics Association (iHEA) conference 2019 in Basel, Switzerland.

Chapter five incorporates paper four, which used data from the Australian Bureau of Statistics (data by region). The title of the article is "*The impact of income inequality on private health insurance coverage: a comparison between different regions of Australia"*. This study is also cross-sectional in nature and is currently under-review in the 'Rural and Remote Health' journal.

Chapter six contains the overall conclusion of the study.

References

1. ACSQH 2015, *Australian commission on safety and quality in healthcare: Entity resources and planned performance,* Canberra, viewed 12 June 2019, <https://www1.health.gov.au/internet/budget/publishing.nsf/Content/2017-2018_Health_PBS_sup2/$File/2017-18_Health_PBS_4.02_ACSQHC.pdf>.

2. Australian Competition and Consumer Commission 2018, *Report to the Australian Senate- On anti-competitive and other practices by health insurers and providers in relation to private health insurance*, Commonwealth of Australia, Canberra, viewed 12 November 2019, <https://www.accc.gov.au/system/files/1494_Private-Health-Insurance.pdf>.

3. Australian Institute of Health and Welfare 2014, *Australia's health 2014: Australia's health series no. 14*, AIHW , Canberra, viewed 12 June 2019, <http://www.aihw.gov.au/WorkArea/DownloadAsset .aspx?id=60129548150>.

4. Australian Institute of Health and Welfare 2017, *Potentially preventable hospitalisations 2015-16*, AIHW, Canberra, viewed 14 June 2019, <https://www.aihw.gov.au/reports/hospitals/potentially-preventable-hospitalisations-2015-16/contents/summary>.

5. Australian Institute of Health and Welfare 2018a, *Private health insurance expenditure 2015–16,* AIHW , Canberra, viewed 14 June 2019, <https://www.aihw.gov.au/getmedia/08320d6a-4ceb-4c75-a16b-aa1a4c9f6d15/aihw-20592-private-health-insurance-expenditure.pdf.aspx>.

6. Australian Institute of Health and Welfare 2018b, *Emergency Department Care 2017–18: Australian Hospital Statistics*, Health services series 2018, AIHW, Canberra, viewed 14 April 2019, <https://www.aihw.gov.au/getmedia/9ca4c770-3c3b-42fe-b071-3d758711c23a/aihw-hse-216.pdf.aspx?inline=true>.

7. Australian Institute of Health and Welfare 2017, *Private health insurance use in Australian hospitals, 2006–07 to 2015–16: Australian hospital statistics*, Health Services Series no. 81. Cat. no. HSE 196, Canberra, AIHW, viewed 16 November 2019,<https://www.aihw.gov.au/getmedia/f95e7fc9-db3f-4e7e-a5f5-38f2f69cd539/aihw-hse-196.pdf.aspx?inline=true>.

8. Australian Institute of Health and Welfare 2018, *Health expenditure Australia 2016-17, Health and welfare expenditure series no. 64. Cat. no. HWE 74*, Health and welfare expenditure series no. 64. Cat. no. HWE 74, AIHW, Canberra.

9. Australian Institute of Health and Welfare 2019, Hospital resources 2017-18: Australian hospital statistics, Cat. No: HSE 233, Canberra, AIHW, viewed 20 November 2019 < https://www.aihw.gov.au/reports/hospitals/hospital-resources-2017-18-ahs/data>

10. Australian Prudential Regulation Authority 2018, *Private health insurance membership and coverage september 2018* The Australian Prudential Regulation Authority, Canberra, viewed 16 November 2019, <https://www.apra.gov.au/publications/private-health-insurance-membership-and-coverage>.

11. Ajzen, I & Fishbein, M 1980, *Understanding Attitudes and Predicting Social Behavior*, Prentice-Hall, Englewood Cliffs, NJ.

12. Andersen, R 1968, *A behavioral model of families' use of health services*, Center for Health Administration Studies, University of Chicago, Chicago, IL.

13. Andersen, RM, Yu, H, Wyn, R, Davidson, PL, Brown, ER & Teleki, S 2002, 'Access to medical care for low-income persons: how do communities make a difference?', *Medical Care Research and Review*, vol. 59, no. 4, pp. 384-411.

14. Anderson, JG 1973, 'Health services utilization: framework and review', *Health Services Research*, vol. 8, no. 3, pp. 184-99.

15. Ani, C, Bazargan, M, Bazargan-Hejazi, S, Andersen, RM, Hindman, DW & Baker, RS 2008, 'Correlates of self-diagnosis of chronic medical and mental health conditions in under-served African American and Latino populations', *Ethnicity & Disease*, vol. 18, no. 2, pp. 105-11.

16. Anikeeva, O, Bi, P, Hiller, JE, Ryan, P, Roder, D & Han, G-S 2012, 'Trends in cancer mortality rates among migrants in Australia: 1981–2007', *Cancer Epidemiology*, vol. 36, no. 2, pp. e74-e82.

17. Australian Bureau of Statistics 2019, *Patient experiences in Australia: summary of findings, 2017-18,* Canberra, viewed 6 June 2019, <https://www.abs.gov.au/ausstats/abs@.nsf/mf/4839.0>.

18. Babitsch, B, Gohl, D & von Lengerke, T 2012, 'Re-revisiting Andersen's Behavioral Model of Health Services Use: a systematic review of studies from 1998–2011', *GMS Psycho-Social-Medicine*, vol. 9, pp. 1-15.

19. Barrett, GF & Conlon, R 2003, 'Adverse selection and the decline in private health insurance coverage in Australia: 1989–95', *Economic Record*, vol. 79, no. 246, pp. 279-96.

20. Barros, PP & Siciliani, L 2012, 'Public and private sector interface', in MV Pauly, et al. (eds), *Handbook of Health Economics*, Elsevier, vol. 2, ch 15, pp. 927-1001.

21. Bastos, JL, Harnois, CE & Paradies, YC 2018, 'Health care barriers, racism, and intersectionality in Australia', *Social Science & Medicine*, vol. 199, pp. 209-18.

22. Blackwell, DL, Martinez, ME, Gentleman, JF, Sanmartin, C & Berthelot, JM 2009, 'Socioeconomic status and utilization of health care services in Canada and the United States: findings from a binational health survey', *Medical Care*, vol. 47, no. 11, pp. 1136-46.

23. Buchmueller, TC, Fiebig, DG, Jones, G & Savage, E 2013, 'Preference heterogeneity and selection in private health insurance: the case of Australia', *Journal of Health Economics*, vol. 32, no. 5, pp. 757-67.

24. Byrne, SK 2008, 'Healthcare avoidance: a critical review', *Holistic Nursing Practice*, vol. 22, no. 5, pp. 280-92.

25. Calder, R, Dunkin, R, Rochford, C & Nichols, T 2019, Australian health services: too complex to navigate. A review of the national reviews of Australia's health service arrangements, Policy Issues Paper No. 1-2019, the Australian health policy collaboration with Victoria University, viewed 20 July 2019, <https://www.vu.edu.au/sites/default/files/australian-health-services-too-complex-to-navigate.pdf>

26. Chen, AW, Kazanjian, A & Wong, H 2008, 'Determinants of mental health consultations among recent Chinese immigrants in British Columbia, Canada: implications for mental health risk and access to services', *Journal of Immigrant and Minority Health*, vol. 10, no. 6, pp. 529-40.

27. Cheng, TC 2014, 'Measuring the effects of reducing subsidies for private insurance on public expenditure for health care', *Journal of Health Economics*, vol. 33, pp. 159-79.

28. Cornally, N & McCarthy, G 2011, 'Help-seeking behaviour: a concept analysis', *International Journal of Nursing Practice*, vol. 17, no. 3, pp. 280-8.

29. Cramb, SM, Moraga, P, Mengersen, KL & Baade, PD 2017, 'Spatial variation in cancer incidence and survival over time across Queensland, Australia', *Spatial and Spatio-Temporal Epidemiology*, vol. 23, pp. 59-67.

30. DeCola, PR 2012, 'Gender effects on health and healthcare', in *Handbook of Clinical Gender Medicine*, Karger Publishers, Basel, pp. 10-7.

31. Dixit, SK & Sambasivan, M 2018, 'A review of the Australian healthcare system: a policy perspective', *SAGE Open Medicine*, vol. 6, pp.1-14.

32. Donabedian, A 1972, 'Models for organizing the delivery of personal health services and criteria for evaluating them', *The Milbank Memorial Fund Quarterly*, vol. 50, no. 4, pp. 103-54.

33. Doran, CM, Ling, R, Byrnes, J, Crane, M, Searles, A, Perez, D & Shakeshaft, A 2015, 'Estimating the economic costs of skin cancer in New South Wales, Australia', *BMC Public Health*, vol. 15, no. 1, pp. 952-68.

34. Dubayova, T, van Dijk, JP, Nagyova, I, Rosenberger, J, Havlikova, E, Gdovinova, Z, Middel, B & Groothoff, JW 2010, 'The impact of the intensity of fear on patient's delay regarding health care seeking behavior: a systematic review', *International Journal of Public Health*, vol. 55, no. 5, pp. 459-68.

35. Duckett, S & Willcox, S 2015, *The Australian Health Care System*, 5th edn, Oxford University Press, Melbourne, VIC.

36. Eldridge, DS, Onur, I & Velamuri, M 2017, 'The impact of private hospital insurance on the utilization of hospital care in Australia', *Applied Economics*, vol. 49, no. 1, pp. 78-95.

37. Ellis, RP & Savage, E 2008, 'Run for cover now or later? The impact of premiums, threats and deadlines on private health insurance in Australia', *International Journal of Health Care Finance & Economics*, vol. 8, no. 4, pp. 257-77.

38. Fisher, ES, Wennberg, JE, Stukel, TA, Skinner, JS, Sharp, SM, Freeman, JL & Gittelsohn, AM 2000, 'Associations among hospital capacity, utilization, and mortality of US Medicare beneficiaries, controlling for sociodemographic factors', *Health Services Research*, vol. 34, no. 6, p. 1351-62.

39. Fisher, M, Baum, FE, MacDougall, C, Newman, L & McDermott, D 2016, 'To what extent do Australian health policy documents address social determinants of health and health equity?', *Journal of Social Policy*, vol. 45, no. 3, pp. 545-64.

40. Fox, P & Boyce, A 2014, 'Cancer health inequality persists in regional and remote Australia', *Medical Journal of Australia*, vol. 201, no. 8, pp. 445-6.

41. Frech III, H & Hopkins, S 2004, 'Why subsidise private health insurance?', *Australian Economic Review*, vol. 37, no. 3, pp. 243-56.

42. Gordon, LG, Tuffaha, HW, James, R, Keller, AT, Lowe, A, Scuffham, PA & Gardiner, RA 2018, 'Estimating the healthcare costs of treating prostate cancer in Australia: a Markov modelling analysis', in *Urologic Oncology: Seminars and Original Investigations*, Elsevier, pp. 91. e7-. e15.

43. Hall, J 2015, 'Australian health care: The challenge of reform in a fragmented system', *The New England Journal of Medicine*, vol. 373, no. 6, pp. 493-7.

44. Hammond, WP, Matthews, D & Corbie-Smith, G 2010, 'Psychosocial factors associated with routine health examination scheduling and receipt among African American men', *Journal of the National Medical Association*, vol. 102, no. 4, pp. 276-89.

45. Harris, K, Burley, H, McLachlan, R, Bowman, M, Macaldowie, A, Taylor, K, Chapman, M & Chambers, GM 2016, 'Socioeconomic disparities in access to assisted reproductive technologies in Australia', *Reproductive Biomedicine Online*, vol. 33, no. 5, pp. 575-84.

46. Heath, JA, Lintuuran, RM, Rigguto, G, Tikotlian, N & McCarthy, M 2006, 'Childhood cancer: its impact and financial costs for Australian families', *Pediatric Hematology and Oncology*, vol. 23, no. 5, pp. 439-48.

47. Hochbaum, G, Rosenstock, I & Kegels, S 1952, 'Health belief model', *United States Public Health Service*, USA, viewd 7 January 2019,

<http://www.infosihat.gov.my/infosihat/artikelHP/bahanrujukan/E_AN_TEOR I/DOC/Health%20Belief%20Model.doc>

48. Huber, CA, Schneeweiss, S, Signorell, A & Reich, O 2013, 'Improved prediction of medical expenditures and health care utilization using an updated chronic disease score and claims data', *Journal of Clinical Epidemiology*, vol. 66, no. 10, pp. 1118-27.

49. Insaf, TZ, Jurkowski, JM & Alomar, L 2010, 'Sociocultural factors influencing delay in seeking routine health care among Latinas: a community-based participatory research study', *Ethnicity and Disease*, vol. 20, no. 2, pp. 148-54.

50. Iwashyna, TJ & Christakis, NA 2003, 'Marriage, widowhood, and health-care use', *Social Science & Medicine*, vol. 57, no. 11, pp. 2137-47.

51. Johnston, NE 2015, 'Delays in accessing electroconvulsive therapy: a comparison between two urban and two rural populations in Australia', *Australasian Psychiatry*, vol. 23, no. 5, pp. 566-70.

52. Jones, AM, Koolman, X & Van Doorslaer, E 2006, 'The impact of having supplementary private health insurance on the use of specialists', *Annales d'Economie et de Statistique*, no. 83/84, pp. 251-75.

53. Joung, I, Van der Meer, J & Mackenbach, J 1995, 'Marital status and health care utilization', *International Journal of Epidemiology*, vol. 24, no. 3, pp. 569-75.

54. Koh, E, Do, V & Barton, M 2008, 'Frontiers of cancer care in Asia-Pacific region: cancer care in Australia', *Biomedical Imaging and Intervention Journal*, vol. 4, no. 3, pp.1-15

55. Langton, JM, Reeve, R, Srasuebkul, P, Haas, M, Viney, R, Currow, D & Pearson, SA 2016, 'Health service use and costs in the last 6 months of life in elderly decedents with a history of cancer: a comprehensive analysis from a health payer perspective', *British Journal of Cancer*, vol. 114, no. 11, p. 1293-308.

56. Lauver, D 1992, 'A theory of care-seeking behavior', *Image: the Journal of Nursing Scholarship*, vol. 24, no. 4, pp. 281-8.

57. Lauver, DR, Ward, SE, Heidrich, SM, Keller, ML, Bowers, BJ, Brennan, PF, Kirchhoff, KT & Wells, TJ 2002, 'Patient-centered interventions', *Research in Nursing & Health*, vol. 25, no. 4, pp. 246-55.

58. Lawal, O, Murphy, F, Hogg, P & Nightingale, J 2017, 'Health behavioural theories and their application to women's participation in mammography screening', *Journal of Medical Imaging and Radiation Sciences*, vol. 48, no. 2, pp. 122-7.

59. Leung, J, Martin, J & McLaughlin, D 2016, 'Rural–urban disparities in stage of breast cancer at diagnosis in Australian women', *Australian Journal of Rural Health*, vol. 24, no. 5, pp. 326-32.

60. Liu, X, Li, N, Liu, C, Ren, X, Liu, D, Gao, B & Liu, Y 2016, 'Urban–rural disparity in utilization of preventive care services in China', *Medicine*, vol. 95, no. 37, pp.1-7.

61. Macri, J 2016, 'Australia's health system: some issues and challenges', *Journal of Health & Medical Economics*, vol. 2, no. 2, pp. 1-3.

62. Maxwell, S, O'Leary, P, Slevin, T & Moorin, R 2014, 'The increase in cancer prevalence and hospital burden in Western Australia, 1992–2011', *Population Health Metrics*, vol. 12, no. 1, pp. 33-46.

63. McGrail, MR & Humphreys, JS 2015, 'Spatial access disparities to primary health care in rural and remote Australia', *Geospatial Health*, vol. 10, no. 358, pp. 138-43.

64. McKercher, C, Jose, MD, Grace, B, Clayton, PA & Walter, M 2017, 'Gender differences in the dialysis treatment of Indigenous and non-Indigenous Australians', *Australian and New Zealand Journal of Public Health*, vol. 41, no. 1, pp. 15-20.

65. Moore, AD, Hamilton, JB, Knafl, GJ, Godley, P, Carpenter, WR, Bensen, JT, Mohler, JL & Mishel, M 2013, 'The influence of mistrust, racism, religious participation, and access to care on patient satisfaction for African American men: the North Carolina-Louisiana Prostate Cancer Project', *Journal of the National Medical Association*, vol. 105, no. 1, pp. 59-68.

66. Nabalamba, A & Millar, WJ 2007, 'Going to the doctor', *Health Reports-Statistics Canada*, vol. 18, no. 1, pp. 23.

67. OECD 2019, *Organisation for Economic Co-operation and Development health statitics*, Paris, viewed 28 July 2019, <https://www.oecd.org/health/health-data.htm>.

68. Osborn, R & Schoen, C 2013, *The commonwealth fund 2013 international health policy survey in eleven countries*, Canberra, viewed 10 June 2019, <http://www.commonwealthfund.org/~/media/files/publications/in-the-literature/2013/nov/pdf_schoen_2013_ihp_survey_chartpack_final.pdf>.

69. Parslow, R, Jorm, A, Christensen, H & Jacomb, P 2002, 'Factors associated with young adults' obtaining general practitioner services', *Australian Health Review*, vol. 25, no. 6, pp. 109-18.

70. Podger, A 2016, 'Federalism and Australia's national health and health insurance system', *Asia Pacific Journal of Health Management*, vol. 11, no. 3, pp. 26-34.

71. Private Health Care Australia 2017, Value and affordability of private health insurance and out-of-pocket medical costs private health care australia, Canberra, viewed on 15 November 2019, <https://www.aph.gov.au/Parliamentary_Business/Committees/Senate/Community_Affairs/Privatehealthinsurance/Report>

72. Prochaska, JO, DiClemente, CC & Norcross, JC 1992, 'In search of how people change: applications to addictive behaviors', *American Psychologist*, vol. 47, no. 9, pp. 1102-15.

73. Reeve, R, Srasuebkul, P, Langton, JM, Haas, M, Viney, R & Pearson, S-A 2018, 'Health care use and costs at the end of life: a comparison of elderly Australian decedents with and without a cancer history', *BMC Palliative Care*, vol. 17, no. 1, pp. 1-12.

74. Roy, K & Chaudhuri, A 2008, 'Influence of socioeconomic status, wealth and financial empowerment on gender differences in health and healthcare utilization in later life: evidence from India', *Social Science & Medicine*, vol. 66, no. 9, pp. 1951-62.

75. Schoen, C, Davis, K, DesRoches, C, Donelan, K & Blendon, R 2000, 'Health insurance markets and income inequality: findings from an international health policy survey', *Health Policy*, vol. 51, no. 2, pp. 67-85.

76. Smith, T 2012, 'A long way from home: access to cancer care for rural Australians', *Radiography*, vol. 18, no. 1, pp. 38-42.

77. Srivastava, D 2014, 'Geographic variations in health care: what do we know and what can be done to improve health system performance?', *OECD Health Policy Studies*, Paris, viewed 25 January 2019, <http://dx.doi.org/10.1787/9789264216594-en>.

78. Srivastava, P, Chen, G & Harris, A 2017, 'Oral health, dental insurance and dental service use in Australia', *Health Economics*, vol. 26, no. 1, pp. 35-53.

79. Steele, LS, Dewa, CS, Lin, E & Lee, KL 2007, 'Education level, income level and mental health services use in Canada: associations and policy implications', *Healthcare Policy*, vol. 3, no. 1, p. 96-109.

80. Colombo, F & Tapay, N 2004, 'Private health insurance in OECD countries: the benefits and costs for individuals and health systems', *Towards high-performing health systems: Policy studies*-ISBN 92-64-01559, Paris, pp. 265-319, viewed 5 April 2018, <https://www.oecd.org/els/health-systems/33698043.pdf>

81. Thaker, DA, Monypenny, R, Olver, I & Sabesan, S 2013, 'Cost savings from a telemedicine model of care in northern Queensland, Australia', *Medical Journal Australia*, vol. 199, no. 6, pp. 414-7.

82. Thode, N, Bergmann, E, Kamtsiuris, P & Kurth, B 2005, 'Predictors for ambulatory medical care utilization in Germany', *Bundesgesundheitsblatt, Gesundheitsforschung, Gesundheitsschutz*, vol. 48, no. 3, pp. 296-306.

83. Tipping, G & Segall, M 1995, *Health care seeking behaviour in developing countries. An annotated bibliography and literature review*, Institute of Development Studies, University of Sussex, UK.

84. Turrell, G, Stanley, L, De Looper, M & Oldenburg, BF 2006, *Health inequalities in Australia: morbidity, health behaviours, risk factors and health service use*, Queensland University of Technology and the Australian Institute of Health and Welfare, Canberra.

85. Van Doorslaer, E, Clarke, P, Savage, E & Hall, J 2008, 'Horizontal inequities in Australia's mixed public/private health care system', *Health Policy*, vol. 86, no. 1, pp. 97-108.

86. Willis, E & Parry, Y 2016, 'The Australian health care system', in E Willis, et al. (eds), *Understanding the Australian Health Care System.*, Elsevier, Chatswood, NSW, Australia, pp. 232-77.

CHAPTER 2

CHAPTER 2: **Introductory note: Relationship between Chapter 1 and Chapter 2**

Chapter 1 provided a background of the thesis, along with the research objective and research questions. Chapter 2 addresses a specific gap identified in Chapter 1: that the extent to which chronic diseases such as cancer impact healthcare utilisation in Australia and whether there are unwarranted variations in healthcare utilisation based on the socioeconomic, demographic and geographic background of the cancer patient. Chapter 2 includes Paper 1, which is published in the 'Cancer Management and Research' journal.

One of the requirements of the journal was to use the "American style of English'. Some minor modifications have been conducted, such as the original page numbers of the published paper were removed.

Cancer Management and Research

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ORIGINAL RESEARCH

Predictors of health care use in Australian cancer patients

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Abstract

Objective: The purpose of this study is to measure health care utilization in Australian cancer patients based on their demographic, geographic and socioeconomic backgrounds.

Method: A total of 13,609 participants (aged 15 and over) from 7,230 households were interviewed as part of Wave 13 of the national Household, Income and Labour Dynamics in Australia (HILDA) survey. Five hundred and seventeen participants indicated a current cancer diagnosis with 90% of those receiving active treatment at the time of interview. Independent sample t-tests, Pearson Chi-sq tests, Kruskal–Wallis H test, binary logistic regression and a zero-inflated Poisson regression were used to examine inequality in health care use.

Results: Demographic and sociocultural factors such as advancing age, gender, low income, low education status, rurality, no private health insurance, increased psychological distress and less access to specialist care are associated with lower health care utilization among cancer patients. However, models of care such as general practitioner-led cancer care is preferable in younger individuals with cancer, while accessing specialist care is associated with lower rates of hospitalization and higher levels of psychological distress increases hospital length of stay.

Conclusions: The findings of lower health care utilization by those cancer patients with characteristics of disadvantage have implications for policy development and intervention design. Broadly, policies targeting structural social inequities are likely to increase health care utilization among the most affected/disadvantaged populations. Further investigation is needed to identify potential links between health care utilization and cancer outcomes as a step toward targeted interventions for improving outcomes in the adversely affected groups.

Keywords: cancer, health care utilization, primary preventive care, inequality, psychological distress, HILDA.

Introduction

In 2018, there were approximately 18.1 million new diagnoses of cancer and the disease was responsible for an estimated 9.6 million deaths globally.[1] For Australia, the incidence of new cancer cases has more than doubled since 1982 with an estimated 50,000 cancer-related deaths in 2017.[2] Although overall cancer survival rates have improved by 20% from 1984 to 2013 in Australia, 13% of premature cancer deaths were related to socioeconomic disparities between 2004 and 2008.[3,4] Cancer is now a leading cause of illness and death in Australia, with 1 in 3 Australians dying from the disease.[3]

With the incidence of cancer increasing, so too is cancer-related health care utilization which is defined as "an individual's use of health care to prevent and/or cure health conditions, promote and sustain good health, and get professional

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information about one's health status and/or prognosis".[5] Health care utilization among cancer patients in Australia is extensive with approximately 10% of all hospitalizations being cancer-related with an average length of stay of 7.8 days in 2014–2015.[3] Cancer-related hospital bed days have also increased between 70% and 80% over the period from 1998 to 2011.[6] For palliative cancer care, health care utilization and costs also factor with increased presentations to emergency, admission to hospital and intensive care admission in the last 30 days of life.[7] Moreover, the cost of health care utilization often extends beyond direct costs to the system and onto individuals, even despite Australia's universal health care coverage. Financial distress is increasingly a factor for individuals living with cancer in Australia with moderate to extreme financial burden caused by out-of-pocket expenditure reported in over one-third (34%) of patients in a 2016 study.[8] This issue has gained considerable political attention in the 2019 Australian Federal election campaign with the opposition promising a $A2.4 billion package to address excessive out-of-pocket expenses for those with cancer.

In this context, the economic impact of cancer is considerable[9] with the cost of cancer care estimated to increase significantly to $7.8 billion by 2022–2023 in Australia.[10] Despite funding allocations growing alongside the demand for health care, resourcing cancer care is complex as cancer incidence and outcomes can vary based on socioeconomic factors such as age, place of residence and income status.[3,11,12] Worldwide, health care utilization in cancer patients has been predicted by demographic factors such as rurality,[4,6,13] cancer type[14–16] and socioeconomic status.[17,18] However, the burden of cancer often falls most heavily on disadvantaged populations with a 2016 study concluding that 13% of premature cancer deaths were related to socioeconomic disparities in the period from 2004 to 2008.[4]

Resourcing health care utilization in the context of substantial variations in health care utilization and cancer outcomes are therefore dependent on identifying and responding to a range of cancer-related demographic and socioeconomic factors as well as health service availability.[19] As more people are diagnosed with cancer in Australia and as treatment costs increase,[10] understanding the care-seeking behavior of cancer patients is necessary to develop in-context solutions for efficient policy-level change and service-level interventions.[16,20] Henceforth, local data is necessary to identify the predictors of health care utilization. The aim of this study is to address this gap and answer the question: "what are the demographic, health-related and socioeconomic

factors associated with health care utilization of Australian cancer patients?"

Materials and methods
Data source and study sample

A total of 13,609 (aged 15 and over) participants from 7,230 households were interviewed as part of Wave 13 (year, 2013) of the Household, Income and Labour Dynamics in Australia (HILDA) annual survey.[21] This nationally representative longitudinal survey is conducted each year since 2001 by the "Melbourne Institute of Applied Economic and Social Research" and accessible via the "Australian Data Archive".[22] Data are available for approved users from the Department of Social Services, Government of Australia. The survey was carried out in accordance with the ethical guidelines approved by the University of Melbourne.[23] Henceforth, additional ethical approvals were not required for the current study.

Affected households were identified by a specific survey question that asked whether anyone within a family was diagnosed with any type of cancer. A total of 7,859 respondents replied to the question and with the remainder being missing values due to nonresponse to the question. Five hundred and seventeen persons answered in the affirmative and 7,342 persons responded negatively. Approximately 6.6% (517 out of 7,859) of HILDA participants in Wave 13 were diagnosed with cancer with the majority (90%) of those currently undergoing cancer treatment.

Outcome variables

Health care utilization was measured using the following variables:

- the number of doctor visits (family doctor or general practitioner [GP from hereon]),
- the number of hospital admissions (overnight stay),
- the number of nights at the hospital (total nights' stay or hospital length of stay),
- hospital doctor visits (outpatient or casualty; yes or no),
- specialist doctor visits (excluding hospital outpatients or casualty; yes or no),
- visits to a mental health professional (during the last 12 months; yes or no).

These individual-level data were collected from each participant. In the regression model, the outcome variable, namely, doctor visits, is denoted by a value of 1 if the patient

visited doctors 10 times or more and 0 otherwise (0–9 visits) and for hospital admission, a value of 0 means no hospital admissions and 1 otherwise (visited at least once).

Independent variables

Annual household disposable income (four quartiles) was used as the primary predictor variable in the regression analysis. Households in quartile 1 have incomes of $54,028 or less, quartile 2 between $54,029 to $85,929, quartile 3 between $85,930 to $124,425 and quartile 4 income was more than $124,425. Several other variables were used as explanatory variables. A dummy variable was generated for education level (1= Education level ≤ high school, and 0 otherwise). The survey contained questions on body mass index (BMI) level (<18.5=1, 18.5–24.9=2, 25–29.9=3, ≥30=4), level of psychological distress (depressed) level (1= most times, 2= sometimes, 3= a little, 4= never), Kessler psychological distress scale (K10) risk categories (1= low, 2= moderate, 3= high, 4= very high), private health insurance status and government health care card (yes=1 and 0 otherwise) and area of residence (urban, 1 and 0 otherwise). Urban and rural areas were defined based on the Australian geographical classification,[24] whereby urban means people living in areas classified as major urban and other urban and rural included localities outside the major urban centers. Another dummy variable was used to assess whether the respondents were born in Australia (=1) or otherwise (=0). Other individual characteristics entered into the regression analysis as control variables were gender (male= 1, female=0), marital status (married= 1, 0 otherwise), age (1= age 19–44, 2= age 45–65, 3= age ≥65), smoking frequency (1= non-smoker, 2= occasional, 3= regular), physical activity (1= less than once, 2=1–3 times, 3= more than 3 times) per week and self-assessed health (1= excellent, 2= very good, 3= good, 4= fair, 5= poor). Financial distress was measured with the respondent's answer to the question "major worsening of finances" (e.g. went bankrupt) in the past twelve months (1=yes and 0= no). Lastly, a dummy variable for the presence of any long-term health condition (impairment or disability to perform everyday activities) was created. A cross-tabulation analysis indicated that this variable (dummy variable of 1= yes, and 0 otherwise) is highly correlated with health care utilization of households. Explanatory variables selected for inclusion were adapted from the literature.[25–27]

Statistical analysis

To determine the factors influencing health care use, this paper applied an explanatory model building approach to implement a multivariate binary logistic and a zero-inflated Poisson regression. Initially, independent sample T-tests and Pearson Chi-square tests were conducted to examine the mean difference in health care utilization of cancer patients based on their demographic and socioeconomic characteristics. The types of tests employed varied based on the characteristics of the response variable. In addition, the Kruskal–Wallis H test (one-way ANOVA on ranks) was used for independent variables with more than two independent groups (income, age and psychological distress level). For the principal outcome variables (number of doctor visits and nights at the hospital), two-part regression models were applied,[26,28,29] which can account for a large number of zero values.[28] The first part of the analysis included a binary logit regression model (multivariate) to estimate the probability of health care use of participants with cancer. Logistic regression is a well-recognised analysis tool and is regularly used for binary response data in a variety of applications including health care.[30,31] In the second part, the zero-inflated Poisson model (multivariate) was used to account for count data that has a large number of zero counts in key dependent variables. The possible values of the variables, number of doctor visits and hospital admissions include non-negative integers such as 0, 1, 2, 3 and so on. For this test, regression coefficients are estimated with the maximum likelihood method. The detailed methodology of the zero-inflated Poisson model is available in several studies.[32–34] Both of these regression equations included several covariates. SPSS statistical software (Version 23.0; IBM Corp, Armonk, NY) and Stata software (Version 14.0) were used to perform all statistical analysis.

Results
Participant demographics

The descriptive analysis illustrates the demographic and socioeconomic characteristics of the two groups. The sample of respondents with cancer (N=517) were further divided based on gender, country of birth, age, education level, area of residence, level of psychological distress, self-assessed health, doctor visits and health check-ups (Table 1).

Evidently as seen in Table 1, more than half (61.7%) of people living with cancer in the HILDA data (Wave 13) reside in major cities and greater than half (51.6%) of cancer households were from the lowest income quartile. Of the 517 respondents with cancer, 81.1% were born in Australia, 43.7% had an education level beyond high school graduation, and 43.3% were

Table 1 Demographic characteristics of Household, Income and Labour Dynamics in Australia survey participants (%)

Variables	No cancer	Cancer	Variables	No cancer	Cancer
Remoteness area	N=7342	N=517	Annual income*	N=6713	N=517
Major city	59.8	61.7	Q1 Bottom quartile	38.9	51.6
Inner regional	26.5	24.8	Q2 Second quartile	22.8	15.9
Outer regional	12.2	12.0	Q3 Third quartile	19.3	15.1
Remote, very remote	1.3	1.4	Q4 Top quartile	19.0	17.4
	0.2	0.2			
Birth place*	N=7342	N=512	Private health insurance cover	N=7342	N=517
Born in Australia	77.4	81.1			
Foreign born	22.6	18.9	Yes	53.1	58.4
Age	N=7342	N=517	Marital status	N=7342	N=517
19–44	33.8	11.0	Married	49.3	58.6
45–64	38.6	40.2	Residence area*	N=6713	N=517
65 or more	27.6	48.7	Urban	83.9	85.1
Education	N=7342	N=517	Gender*	N=6713	N=517
≤ High school	50.9	56.3	Female	57.3	43.3
> High school	49.1	43.7	Self-assessed health*	N=6497	N=460
PDS (psychological distress)*	N=6494	N=461	Excellent	4.8	4.3
			Very good	27.1	19.3
Low	56.1	63.3	Good	40.4	36.7
Moderate	21.8	19.3	Fair	22.3	26.7
High	13.4	10.8	Poor	5.4	12.8
Very high	8.7	6.5	BMI	N=7340	N=517
Visited (last 12 months)*	N=5765	N=483	<18.5	16.9	14.7
Psychiatrist	17.8	6.4	18.5–24.9	26.0	29.8
Specialist doctor	50.7	80.5	25–29.9	30.3	30.6
Hospital doctor	29.9	42.7	≤30	26.8	25.0
Health checkups*	N=6343	N=493	Visiting other health practitioners*	N=5765	N=483
Pap smear	21.7	14.8			
Breast screening	18.2	21.3	Podiatrist	19.4	22.8
Prostate check	13.8	30.2	Chiropractor	15.3	12.0
Bowel cancer	16.8	31.2	Physiotherapist	21.9	19.7
X-rays	28.1	42.4	Optometrist	44.2	45.8
Cholesterol test	58	63.5	Community nurse	6.3	8.9
Blood test	69	81.7	Other Allied health	9.1	7.2
Blood pressure	83.2	85.6	Provider		

Notes: N= number of respondents who answered the corresponding question in Wave 13. *If the N of cancer and no cancer respondents are not equal to 7859 (number of respondents who answered the question "Diagnosed with cancer"), there are missing values, either due to non-response or not asked. Q1 indicates bottom quartile, annual income $54,028 or less; Q2 is second quartile, annual income $54,029 to $85,929; Q3 is third quartile, annual income 85,930 to $124,425 and Q4 is highest quartile, annual income more than $124,425 (authors own calculation form the Wave 13 of HILDA data).

female, 48.7% were aged over 65 and 58.4% of them were covered by private health insurance. Moreover, 17.3% (high=10.8% and very high, 6.5%) of cancer patients reported a high level of psychological distress and 39.5% (fair=26.7% and poor=12.8%) of them viewed their current health status as fair or poor. On average, 80.5% of people with a cancer diagnosis visited specialists and 42.7% visited hospital doctors, in the previous 12 months. Approximately, one in seven (14.8%) of these cancer patients had pap smear test and one in five (21.3%) had breast screening. Comparatively, one in three male cancer patients had a prostate (30.2%) and a bowel cancer (31.2%) screening and 42.4% had an X-ray in the last 12 months.

The mean differences in health care utilization of cancer patients by demographic and socioeconomic characteristics had some interesting and surprising results (Table 2). For several variables, the Kruskal–Wallis H test was conducted which is more appropriate than the independent sample T-test for the predictor variables with more than two groups.[31] Income was highly associated with the pattern of health care utilization among individuals with cancer. For instance, cancer patients in the lowest income quartile made a higher number of GP visits (11.85 vs 6.62; $P<0.05$) but stayed fewer nights in hospital (2.61 vs 2.99; $P<0.05$) and had marginally smaller number hospital admissions (0.68 vs 0.75; $P<0.05$) per year than the highest income group. Conversely, specialist doctors and mental health doctor visits did not vary significantly among cancer patients based on income quartile. On average, female cancer patients have marginally more doctor visits, 0.36 times more hospital admissions (1.08 vs 0.72; $P<0.05$) and 3.27 more nights' stay in hospital (6.01 vs 2.74; $P<0.05$), all of which are considerably higher than male cancer patients.

Being born outside of Australia (BOA) also appeared to predict health care utilization among individuals with cancer who reported a higher average of doctor visits (14.51 vs 8.67; $P<0.05$), more hospital nights (4.68 vs 3.70; $P<0.05$) and marginally more specialist (89.1% vs 78.3%; $P<0.05$) and mental health doctor visits (10.9% vs 5.2%; $P<0.05$), than patients born in Australia. One probable explanation of these findings is that 95% of the BOA group reside in urban areas with the same population reporting mixed education levels with just under half possessing qualifications more than high school study (data not shown). The variations in the health care utilization between the two groups were not statistically significant, once other key explanatory variables were adjusted for in the model.

The health care utilization of cancer patients aged 65 or over was comparably higher than the two relatively younger age groups: 19–44 years and 45–64 years. Cancer patients aged 65 or more visited their GP throughout the year more often (12.96 visits), compared to those between the age of 45–64 years (7.33 visits) and 19–44 years (9.40 visits). For cancer patients (≥65 years), hospital length of stay was also higher with an average length of stay (5.49 nights) compared to the 19–44 age bracket (2.90 nights) and those in the 45–64 years age bracket (2.56 nights). The mean differences are significant at a 95% confidence interval (CI).

A higher level of education was found to significantly predict access to and use of health care. For instance, individuals with cancer who held a greater than high school qualification had a higher number of doctor visits (11.40 vs 8.61; $P<0.05$), hospital admissions (0.94 vs 0.82; not significant at 95% CI), longer stays in hospital (4.79 vs 4.00; not significant at 95% CI) and higher number of specialist doctor visits (83.3% vs 77.1%; $P<0.05$) than cancer patients with education level of high school or less. In Australia, individuals with private health insurance (PHI) can opt to access universal health care (primary health care and public hospitals) or use private providers (private hospitals). Among cancer patients with PHI, specialist care visits are marginally higher (84.2% vs 75.4%; $P<0.05$) than those without coverage. But GP visits (8.14 vs 12.30; $P<0.05$) and hospital admissions (0.73 vs 1.07; $P<0.05$) are significantly higher among patients without PHI cover than those with PHI, except for the average number of hospital nights stay (4.17 vs 4.61; not significant at 95% CI). As expected, cancer patients with other long-term health conditions reported significantly higher health care utilization of all kinds compared to those without such conditions.

Individuals who reported high levels of psychological distress were more likely to visit the GP more than 10 times (18.97 vs 6.93; $P<0.05$), higher length of stays in hospital (8.90 vs 3.02; $P<0.05$) and significantly more visits to mental health professionals (21.4% vs 2.6%; $P<0.05$) than those with lower distress levels. Urban cancer patients reported a greater number of visits to GPs (10.51 vs 9.14; $P<0.05$), longer hospital stays (4.08 vs 3.59; $P<0.05$), higher percentage of mental health doctor visits (7.4% vs 1.3%; $P<0.05$) but slightly lower hospital admissions (0.83 vs 0.96; $P<0.05$) compared to those in rural areas.

State-based differences were also observed (although statistically not significant) in patterns of health care utilization of cancer patients. For instance, Victorian patients had the highest number of hospital admissions and hospital nights' stay compared to those living in other states, with South Australia and Western Australia the lowest, respectively. Average specialist doctor visits are highest in South Australia with Western Australia the lowest. However, there was no association between a lower number of specialist doctor visits in Western Australia and fewer overall hospital admissions in the state. Further analysis revealed that 20% of cancer patients from Western Australia had hospital stays of 10 nights or more which

Table 2 Mean differences in health care utilization of cancer patients by demographic and socioeconomic characteristics

Variables	Doctor visits (Mean)	Hospital admissions (mean)	Nights at hospital (mean)	Seen a hospital doctor in the last 12 months (%)	Seen a specialist doctor in the last 12 months (%)	Seen a mental health professional in the last 12 months (%)
				Chi-sq test		
Income*	0.00	0.04	0.02	0.03	0.32	0.30
Income Q 1	11.85 (0.03)	0.68 (0.00)	2.61 (0.03)	46.7 (257)	77 (257)	6.6 (257)
Income Q 2	14.88 (0.04)	0.67 (0.00)	3.28 (0.03)	46.7 (75)	84 (75)	8.0 (75)
Income Q 3	6.51 (0.02)	0.61 (0.00)	2.14 (0.02)	27.9 (68)	86 (68)	1.5 (68)
Income Q 4	6.62 (0.03)	0.75 (0.00)	2.99 (0.03)	38.6 (83)	81 (83)	8.4 (83)
Gender	0.91	0.00	0.00	0.27	0.82	0.24
Male	10.30 (0.01)	0.72 (0.00)	2.74(0.01)	40.4 (267)	80.9 (267)	5.2 (267)
Female	10.40 (0.02)	1.08 (0.00)	6.01 (0.03)	45.4 (216)	80.1 (216)	7.9 (216)
Birth place	0.00	0.04	0.28	0.01	0.01	0.04
Australia	8.67 (0.01)	0.77 (0.00)	3.70 (0.01)	39.8 (387)	78.3 (387)	5.2 (387)
Other	14.51 (0.04)	1.05 (0.00)	4.68 (0.03)	54.3 (92)	89.1 (92)	10.9 (92)
Age*	0.00	0.00	0.00	0.05	0.95	0.02
19–44	9.40 (0.03)	0.91 (0.00)	2.90 (0.02)	52.8 (53)	81.1 (53)	15.1 (53)
45–64	7.33 (0.02)	0.62 (0.00)	2.56 (0.01)	36.5 (189)	79.9 (189)	4.8 (189)
65 or more	12.96 (0.03)	1.01 (0.00)	5.49 (0.02)	45.2 (241)	80.9 (241)	5.8 (241)
Education level	0.00	0.23	0.15	0.00	0.08	0.22
> High school	11.40 (0.70)	0.94 (0.09)	4.79 (0.74)	36.4 (269)	83.3 (269)	5.2 (269)
≤ High school	8.61 (0.64)	0.82 (0.10)	4.00 (0.59)	50.5 (214)	77.1 (214)	7.9 (214)
Marital status	0.02	0.28	0.04	0.21	0.15	0.02
Married	8.94 (0.54)	0.80 (0.08)	5.37 (0.88)	40.3 (283)	82.7 (283)	4.2 (283)
Otherwise	11.13 (0.85)	0.97 (0.12)	3.63 (0.48)	46.0 (200)	77.5 (200)	9.5 (200)
Health care card	0.07	0.12	0.81	0.17	0.68	0.19
Yes	12.00 (1.8)	1.20 (0.38)	4.57 (1.68)	52.2 (46)	78.3 (46)	10.9 (46)
No	9.62 (0.49)	0.84 (0.07)	4.33 (0.48)	41.6 (437)	80.8 (437)	5.9 (437)
PHI cover	0.00	0.01	0.77	0.00	0.01	0.11
Yes	8.14* (0.59)	0.73* (0.09)	4.17 (0.63)	35.2 (284)	84.2 (239)	4.9 (284)
No	12.30* (0.75)	1.07* (0.11)	4.61 (0.67)	53.3 (199)	75.4 (199)	8.5 (199)
Long-term health condition	0.00	0.00	0.00	0.00	0.02	0.09
Yes	12.53 (0.67)	1.13 (0.10)	6.08 (0.69)	50 (306)	83.7 (306)	7.8 (306)
No	5.24 (0.39)	0.42 (0.07)	1.38 (0.31)	29.9 (177)	75.1 (177)	4.0 (177)

(*Continued*)

Table 2 (Continued).

Variables	Doctor visits (Mean)	Hospital admissions (mean)	Nights at hospital (mean)	Seen a hospital doctor in the last 12 months (%)	Seen a specialist doctor in the last 12 months (%)	Seen a mental health profes-sional in the last 12 months (%)
Psychological distress level*	0.00	0.00	0.00	0.00	0.46	0.00
Low	6.93 (3.57)	0.66 (0.36)	3.02 (2.03)	35.1 (271)	78.2 (271)	2.6 (271)
Moderate	10.61 (8.92)	1.09 (0.95)	5.27 (1.96)	53.5 (86)	86.0 (86)	9.3 (86)
High	12.78 (7.20)	0.62 (0.86)	4.30 (5.47)	53.2 (47)	80.9 (47)	12.8 (47)
Very high	18.97 (10.9)	1.33 (0.78)	8.90 (3.87)	42.9 (28)	78.6 (28)	21.4 (28)
Location	0.00	0.00	0.00	0.88	0.57	0.04
Urban	10.51 (0.02)	0.83 (0.00)	4.08 (0.02)	42.5 (407)	80.1 (407)	7.4 (407)
Rural	9.14 (0.03)	0.96 (0.00)	3.59 (0.03)	43.4 (76)	82.9 (76)	1.3 (76)
State*	0.77	0.52	0.57	0.39	0.46	0.14
New South Wales	10.57 (0.86)	0.83 (0.14)	3.64 (0.69)	36.3 (160)	81.9 (160)	4.4 (160)
Victoria	8.99 (1.18)	1.12 (0.17)	6.20 (1.36)	43.5 (108)	82.4 (108)	5.6 (108)
Queensland	9.99 (0.94)	0.85 (0.16)	3.94 (1.01)	48.2 (110)	77.3 (110)	8.2 (110)
South Australia	8.37 (1.70)	0.80 (0.24)	3.13 (1.19)	42.5 (40)	90.0 (40)	7.5 (40)
Western Australia	10.02 (1.72)	0.81 (0.19)	3.23 (0.96)	51.2 (43)	72.1 (43)	9.3 (43)
Financial distress	0.82	0.97	0.04	0.04	0.74	0.02
Yes	9.65 (1.4)	0.87 (0.24)	2.48 (0.82)	60.9 (23)	82.6 (23)	21.7 (23)
No	9.37 (0.48)	0.84 (0.08)	4.36 (0.54)	39.9 (411)	79.8 (411)	5.4 (411)

Notes: Standard error in the parenthesis. Q indicates quartile. Three states not included as the number of observations were less than 15. Bootstrap standard errors and *P*-values. Results are based on 1000 bootstrap samples. Health shocks have been measured with serious personal illness and financial distress with major worsening in finances. For the Chi-sq test: values are in percentage of respondents answered "Yes" and total respondents in the parenthesis. Each variable is represented with a corresponding *P*-value. *Indicates the Kruskal–Wallis H test *P*-values.

reflects its lower population density and longer distances involved in accessing treatment (data not shown).

Of the 517 cancer patients, 5% (n=25) had a major worsening of finances with 11 of them from the lowest income quartile, although this finding was not significant at a 5% confidence interval (data not shown). Financial distress was not related to the place of residence (i.e. urban vs rural), household income or gender. However, having major financial distress is associated with fewer nights' stay in hospital (4.36 vs 2.48; P=0.04) compared to no financial distress and a significantly higher number of visits to a mental health professional (21.7% vs 5.4%; P<0.05).

The key determinants of health care utilization of cancer patients by socioeconomic and demographic characteristics are shown in Table 3. The adjusted logistic regression results indicate that younger individuals with cancer (age <44) were 2.74 times more likely to have 10 or more doctor visits than older patients (≥65) per year (odds ratio 2.74; P<0.05). Further analyses of income status and the type and frequency of cancer care accessed showed that cancer patients from the lowest income quartile have a lower probability of hospital admission (odds ratio 0.702; P<0.05) compared to patients from the highest income quartile. In addition, women patients have 1.65 times higher probability of hospital admissions (odds ratio 1.65; P<0.05). The results also show that cancer patients with PHI are twice more likely to access a GP (ten times or more) compared to patients without private cover (odds ratio 2.04; P<0.05). However, the heterogeneity in hospital admissions was not statistically significant (odds ratio 0.86; P>0.05).

Access and uptake of specialist care predicted subsequent health care utilization among individuals living with cancer. Cancer patients who visited hospital doctors (2.3 times) or accessed specialist doctors (2.7 times) were less likely to access GP care (10 or more times) and, importantly, less likely to be subsequently admitted to hospital (odds ratio 0.432 and 0.360, respectively; P<0.05). Cancer patients who received care from a hospital doctor were seven times less likely to be admitted to hospital while those receiving specialist care had a 1.87 times lower chance of hospital admission (odds ratio 0.141 and 0.535, respectively; P<0.05).

Further analysis on factors impacting health care utilization of cancer patients using the zero-inflated Poisson regression model shows several key and interesting findings (Table 4). For instance, self-assessed health, gender,

long-term health condition and visits to hospital and specialist doctors significantly influence the number of doctor visits and hospital admissions of cancer patients. A unit increase in self-assessed health increases the expected number of doctor visits by a factor of 1.264 (exponent of 0.234) and hospital admissions by 1.328 (exponent of 0.284). In addition, for a male cancer patient, the expected number of zero doctor visit is 0.908 (exponent of −0.096) times and expected number of zero hospital admissions is 0.69 (exponent of −0.371) times the expected number of females, while holding all other variables constant. This indicates that female cancer patients have a higher likelihood than males of non-zero counts for number of doctor visits and hospital admissions. Furthermore, cancer patients with other long-term health conditions have 1.495 (exponent of 0.402) times, and those without a specialist doctor visit have 2.567 (exponent of 0.943) times the expected number of hospital admissions than patients with no long-term health conditions and specialist doctor visits, respectively.

Finally, while predicting the "Certain Zero" group, the findings of the zero-inflated regression show that if a cancer patient has no long-term health conditions, the odds that s/he would be in the "Certain Zero" group (zero or no doctor visits) is higher (results not shown). On the other hand, patients who visited hospital doctors have a higher likelihood of being in the "Certain Zero" group of no hospital admissions (results not shown).

The level of psychological distress among cancer patients varied significantly based on their demographic characteristics and health care utilization (Table 5). Cancer patients with lower education levels, aged less than 45 years, female or were not currently married reported a higher level of psychological distress compared to those who were highly educated, aged 45 and over, male and married.

Education level also appears to predict psychological distress as cancer patients with a qualification level of secondary school or lower reported very high levels of psychological distress compared to those with higher education status (9.9% vs 4.1%; P=0.019). About 6.4% of urban cancer patients reported very high psychological distress compared to 7.4% of rural cancer patients (P=0.53). Cancer patients with very high psychological distress level had a significantly higher number of hospital doctor visits (42.9% vs 35.1%; P<0.05), admissions (36.6% vs 15.2%; P=0.043) and more than one night stay (46.4% vs 24.1%; P<0.05) than those reporting a

Table 3 Key determinates of health care utilization of cancer patients by socioeconomic and demographic characteristics (binary logistic regression)

Factors (reference category)	Doctor visits			Hospital admissions		
	Odds R	*CI*	*P-Value*	*Odds R*	*CI*	*P-Value*
Self-assessed health (poor)						
Excellent	0.23	0.02–2.64	0.24	0.22	0.04–1.21	0.08
Very good	0.65	0.20–2.10	0.47	0.40	0.13–1.20	0.10
Good	0.89	0.37–2.15	0.79	0.43	0.17–1.05	0.03
Fair	1.02	0.44–2.36	0.96	0.74	0.32–1.68	0.46
Household disposable income (high)						
Low income	1.16	0.51–2.64	0.72	0.70	0.32–1.53	0.03
Lower-middle income	1.42	0.55–3.67	0.46	0.39	0.15–0.98	0.04
Higher-middle income	0.75	0.27–2.09	0.58	1.45	0.62–3.41	0.39
BMI (BMI≤30)						
BMI ≤18.5	1.98	0.51–3.73	0.32	0.58	0.16–2.01	0.38
BMI 18.6–24.9	0.51	0.26–0.98	0.04	1.19	0.63–2.25	0.59
BMI 25–29.9	0.70	0.37–1.32	0.27	1.14	0.61–2.14	0.68
Age (65 or more)						
Age<45	2.74	0.93–2.84	0.04	0.58	0.22–1.54	0.27
Age 45–65	0.69	0.38–1.25	0.02	0.56	0.32–1.00	0.04
Smoking frequency (regular)						
Non-smoker	1.83	0.80–3.17	0.15	0.81	0.36–1.80	0.60
Physical activity (more than 3 times a week)						
Less than once a week	1.58	0.81–3.10	0.17	1.38	0.73–2.62	0.31
1–3 times a week	0.99	0.50–1.95	0.98	0.90	0.48–1.69	0.74
Psychological distress: depressed (never)						
Most times	2.67	0.70–5.16	0.15	0.89	0.25–3.22	0.86
Some times	1.31	0.57–2.98	0.52	0.71	0.31–1.66	0.43
A little	1.88	1.02–3.47	0.04	1.14	0.64–2.03	0.65
Other confounding variables						
Born outside Australia (Australia)	0.97	0.50–1.88	0.93	0.74	0.39–1.39	0.35

(*Continued*)

Table 3 (Continued).

Factors (reference category)	Doctor visits			Hospital admissions		
	Odds R	*CI*	*P-Value*	*Odds R*	*CI*	*P-Value*
Female (male)	1.23	0.72–2.12	0.44	1.65	0.99–2.74	0.03
No long-term health condition (yes)	0.20	0.10–0.39	0.00	1.05	0.57–1.90	0.87
Health care card (yes)	1.47	0.62–3.47	0.38	1.17	0.51–2.67	0.70
Currently not married (married)	1.08	0.63–1.87	0.77	1.14	0.67–1.95	0.62
Rural (urban)	0.87	0.43–1.78	0.71	1.58	0.81–3.08	0.18
Education more than high school (otherwise)	1.57	0.91–2.70	0.10	1.27	0.75–2.15	0.36
Private health insurance (yes)	2.05	1.16–3.62	0.01	0.87	0.49–1.53	0.62
Hospital doctor visit (otherwise)	0.43	0.25–0.73	0.00	0.14	0.08–0.23	0.00
Specialist doctor visits (otherwise)	0.36	0.18–0.72	0.00	0.53	0.28–1.02	0.05
Constant	0.74		0.39	2.99		0.83
	Chi-sq		*P-value*	*Chi-sq*		*P-value*
Omnibus test model coefficients	166.66		0.000	130.96		0.000
Hosmer & Lemeshow	9.65		0.29	10.16		0.25
−2 Log likelihood	392.46			430.11		
Cox & Snell (R-Sq)			0.33			0.27
Nagelkerke (R-Sq)			0.44			0.36

Notes: Data from Wave 13. Bootstrap standard errors and *P*-values. Results are based on 1000 bootstrap samples. Reference category presented in the parenthesis. Response variable number of doctor visits is a binary variable where values zero to nine, 0 and 1= otherwise; hospital admission in the last twelve months is a binary variable where 1= yes and 0= otherwise. CI indicates the 95% confidence interval.

Table 4 Factors impacting health care utilization of cancer patients (zero-inflated Poisson regression model)

Variables	Doctor visits			Hospital admissions		
	Coef	*CI*	*P-Value*	*Coef*	*CI*	*P-Value*
Self-assessed health	0.234	0.193– 0.275	0.00	0.284	0.136– 0.432	0.00
Household disposable income	−0.00018	−0.000- 0.000	0.00	0.00004	−0.000– 0.000	0.55
BMI	−0.003	−0.007–0 .000	0.04	−0.006	−0.021– 0.007	0.35
Age	−0.001	−0.004– 0.001	0.43	−0.001	−0.011– 0.009	0.85
Smoking frequency	−0.016	−0.065– 0.031	0.50	−0.250	−0.449– −0.051	0.01
Physical activity	−0.014	−0.055– 0.026	0.48	0.063	−0.084– 0.211	0.40
Psychological distress	0.144	0.110– 0.178	0.00	−0.029	−0.172– 0.113	0.68
Born outside Australia	−0.082	−0.159- −0.005	0.03	0.082	−0.213– 0.379	0.58
Gender	−0.096	−0.163– −0.029	0.00	−0.371	−0.629– −0.113	0.00
Long-term health condition	0.385	0.295– 0.475	0.00	0.402	−0.023– 0.828	0.06
Possess health care card	0.155	0.056– 0.254	0.00	0.310	−0.040– 0.660	0.08
Marital status	−0.068	−0.136– 0.000	0.05	−0.120	−0.381– 0.141	0.36
Place of residence	0.061	−0.032– 0.154	0.20	0.031	−0.297– 0.358	0.85
Education level	−0.013	−0.081– 0.054	0.69	0.222	−0.027– 0.472	0.08
Has private health insurance	−0.054	−0.126– 0.017	0.13	−0.082	−0.347– 0.182	0.54
Visited a hospital doctor	0.273	0.210– 0.336	0.00	0.624	0.252– 0.996	0.00
Visited a specialist doctor	0.177	0.104– 0.249	0.00	0.943	0.452–1.43	0.00
Constant	1.059	0.737–1.38	0.00	−1.913	−3.18– −0.658	0.00
Log likelihood	−1860.01			−461.58		
LR Chi-sq (17)	1358.76			93.69		
Zero Obs	22			291		
Nonzero Obs	433			164		
Vuong test value	2.55 (0.00)			2.62 (0.00)		

Notes: Doctor visits, number of doctor visits including zero; Hospital admission= number of hospital admissions including zero; Household annual disposable income is a continuous variable without negative value; Gender is a dummy variable (male, 1 and female, 0); Age is a continuous variable without negative value; Edu1= Education level dummy (high school or less=0 and otherwise=1); BMI= Body mass index is a continuous variable without negative; Place of residence is a dummy variable (urban, 1 and rural, 0). Private health insurance dummy (yes=1 and no=0); Long-term health conditions dummy (yes, 1 and no=0); Health care card is a dummy variable (yes,1 and no=0); Psychological distress is Kessler psychological distress scale; Seen a hospital doctor in the last 12 months; Seen a specialist doctor in the last 12 months; CI indicates the 95% confidence interval.

Table 5 Characteristics and health care utilization of cancer patients with high or very high level of psychological distress (Pearson Chi-sq test)

Variables	Psychological distress level (%)				Chi-sq test (*P*-value)
	Low	Moderate	High	Very high	
Education level					0.019
> High school	67.4	19.6	8.9	4.1	
≤High school	57.6	18.8	13.6	9.9	
Place of residence					0.530
Urban	61.8	20.6	11.2	6.4	
Rural	72.1	11.8	8.8	7.4	
Household income					0.136
Low	60.3	21.1	11.6	6.9	
Lower-middle	56.0	21.3	10.7	12.0	
Upper-middle	66.7	21.7	8.7	2.9	
High	75.3	10.6	10.6	3.5	
Age					0.001
19–45	42.9	22.4	22.4	12.2	
45–65	66.7	15.4	8.7	9.2	
65 or more	65.0	22.1	10.1	2.8	
Gender					0.001
Female	55.9	22.1	10.8	11.3	
Male	68.8	17.3	10.9	3.0	
Marital status					0.000
Married	70.1	16.5	10.8	2.5	
Otherwise	53.0	23.5	10.9	12.6	
Health care utilization					
Hospital doctor visit (yes)	35.1	53.5	53.2	42.9	0.006
Specialist doctor visit (yes)	78.2	86.0	80.9	78.6	0.465
Mental health professional visit (yes)	2.6	9.3	12.8	21.4	0.000
Hospital admissions >1	15.2	22.4	14.0	36.6	0.043
Hospital nights stay >1	24.1	35.3	30.0	46.4	0.001

lower level of distress. Noticeably, only one in five (21.4%) cancer patients with very high psychological dis- tress has visited a mental health professional.

Discussion

The findings demonstrate trends and inequalities in health care utilization across the cancer continuum associated with advancing age, gender, income, education status, rurality, urbanity, migrant status, private health insurance coverage and access to specialist care. Given that even moderate health care utilization has been associated with longer survival times,[35,36] inequalities that act as barriers to receiving care may have devastating implications for those individuals with cancer.

In society, increased health care utilization is associated with advancing age in Australia, with hospitalization rates for those 65 years and over four times higher than the rest of the population. This older age group also accesses GP care (10 visits or more times per year) at double the rate of those under 65.[37,38] The study results show that younger adults (19–45 years) with cancer appear to contradict previously reported Australian trends by accessing their GP at a higher rate than older age groups with cancer. Reasons for such health care-seeking behavior are unclear[39]; however, younger adults' apparent preferences for GP-led care may present a more effective and lower cost means of disseminating cancer survivorship interventions among this age-group.

The findings of gender-based utilization of health care largely reflect current trends in Australian health care. It was reported in 2017 that women seek hospital care more frequently, stay in the hospital longer and access all types of health care more than men.[40] This was confirmed for men with poorer health who are still less likely to access all types of health care as reported in the "Ten to Men Australian Longitudinal Study on Male Health".[41] However, the study results show that men with cancer are more likely to seek out specialist care than females with cancer, possibly reflecting a masculine tendency to seek out a viewpoint on their illness which they perceive to be dominant or authoritative.[42] Masculine inclinations to access specialist care may also explain an increased uptake of screening compared to those without a cancer diagnosis as increased usage of diagnostic tests are associated with specialist care.[43]

Despite Australia becoming the wealthiest country in the world in 2018 based on median wealth per adult,[44] there is clear evidence that income inequality is associated

with differing patterns of health care utilization. For those of low income, less engagement with hospital-based care and increased use of GP services may reflect the financial pressures of remaining in paid work to support the high cost of living in Australia.[44] However, these patterns were reversed in high-income individuals who not only accessed hospital care more but accessed specialist care and sought treatment from mental health professionals more often than lower income cancer patients.

Noticeably, cancer patients reporting financial distress had the lowest length of stay of all, with single people most affected. Given financial distress has been linked with decision-making on treatment,[45] reduced length of stay in this sample may reflect a need to leave the hospital early to avoid the loss of income and the cost of treatment. The usual factors such as advanced education status and urban residence linked with increased health care utilization were also found in this study; however, both variables were also correlated with an increased probability of psychological distress. However, increased length of hospital stay for rural individuals is typical in the geographically dispersed Australian context and reflects the lack of appropriate local treatment services for rural people and increases their need to travel for medical treatment.[40,43] The findings of higher psychological distress in more educated, urban-dwelling individuals with cancer contrast with other studies where rural individuals of lower education status report higher psychological distress.[46,47] Accessing mental health services[48] and positive attitudes[49] toward seeking psychological support have previously been associated with higher incomes, although it is unclear how higher income increases care-seeking behaviors in this study population. Lastly, cancer patients with very high levels of psychological distress showed a higher level of health care utilization; however, around four in five of these patients surprisingly did not seek mental health care services.

Significantly increased health care utilization by migrants with cancer is a new finding in the Australian context; however, this finding may in part further explain more favorable cancer mortality outcomes among Australian migrants as previously reported in a 2012 study.[17] More broadly, it was found that state-based patterns of cancer care differ widely and are not explainable by typical patterns of health-seeking behavior. Nevertheless, significant variation in cancer care may reflect ongoing state-based differentials in the (in)efficiency of care delivery[50] as well as a lack of care coordination reported in aspects of cancer services.[51] How to achieve consistency in care delivery is a federal health priority in

Australia, with further research needed on improving the coordination and efficiency of care at multiple levels. Importantly for care coordination, specialist care appears to be strongly linked with the prevention of hospitalization which highlights both the value of specialists in the health care system and their contribution to improved care coordination.

While cross-sectional analysis is susceptible to the risk of bias, the representative population data used in this study provides a solid basis for the results obtained and enables further exploration of the demographic and socio- cultural drivers of health care utilization in cancer patients in Australia. The results also serve to inform which populations are experiencing inequality and identifies potential areas where tailored solutions might inform models for improving service access and care optimization.

Limitations

This study has some limitations. Data inadequacy, for instance, means a lack of follow-up questions like what type of cancer and time diagnosed with cancer could not be factored into or controlled for in the regression analysis. Due to the cross-sectional nature of the data, the causality effect between variables could not be estimated. Future studies using longitudinal data may be able to use more in-depth confounding estimates of the causal relationship. The fewer number of respondents with cancer (in the database) also limited the ability to create more age groups. Lastly, the expenditure on and utilization of health care are subject to several unobserved variables which may lead to omitted variable bias.[52] Although this study has attempted to limit the bias through the inclusion of relevant covariates and by using a two-part model, some potential bias may still exist.[27,51] Lastly, the term "no cancer" means survey respondents reported negative to the question "have you been diagnosed with any type of cancer?" However, this does not mean these respondents do not have other long-term health conditions. Therefore, the heterogeneity of health expenditure and health care utilization between the two groups (cancer vs no cancer) should be interpreted with caution. Future studies may use "quasi-experimental design" or "social experiments" to address these methodological issues.

Conclusions

The findings from this study have implications for policy- makers and health professionals as they reflect structural inequalities in Australian

society which impact upon cancer patients, their treatment pathways and ultimately their survival or otherwise. Factors such as age, gender, income, psychological health, education and place of residence indicate the need for appropriate policy and program responses. Encouragingly, the findings also point to the value of some models of care in specific cohorts as well as the value of specialists in preventing hospitalizations through improved care coordination. Further research into effective models of care is needed to understand why, where and when they work and how their effective- ness can be implemented across the health system.

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Disclosure

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References

1. Bray F, Ferlay J, Soerjomataram I, Siegel RL, Torre LA, Jemal A. Global cancer statistics 2018: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. *CA Cancer J Clin*. 2018;68(6):394–424. doi:10.3322/caac.21492

2. Australian Institute of Health and Welfare. *Australian Cancer Incedence and Mortality (ACIM) Books: All Cancers*. Canberra: Australian Institue of Health and Welfare; 2017.

3. Australian Institute of Health and Welfare. *Cancer in Australia 2017. Cancer Series No. 101. Cat. No. CAN 100*. Canberra: Australian Institute of Health and Welfare; 2017.

4. Stanbury JF, Baade PD, Yu Y, Yu XQ. Cancer survival in New South Wales, Australia: socioeconomic disparities remain despite overall improvements. *BMC Cancer*. 2016;16(1):48. doi:10.1186/s12885- 016-2065-z

5. Carrasquillo O. Health care utilization. In: Gellman MD, Turner JR, editors. *Encyclopedia of Behavioral Medicine*. New York: Springer; 2013:909‒910.

6. Maxwell S, O'Leary P, Slevin T, Moorin R. The increase in cancer prevalence and hospital burden in Western Australia, 1992‒2011. *Popul Health Metr*. 2014;12(1):33. doi:10.1186/s12963-014-0033-x

7. Langton JM, Blanch B, Drew AK, Haas M, Ingham JM, Pearson S-A. Retrospective studies of end-of-life resource utilization and costs in cancer care using health administrative data: a systematic review. *Palliat Med*. 2014;28(10):1167‒1196. doi:10.1177/0269216314533813

8. McGrath P. Financial distress during relocation for treatment of a hematological malignancy: findings for social work. *Soc Work Health Care*. 2016;55(4):265‒279. doi:10.1080/00981389.2015.1130008

9. Callander E, Topp SM, Larkins S, Sabesan S, Bates N. Quantifying Queensland patients with cancer health service usage and costs: study protocol. *BMJ Open*. 2017;7(1):e014030. doi:10.1136/bmjopen- 2016-014030

10. Cancer Australia. *Cancer Australia Strategic Plan 2014-2019*. Surrey Hilss, New South Walse: Cancer Australia; 2014.

11. Baade P, Aitken J, Fritschi L. *Geographical differentials in cancer incidence and survival in Queensland, 1996 to 2002*. Viertel Centre for Research in Cancer Control, Queensland Cancer Fund; Queensland; 2005.

12. Cramb S, Mengersen K, Baade PD. *Atlas of cancer in Queensland: geographical variations in incidence and survival 1998‒2007*. Viertel Centre for Research in Cancer Control, Cancer Council Queensland; Queensland; 2011.

13. Cramb SM, Moraga P, Mengersen KL, Baade PD. Spatial variation in cancer incidence and survival over time across Queensland, Australia. *Spat Spatiotemporal Epidemiol*. 2017;23:59‒67. doi:10.1016/j. sste.2017.09.002

14. Ananda S, Kosmider S, Tran B, et al. The rapidly escalating cost of treating colorectal cancer in Australia. *Asia Pac J Clin Oncol*. 2016;12(1):33‒40. doi:10.1111/ajco.12350

15. Doran CM, Ling R, Byrnes J, et al. Estimating the economic costs of skin cancer in New South Wales, Australia. *BMC Public Health*. 2015;15(1):952. doi:10.1186/s12889-015-2267-3

16. Gordon LG, Tuffaha HW, James R, et al. Estimating the healthcare costs of treating prostate cancer in Australia: a Markov modelling analysis. *Urologic Oncology*: Seminars and Original Investigations. Elsevier, Vol 3; 2018:91.e7‒e15. doi:10.1016/j.urolonc.2017.10.024

17. Anikeeva O, Bi P, Hiller JE, Ryan P, Roder D, Han GS. Trends in cancer mortality rates among migrants in Australia: 1981‒2007. *Cancer Epidemiol*. 2012;36(2):e74‒e82. doi:10.1016/j.canep.2011.10.011

18. Koh E, Do V, Barton M. Frontiers of cancer care in Asia-Pacific region: cancer care in Australia. *Biomed Imaging Interv J*. 2008;4:3. doi:10.2349/biij.4.3.e30

19. Langton JM, Reeve R, Srasuebkul P, et al. Health service use and costs in the last 6 months of life in elderly decedents with a history of cancer: a comprehensive analysis from a health payer perspective. *Br J Cancer*. 2016;114(11):1293. doi:10.1038/bjc.2016.75

20. Iadeluca L, Mardekian J, Chander P, Hopps M, Makinson GT. The burden of selected cancers in the US: health behaviors and health care resource utilization. *Cancer Manag Res*. 2017;9:721. doi:10.2147/CMAR.S143148

21. Milner A, Krnjacki L, LaMontagne A. Age and gender differences in the influence of social support on mental health: a longitudinal fixed- effects analysis using 13 annual waves of the HILDA cohort. *Public Health*. 2016;140:172‒178. doi:10.1016/j.puhe.2016.06.029

22. Department of Social Services. *The household, income and labour dynamics in Australia (HILDA) survey, GENERAL RELEASE 16 (Waves 1-16)*. Australia: ADA Dataverse, V4; 2017.

23. Butterworth P, Leach LS, Rodgers B, Broom DH, Olesen SC, Strazdins L. Psychosocial job adversity and health in Australia: analysis of data from the HILDA Survey. *Aust N Z J Public Health*. 2011;35(6):564‒571. doi:10.1111/j.1753-6405.2011.00771.x

24. Watson N, Wooden MP. The HILDA survey: a case study in the design and development of a successful household panel survey. *Longit Life Course Stud*. 2012;3(3):369‒381.

25. Becchetti L, Conzo P, Salustri F. The impact of health expenditure on the number of chronic diseases. *Health Policy*. 2017;121(9):955‒962. doi:10.1016/j.healthpol.2017.07.008

26. Han X, Lin CC, Li C, et al. Association between serious psycholo- gical distress and health care use and expenditures by cancer history. *Cancer*. 2015;121(4):614‒622. doi:10.1002/cncr.29102

27. Short PF, Moran JR, Punekar R. Medical expenditures of adult cancer survivors aged<65 years in the United States. *Cancer*. 2011;117 (12):2791‒2800. doi:10.1002/cncr.25835

28. Buchmueller TC, Johar M. Obesity and health expenditures: evidence from Australia. *Econ Hum Biol*. 2015;17:42‒58. doi:10.1016/j. ehb.2015.01.001

29. Zhang D, Wang G, Zhang P, Fang J, Ayala C. Medical expenditures associated with hypertension in the US, 2000‒2013. *Am J Prev Med*. 2017;53(6):S164‒S171. doi:10.1016/j.amepre.2017.05.014

30. Agresti A. *Categorical Data Analysis*. 2nd ed., Vol. 482. New Jersey: John Wiley & Sons; 2003.

31. Field A. *Discovering Statistics Using IBM SPSS Statistics*. 5th ed. London: Sage; 2013.

32. Cameron AC, Trivedi PK. *Regression Analysis of Count Data*. Vol. 53. New York: Cambridge University Press; 2013.

33. Lambert D. Zero-inflated Poisson regression, with an application to defects in manufacturing. *Technometrics*. 1992;34(1):1‒14. doi:10.2307/1269547

34. Zeileis A, Kleiber C, Jackman S. Regression models for count data in R. *J Stat Softw*. 2008;27(8):1‒25. doi:10.18637/jss.v027.i08

35. Yim J, Hwang -S-S, Yoo K-Y, Kim C-Y. Contribution of income- related inequality and healthcare utilisation to survival in cancers of the lung, liver, stomach and colon. *J Epidemiol Community Health*. 2012;66(1):37‒40. doi:10.1136/jech.2009.104554

36. Semnani S, Noorafkan Z, Aryaie M, et al. Determinants of healthcare utilisation and predictors of outcome in colorectal cancer patients from Northern Iran. *Eur J Cancer Care (Engl)*. 2016;25(2):318‒ 323. doi:10.1111/ecc.12313

37. Britt H, Miller GC, Henderson J, et al. *A Decade of Australian General Practice Activity 2003‒04 to 2012‒13*. Sedney: Sydney University Press; 2013.

38. Family Medicine Research Center. *Care of Older People in Australian General Practice*. Sydney: The University of Sydney; 2015.

39. Nathan PC, Daugherty CK, Wroblewski KE, et al. Family physician preferences and knowledge gaps regarding the care of adolescent and young adult survivors of childhood cancer. *J Cancer Surviv*. 2013;7 (3):275‒282. doi:10.1007/s11764-013-0271-0

40. Australian Institute of Health and Welfare. *The health of Australia's female*. Canberra: AIHW;2017. Available from https://www.aihw. gov.au/reports/men-women/female-health/contents/who-are. Accessed November 25, 2018.

41. Schlichthorst M, Sanci LA, Pirkis J, Spittal MJ, Hocking JS. Why do men go to the doctor? Socio-demographic and lifestyle factors asso- ciated with healthcare utilisation among a cohort of Australian men. *BMC Public Health*. 2016;16(3):1028. doi:10.1186/s12889-016- 3706-5

42. Noone JH, Stephens C. Men, masculine identities, and health care utilisation. *Sociol Health Illn*. 2008;30(5):711‒725. doi:10.1111/ j.1467-9566.2008.01095.x

43. Australian Institute of Health and Welfare. *The health of Australia's males*. Canberra: AIHW; 2017. Available from https://www.aihw.gov.au/reports/men-women/male-health/con tents/who-are. Accessed November 25, 2018.

44. Shorrocks A, Davies J, Lluberas R. *Global Wealth Report 2018*. Switzerland: Credit Suisse Research Institute; 2018.

45. Neumann PJ, Palmer JA, Nadler E, Fang C, Ubel P. Cancer therapy costs influence treatment: a national survey of oncologists. *Health Aff*. 2010;29(1):196‒202. doi:10.1377/hlthaff.2009.0077

46. Weaver KE, Geiger AM, Lu L, Case LD. Rural-urban disparities in health status among US cancer survivors. *Cancer*. 2013;119(5):1050–1057. doi:10.1002/cncr.27840

47. Zahnd WE, McLafferty SL. Contextual effects and cancer outcomes in the United States: a systematic review of characteristics in multilevel analyses. *Ann Epidemiol*. 2017;27(11):739–748. e733. doi:10.1016/j.annepidem.2017.10.002

48. Henderson C, Robinson E, Evans-Lacko S, et al. Public knowledge, attitudes, social distance and reported contact regarding people with mental illness 2009–2015. *Acta Psychiatr Scand*. 2016;134:23–33. doi:10.1111/acps.12607

49. Mission W. *Living with Mental Illness; Attitudes, experiences and challenges*. Sydney: Wesley Mission; 2007:16.

50. Australian Institute of Health and Welfare. *Australia's hospitals at a glance 2016–17*. Canberra: AIHW; 2018. Available from https://www.aihw.gov.au/getmedia/d5f4d211-ace3-48b9-9860-c4489ddf2c35/aihw-hse-204.pdf.aspx?inline=true. Accessed November 24, 2018.

51. Crawford-Williams F, March S, Goodwin BC, et al. Interventions for prostate cancer survivorship: A systematic review of reviews. *Psycho-Oncology*. 2018;27(10):2339–2348. doi:10.1002/pon.4888

52. Dismuke CE, Egede LE. Association of serious psychological distress with health services expenditures and utilization in a national sample of US adults. *Gen Hosp Psychiatry*. 2011;33(4):311–317. doi:10.1016/j.genhosppsych.2011.03.014

CHAPTER 3

CHAPTER 3: **Introductory note: Relationship between Chapter 2 and Chapter 3**

In the previous section, Chapter 2 identified that although Australia has one of the most efficient and relatively well-functioning healthcare systems and follows the best-recommended guidelines for cancer treatments, there are heterogeneities in the healthcare utilisation of cancer patients. Factors such as age, gender, income, place of residence and private health insurance significantly influenced the use of healthcare among Australian cancer patients. The paper included in Chapter 3 explicitly looks at gender as a factor, and rather than looking at all types of cancer. In this study, specific focus was given to lung cancer which is responsible for the highest number of cancer-related deaths among males and females. This study is a systematic literature review. The initial idea was to conduct the study only with literature related to Australia. However, a primary literature search resulted in insufficient relevant studies for Australia. Finally, no country-specific limit was placed while conducting the literature search, and all English language studies were included.

The paper is currently under review in the '*Journal of Cancer Research and Clinical Oncology*.

3.0 Gender-specific differences in care-seeking behaviour among lung cancer patients: a systematic review

3.1 Abstract

Background: In the literature, men are often described as unwilling to use healthcare services and women as frequent users. We conducted a systematic literature review to examine the gender differences in healthcare utilisation of lung cancer patients. Our aim was to synthesise evidence to assess whether men and women utilise cancer diagnosis and treatments differently.

Methods: The database of PubMed, Scopus, Web of Science, EBSCO Host, Ovid nursing, and Cochrane was systematically searched. We used pre-defined eligibility criteria to identify peer-reviewed published literature that reported healthcare use of lung cancer patients. Two reviewers independently screened the title, abstract, full texts and retrieved relevant data.

Results: A total of 42 studies met the eligibility criteria from 1356 potential studies. In these studies, the most commonly measured healthcare utilisation is surgery (n=19), followed by chemotherapy (n=13). All the studies used data from developed countries and had a higher percentage of male participants. Substantial evidence of heterogeneities in the use of treatments by gender were found. In relation to diagnosis interval and stage of cancer diagnosis, studies suggested that women had longer diagnostic intervals. Nonetheless, they often get diagnosed at an earlier stage. Furthermore, women had a higher probability of using inpatient cancer-care services and surgical treatments. Conversely, men had greater risks of readmission after surgery (n=2) and longer length of stay (n=2). Lastly, there were no significant gender differences in the likelihood of receiving chemotherapy and radiation therapy.

Conclusion: This study synthesised evidence of disparities in the use of lung cancer treatments based on gender in developed countries, and no evidence was available from least-developed and developing countries. Further studies are required to understand this gender-specific inequality and to design interventions to improve the survival rate of lung cancer patients.

Key Words: Gender difference; healthcare utilisation; lung cancer; systematic review.

3.2 Introduction

Lung cancer is the most frequently diagnosed cancer in both men and women globally (11.6% of total cancer cases in 2018). It is the principal cause of cancer-related mortality (18.4% of total cancer deaths in 2018) (Bray et al. 2018); 1.18 million deaths in men and 0.58 million in women worldwide in 2018 (International Agency for Research on Cancer 2018; Thun et al. 2018). There is evidence in the last few decades of a reducing trend in age-adjusted lung cancer mortality rate among men but increasing in women mainly due to the increasing smoking rate among women (Australian Institute of Health Welfare 2018; Siegel et al. 2014). Moreover, increasing lung cancer incidence is placing an additional burden on the healthcare system, and it is becoming a major component of overall health expenditure in developed countries (Sullivan et al. 2011). Therefore, lung cancer has been a major area of scientific study (both quantitative and qualitative) in recent years, especially in developed countries.

Lung cancers are commonly classified into two types: small cell (SCLC) and non-small cell lung cancer (NSCLC) and with clinical, therapeutic and pathophysiological implications (Patel et al. 2007). National Institute for Clinical Excellence (NICE) and the American Society of Clinical Oncology (ASCO) are continuously updating their evidence-based guidelines on lung cancer treatments. These guidelines, as well as the latest literature, recommend surgical resection for early-stage (Stage I and II) patients with minimal comorbidities and medical complications, while chemotherapy is advised for advanced stage (Stage III and IV) patients with good prospects of survival (Patel et al. 2007; Rich et al. 2011). Despite these closely followed guidelines, significant heterogeneities in men's and women's lung care mortality and 5 year survival rates are well documented. There is limited evidence, and it is not clear whether the differences are biological or social in nature, or due to psychological differences driven by the gender-specific characteristics (Bird & Rieker 1999).

The question of discrepancies in healthcare utilisation by lung cancer patients differentiated by gender is a source of heightened debate. Previous literature concluded that lung cancer in women contains specificities that distinguish it from lung cancer in men (Mennecier et al. 2003). For example, adenocarcinoma is the most frequent histologic subtype, and it is more common in women than men (Levi et al. 1997). Could this mean gender-specific biological differences might determine the

demand for lung cancer treatments irrespective of the stage of diagnosis? In a recent study, Hunt et al. (2010) stated the importance of the further investigation to compare the gender-specific differences in healthcare utilisation of lung cancer patients which will assist in developing modulated policies and practices concerning critical cancer care. Understanding the influence of gender on the pattern of healthcare utilisation or care-seeking behaviour of lung cancer patients is pivotal to improving the survival rates, of both genders.

Health policymakers recognise reducing disparity (e.g. gender-specific) in cancer mortality as a critical priority; however, designing appropriate interventions is often impeded by incomplete or inadequate evidence (Chirikos et al. 2008). In this systematic review, the aim is to provide a comprehensive overview of the available evidence and obvious omissions in the current literature on the gender-specific differences in healthcare utilisation of lung cancer patients. This will involve summarising features such as study design and measurement aspects of treatment, assessment of the quality of the reported results, and to provide a narrative synthesis of the key findings. In this review, seven categories of healthcare utilisation (from diagnosis to radiation therapy) have been included. The narrative synthesis of the current evidence from the peer-reviewed published papers presented in this review will assist in understanding the current knowledge gaps and to better understand why men and women have differing adoption and utilisation rates of the range of lung cancer treatments. These are important issues to identify and potentially influence healthcare provision, policies and procedures in developing and implementing interventions to reduce lung cancer mortality.

3.3 Methods

This study used the PRISMA (preferred reporting items for systematic reviews and meta-analysis) guidelines to develop the systematic literature review (McInnes et al. 2018). A review protocol was registered with the International Prospective Register of Systematic Reviews (PROSPERO) on March 11, 2019 (registration number CRD42019124672) (Appendix A).

3.3.1 Literature search

The online databases of PubMed, Scopus, Web of Science, EBSCO Host, Ovid nursing, and Cochrane were searched from inception to April 2019 to find articles that

estimated the healthcare utilisation of lung cancer patients based on their gender. The following categories of care were considered: diagnosis interval and screening for lung cancer; physician visits; emergency department visits; hospital admissions and readmissions (including the length of stay); and life-extending treatments such as surgery, chemotherapy and radiation therapy.

Only peer-reviewed published articles written in the English language were considered. No time/date restriction was applied. Additional literature was identified by scanning the references of the selected articles.

The complete search strategy is provided in the study protocol. Search terms included gender, healthcare use and lung cancer. The search strategy was planned using the help of a research librarian and a clinical librarian. Two reviewers independently conducted the search, based on the adopted strategy and the inclusion and exclusion criteria. EndNote (X8) software was used to organise and manage the references.

3.3.2 Eligibility criteria

Journal articles included had healthcare utilisation or treatment of lung cancer patients with the following criteria: 1) the published article was a novel work (including review papers of all kind), 2) the study included adult (18+) human participants or cohorts, and 3) the study explicitly showed quantitatively specified healthcare use of lung cancer patients by gender. Studies of all types and stages of lung cancer were within the scope of the review, and no limitations were applied to study design.

Excluded studies included those with children and patients suffering from other acute long-term health conditions, as their intensity of care utilisation will differ. Studies with a primary focus on the utilisation of palliative, nursing home and social care were also omitted. In addition, quantitative studies that reported gender-based differences in lung cancer incidence, risk factors, mortality or survivorship, disease management and patient satisfaction were not included. All studies that did not present gender-specific differences in care-seeking events were excluded. Finally, qualitative studies that did not document the occurrences of healthcare use were also deemed outside the scope of this study.

3.3.3 Study selection and data extraction

Studies identified from the database search were independently evaluated by two investigators (RHR and FA) to assess their eligibility for inclusion by using the title, abstract, and screening of full-text (if required). Disagreements were resolved by discussion between the two reviewers, and KA was involved when no agreement could be reached and KA resolved the conflict. Four studies were not included due to disagreements, where RHR was in favour of including those studies but FA and KA disagreed. No other major issues aroused while conducting the study. Full-text versions of the selected articles were further examined by KA and JG. Lastly, the reference lists of the included articles were also searched for potential additional studies by RHR.

The following data from each selected study was extracted: author, year of publication, journal, study design, study population and setting, sample size, distribution of gender and age, stage and type of lung cancer, types of treatment used and main outcome measures and key findings. Data extraction was conducted by RHR using the guidelines provided by the PRISMA statement (McInnes et al. 2018). KA and JG verified the extraction of data from the selected studies.

3.3.4 Assessment of study quality

The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement checklist was used to evaluate the quality of the included studies (Von Elm et al. 2007). Nineteen key items from the checklist were used: background, objective, setting, participants, data source, study size, quantitative variables, statistical method, missing data, sensitivity analysis, descriptive data adjusted and unadjusted results, limitations, interpretation of findings and funding sources of the study (items 2, 3, 5-8, 10-14, 16,18-20, 22). The quality appraisal was conducted by RHR and FA independently, which was rechecked by JG. Each item was coded Y= present, N= not present, P= partially present and N/A = not applicable followed by the calculation of the percentage positive judgement.

3.3.5 Data synthesis

Significant heterogeneity was observed in study design, methods, measures of outcomes and key findings among the selected studies, and therefore, a meta-analysis was not conducted. Instead, a descriptive analysis of the characteristics of the included studies was performed, and a qualitative synthesis of the principal outcomes was

developed. The main focus was to identify both qualitative and quantitative estimates that reported variations in healthcare use of lung cancer patients by gender. The different categories of treatment use reported were also evaluated as to whether the papers concluded any significant differences in care usage or care-seeking behaviour by gender.

3.4 Results

3.4.1 Identification of studies

The title and abstract of 1,356 articles were screened, and 190 full texts were reviewed, out of which 42 studies met the inclusion criteria and reported gender-specific differences in healthcare use of lung cancer patients (Figure 3.1). Forty-one of these were population-based observational studies, and there was a single literature review. No randomised control trials which investigated the primary question of this study were identified.

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┌──────────────────────────┐              ┌──────────────────────────┐
│ Research studies identified │            │ Additional research studies │
│ through database searching │            │ identified through reference │
│        (n= 1408)          │              │ screening of included studies │
└──────────────────────────┘              └──────────────────────────┘
                    ↘                    ↙
              ┌──────────────────────────┐
              │ Research studies after duplicate │
              │ removed and screened (n= 1356) │
              └──────────────────────────┘
                          ↓
              ┌──────────────────────────┐
              │ Research studies excluded after │
              │ screening titles and abstracts │
              │        (n= 1166)          │
              └──────────────────────────┘
                          ↓
              ┌──────────────────────────┐      ┌──────────────────────────┐
              │ Studies retained for full text │ → │ Research studies excluded after │
              │        review             │      │ analysing full text       │
              │        (n=190)            │      └──────────────────────────┘
              └──────────────────────────┘
                          ↓
              ┌──────────────────────────┐
              │ Studies included for quantitative │
              │ synthesis (n=42)          │
              └──────────────────────────┘
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Figure 3.1 Framework of the systematic literature review process

3.4.2 Study characteristics

In total, the main objective of the thirty-eight (out of forty-two) selected articles were to examine healthcare utilisation of lung cancer patients, one evaluated health expenditure, and three papers studied both (Table 3.1). The articles were published from 1982 to 2018 and twenty-one of these were published after the year 2010, while only four were published before 2000. Noticeably, the study setting and population of all the included papers were primarily from high-income countries (North America = 17; Europe = 20; Australia and New Zealand = 2, Japan = 1 and South Korea = 1). The median time gap between final observation year and publication year is in the range of 3-5 years. The minimum age for the inclusion of lung cancer patients in these papers were 18 years. In total, eleven papers (26.9 %) specifically looked at older age group (60+) and five did not specify the age range. The studied population size extended from 271 to 186,741.

There are significant heterogeneities in the types and number of treatments measured. Thirteen studies reported healthcare utilisation data for multiple lung cancer treatment usages and the rest reported a single measure of healthcare use. Nineteen studies considered patients with non-small cell only, and one study focused on only small cell lung cancer, while eight included both types of lung cancer. The gender distribution of the population of the selected studies was predominantly male. Thirty-six of them had more than 50% of the participants as male. Finally, twenty of the included articles reported statistically significant differences in healthcare utilisation of lung cancer patients by gender and two reported mixed findings. The rest of the studies concluded that there were no significant gender-based differences.

Table 3.1 Characteristics of included studies (n = 42)

Study objective	All studies (%)	Recentness (the gap between final observation year and publication year)	All studies (%)
Healthcare utilisation	38 (90.5)	1-3 years	10 (23.8)
Health expenditure	1 (2.4)	3-5 years	17 (40.5)
Both	3 (7.1)	>5 years	14 (33.3)
Publication year		Not reported	1 (2.4)
≤1990	2 (4.8)	**Number of care utilisation reported***	
1991-2000	2 (4.8)	Single measure	28 (68.3)
2001-2010	17 (40.4)	Multiple measures	13 (31.7)
2011≤	21 (50)	**Type of lung cancer studied**	
Study setting*		Small cell	1 (2.4)
North America	17 (41.4)	Non-small cell	19 (46.4)
Europe	20 (48.8)	Both	8 (19.5)
Australia & New Zealand	2 (4.9)	Not reported	13 (31.7)
Japan and Korea	2 (4.9)	**Reported outcome (gender difference)**	
Minimum age for inclusion (years)		Significant difference in care use	20 (47.6)
Any age	5 (11.9)	No significant difference in care use	20 (47.6)
18+	5 (11.9)	Mixed findings	2 (4.8)
30+	6 (14.3)	**Percentage of male participants***	
40+	3 (7.1)	50%	3 (7.3)
50+	7 (17)	50% -60%	19 (46.3)
60+	11(25.9)	>60%	17 (41.5)
Other/ not specified	5 (11.9)	Not reported	2 (4.9)

Note: * indicates n=41 as we selected 1 systematic literature review, some of the criteria were not applicable. Year of publication and lag was used.

Table 3.2 Specialisation of healthcare utilised in the included studies

Category of care	n	References
Diagnosis/delays in seeking care	4	Din et al. (2015); Lyratzopoulos et al. (2012); Marshall et al. (1982); Neal & Allgar (2005).
Physician visit	2	Kurtz et al. (2006); Shugarman et al. (2008)
Emergency department visit	6	Abel et al. (2015); Beatty et al. (2009); Kurtz et al. (2006); Mitchell et al. (2015); Raine et al. (2010); Sikka & Ornato (2010).
Hospitalisation	9	Kurtz et al. (2006); McDevitt et al. (2013); Mennecier et al. (2003); Ogawa et al. (2015); Nebreda et al. (2016); Puri et al. (2015); Shugarman et al. (2008); Skaug et al. (2009); Wright et al. (2008).
Surgery	19	Berglund et al. (2012); Chirikos et al. (2008); Currow et al. (2014); de Perrot et al. (2000); Mahmud et al. (2003); McMahon et al. (2011); Mehta et al. (2012); Mennecier et al. (2003); Nilssen et al. (2016); Ouellette et al. (1998); Potosky et al. (2004); Raine et al. (2010); Rich et al. (2011); Starr et al. (2013); Smith et al. (1995); Strand et al. (2012); Tammemagi et al. (2004); Visbal et al. (2004); Wouters et al. (2010).
Chemotherapy	13	Berglund et al. (2012); Lairson et al. (2015); Lee et al. (2018); Mahmud et al. (2003); Mennecier et al. (2003); Noonan et al. (2015); Patel et al. (2007); Potosky et al. (2004); Ramsey et al. (2004); Smith et al. (1995); Tammemagi et al. (2004); Visbal et al. (2004); Wouters et al. (2010).
Radiation therapy	9	Berglund et al. (2012); Chirikos et al. (2008); Hayman et al. (2007); Koning et al. (2012); Mahmud et al. (2003); Nilssen et al. (2016); Smith et al. (1995); Visbal et al. (2004); Wouters et al. (2010).

Table 3.2 presents the various aspects of healthcare utilisation evaluated in the selected studies. Surgery (n= 19) was the most common nature of healthcare utilisation investigated, followed by chemotherapy (n= 13) and radiation therapy (n = 9) (Table

3.2). Many of these studies examined all three categories of treatments (Berglund et al. 2012; Mahmud et al. 2003; Smith et al. 1995; Visbal et al. 2004; Wouters et al. 2010).

Generally, the methodological quality and comprehensiveness of reporting of the studies were in the range of moderate to good. Background/rationale, study setting, eligibility of the participants, data sources and management, statistical methods with control variables, category of continuous variables and a discussion on main results were reported by all studies either partially or whole. In addition, nineteen of the included articles declared funding information. Eighteen of these published papers presented information about the methods used for handling missing data, and only one in five included a detailed sensitivity analysis.

Table 3.3 Methodological quality assessment and depth of reporting

STROBE ITEMS*	2	3	5	6	7	8	10	11	12A	12C	12E	13A	14A	16A	16B	18	19	20	22
Paper Names																			
McDevitt J et al. (2013)	Y	P	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Shugarman LR et al. (2008)	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	Y	Y	N
Din NU et al. (2015)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y
Sikka V et al. (2012)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N
Abel GA et al. (2015)	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	Y	Y	Y
Ramsey SD et al. (2004)	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	Y	Y	N
Ogawa et al (2014)	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	P	Y	Y	Y	Y	N
Chirikos TN et al. (2008)	Y	Y	Y	Y	Y	Y	P	Y	Y	Y	N	P	Y	Y	N/A	Y	Y	Y	N
Lairson DR et al. (2015)	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	P	Y	Y	Y	Y	Y
Smith TJ et al. (1995)	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	P	N	Y	Y	P	Y	Y
Noonan K et al. (2015)	Y	Y	Y	Y	P	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	P	Y	Y
Visbal AL et al. (2004)	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	N	Y	Y
Skaug K et al. (2009)	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	Y	Y	N
Tammemagi CM et al. (2004)	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	P	Y	Y	Y	P	Y	Y
Rich AL et al. (2011)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y
Ouellette D et al. (1998)	Y	Y	Y	Y	P	Y	Y	P	Y	N	N	Y	P	N	N/A	Y	N	Y	N
Beatty S et al. (2009)	Y	P	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	N	Y	Y	N	Y	Y
Nilssen Y et al. (2016)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N
Koning CC et al. (2012)	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	P	Y	Y	Y	Y	N
Strand T-E et al. (2012)	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	P	Y	Y	Y	Y	N
Mahmud SM et al. (2003)	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	Y	Y	N
Potosky AL et al (2004)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N
McMahon M et al. (2011)	Y	P	Y	Y	N/A	Y	Y	Y	Y	N	Y	Y	Y	N	Y	Y	P	Y	N
Wright CD et al. (2008)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N

	2	3	5	6	7	8	10	11	12a	12c	12e	13a	14a	16a	16b	18	19	20	22
Kurtz ME et al (2006)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	P	Y	Y	Y	Y	Y
Mehta RS et al. (2012)	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	Y	Y	N
Mitchell ED et al. (2015)	Y	Y	N/A	N/A	Y	Y	Y	N/A	N/A	N/A	N/A	Y	N/A	N/A	N/A	Y	Y	Y	Y
Marshall JR et al. (1982)	Y	Y	Y	Y	P	Y	N	P	Y	N	N	N	N	N	N/A	Y	Y	Y	N
de Perrot M et al (2000)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	P	Y	Y	N	Y	N
Raine R et al. (2010)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y
Berglund A et al. (2012)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y
Neal and Allgar (2005)	Y	Y	P	P	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N/A	Y	Y	P	Y
Lyratzopoulos G et al. (2012)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Starr LK et al. (2013)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y
Nebreda MM et al (2016)	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	P	Y	Y	Y	Y	N
Puri V et al. (2015)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	P	Y	Y	Y	Y	Y	N
Hayman JA et al. (2007)	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	Y	Y	N
Patel N et al. (2007)	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	N	Y	N
Wouters et al (2010)	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	Y	Y	Y	Y	Y	Y	Y
Currow DC et al. (2014)	Y	Y	Y	Y	P	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	P	N
Mennecier B et al. (2003)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	P	Y	Y	P	Y	N
Lee YG (2018)	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	Y	Y	Y	Y	Y	Y	Y
% positive judgements	100%	93%	97.50%	97.50%	90.4%	100%	95%	95%	100%	45%	19%	93%	87.50%	67.50%	100%	100%	73%	95%	45%

note: 2. background/rationale, 3. objective, 5. setting, 6. eligibility of the participants, 7. variables, 8. data sources/measurement, 10. study size, 11. quantitative variables, 12a. statistical methods with control variables, 12c. addressing missing data, 12e. sensitivity analysis, 13a. participant number, 14a. descriptive data, 16a. main results, 16b. category of continuous variables, 18. key results, 19. limitations, 20. interpretation, 22. funding. Items 1, 4, 9,12b, 12d, 13b, 13c, 14b, 14c, 15, 16b, 16c and 17 were not applicable for assessing the papers included in this study.

Y = present, N = not present, P = partially present, N/A = not applicable. **% positive judgements =** total +/total number of papers

Table 3.4 Included studies on gender difference in healthcare utilisation of lung cancer patients

First author, year	Sample characteristics	Gender distribution	Stage of cancer studied	Outcome measured or type of treatment estimated	Key findings
Abel GA et al. (2015)	National Cancer Data repository (England). N = 162,543	Not reported	Not specified	Emergency presentation	1. Women had a significantly greater risk of emergency presentation than men for lung cancer: (odds ratio) women 1.06 vs men 1.00, $p < 0.05$.
Beatty S et al. (2009)	Auckland-Northland regional oncology service and ED data of District Health Boards (New Zealand). N = 478	M = 55.85; F = 44.15	Localised; Locally Advanced; Metastatic	Emergency department presentation	1. Gender was not associated with ED presentation for lung cancer patients. Noticeably, women's ED presentations were often associated with GP referrals, but men's ED visits were mostly self-referral. 2. ED presentations were associated with GP referral in women 48% vs men 37%, *NS.* ED presentations were associated with no GP referral in women 52% vs men 63%, *NS.*
Berglund A et al. (2012)	Thames Cancer Registry in South East England (England). N = 15,582	M = 57.1; F = 42.9	I; II; III; IV	The likelihood of receiving surgical resection, radiation therapy and chemo therapy	1. There were no significant differences in the probability of having surgical resection in early-stage NSCLC and radiation therapy in stage III disease. 2. Women showed a lower likelihood of receiving chemotherapy in advance stage lung cancer or SCLC. The adjusted odds ratio: men 1.0 vs women 0.90, $p < 0.05$.

Chirikos TN et al. (2008)	Surveillance, Epidemiology, and End Results. N= 73,771 (SEER) cancer registry files linked to Medicare claim files (USA). N= 73,771	M = 54.61; F = 45.39	I; II; III; IV	Use of surgery and radiation therapy	1. No significant difference in treatment use between men and women. 2. Women enjoy a slight advantage in being candidates for surgery. Descriptive statistics (% of patients): (surgery) white men=27.7 vs white women=29.0; (radiation therapy) white men=44.9 vs white women 40.6, *NS.*
Currow DC et al. (2014)	The NSW Central Cancer Registry (NSWCCR) and hospital patient data were linked by the Centre for Health Record Linkage (Australia). N = 3,040	M = 62.5; F = 37.5	I; II	Receiving surgical resection	1. Women with NSCLC had a higher resection rate than men. However, the result was not statistically significant after adjusting for age, histology type and comorbidity. 2. The odds of resection for localised NSCLC were: women 1.05 vs men 1.0, *NS.*
Din NU et al. (2015)	The Clinical Practice Research Datalink—CPRD and General Practice Research Database-GPRD. It is a longitudinal general practice database of (England and Wales). N = 6,552	M=57.2; F = 42.8	Not specified	Variations in diagnostic intervals (in days)	1. Longer diagnostic intervals were associated with women. They had a longer diagnostic interval than men: Adjusted mean difference (women vs men) = 8 days, $p < 0.05$.
de Perrot M et al (2000)	The Thoracic Surgery Unit, University Hospital of Geneva (Switzerland). N = 1,046	M = 80; F = 20	I; II; III; IV	Use of surgical treatment	1. Type of surgical procedure performed significantly varied by gender. 2. Higher proportion men received Pneumonectomy: men 32% vs women 22%, $p < 0.05$. More women underwent segmentectomy: women 11% vs men 5%, $p < 0.05$.

Hayman JA et al. (2007)	Surveillance, Epidemiology and End Results (SEER)-Medicare data (USA). N = 11,084	M = 59; F = 41	IV	Use of radiation therapy	1. Gender was not associated with the receipt of radiation therapy among patients with NSCLC. 2. The adjusted odds ratio of receipt of radiation therapy were: men 1.0 vs women 0.96, *NS.*
Koning CC et al. (2012)	Regional cancer registries of four of nine Dutch comprehensive cancer centres (CCCs): Amsterdam (A), Stedendriehoek Twente (B), West (C) and South (D) (The Netherlands). N = 24,185	M = 71; F = 29	I; II; III	Utilisation rate of radiotherapy.	1. Women had a lower probability of utilizing radiotherapy at all stages of lung cancer, although, the results were not statistically significant. 2. Probability of receiving radiotherapy (odds ratio) Stage I and II: men 1.00 vs women 0.95, *NS.* Probability of receiving radiotherapy (odds ratio) Stage III: male 1.00 vs female 0.97, *NS.*
Kurtz ME et al (2006)	Data were obtained by a combination of patient interview and patient self-administered questionnaire at four intervals: baseline (wave 1), 3 months (wave 2), 6 months (wave 3), and 12 months (wave 4) (USA). N = 277	M= 62.5; F = 37.5	Early; Late	Number of physician visits, emergency room visits and hospital nights.	1. Women reported lower frequent emergency room visits and fewer nights in hospital than men during the active treatment period. 2. The mean treatment use during the active treatment period, Physician visits: men 4.43 vs women 3.37, *NS.* Hospital nights: men 2.08 vs women 1.16, $p < 0.05$. Emergency room visits: men 0.19 vs women 0.06, $p < 0.05$.
Lairson DR et al. (2015)	SEER (Surveillance, Epidemiology, and End Results) program- and	M = 54.61; F = 45.39	III; IV	Platinum-based chemotherapy and platinum+ targeted therapy	1. No significant difference in the use of chemotherapy between men and women. 2. Descriptive statistics: (platinum-based chemotherapy) men 54.61% vs women

	Medicare-linked data (USA). N = 4,884				45.39%; (platinum + targeted therapy) men 53.56% vs women 46.44%, *NS.*
Lee et al. (2018)	National Health Insurance Service Database (South Korea). N = 7298	M= 76.25 F=23.75	Advanced NSCLC	Use of combination of Chemotherapy	1. Lower use of a combination of chemotherapy for women compared to men (odds ratio: men 1.0 vs women 0.71, p < 0.05).
Lyratzopoulos G et al. (2012)	The Eastern Cancer Registration and Information Centre (ECRIC) (United Kingdom). N = 16,714	M = 58; F = 42	I; II; III; IV	Lung cancer diagnosis	1. Women were less likely to be diagnosed in advanced stage compared with men for lung cancer. 2. The adjusted odds ratio of advanced stage lung cancer diagnosis: men 1.0 vs women 0.88, p < 0.05.
Mahmud SM et al. (2003)	The database of the National Cancer Registry (Ireland). N = 7,286	M = 65.55; F = 34.45	Not specified	Use of chemotherapy, radiotherapy and surgery	1. There were no significant differences in patterns of treatment for SCLC and NSCLC by gender.
Marshall JR et al. (1982)	The Great Lakes Area Tumour Service Registry, which re- corded all cancers diagnosed at major hospitals in Western New York and Western Pennsylvania (USA). N= 1,976	M = 76.9; F = 23.1	Local disease; Regional disease; Distant disease	Delay in seeking treatment	1. Women delay longer in obtaining treatment for cancers of the lung. However, the result is not statistically significant. 2. Mean reported delay (in months) between first symptom notice and cancer diagnosis: Men 2.6 vs women 2.7, *NS.*
McDevitt J et al. (2013)	The National Cancer Registry (NCR) and the Hospital In-Patient Enquiry (HIPE) database (Ireland). N= 1,284	M=58; F = 42	I; II; III	Length of stay/ Factors predicting longer LOS (upper quartile, >20 days), and emergency readmission within 28 days	1. No significant gender difference in hospital readmissions following surgery. 2. Median inter-decile range LOS: men=13 vs women 12, *NS.* Prolonged LOS in patients having resection for NSCLC. Prolonged LOS (>20 days): (risk ratio) women=1 vs men=0.99, *NS.*

					3. Emergency readmission in patients having a resection. Readmitted within 28 days after surgery: (risk ratio) women =1 vs male = 1.06, *NS*.
McMahon M et al. (2011)	Eastern Cancer Registration and Information Centre (ECRIC) (United Kingdom). N = 18,813	M = 65.42; F = 34.58	Not specified	Use of surgery	1. No gender-related differences in the percentage of patients treated with surgery. 2. The adjusted odds ratio of patients treated with surgery: men 1.0 vs women 0.95, *NS*.
Mehta RS et al. (2012)	The Surveillance, Epidemiology, and End Results (SEER) database (USA). N = 51,938	M = 53.7; F = 46.2	I; II	Receipts of surgical treatment	1. Women had lower odds of refusing surgical treatment than men. 2. The adjusted odds ratio of refusing treatment: men 1.17 vs women 1.0, p < 0.05.
Mennecier B et al. (2003)	The population based cancer registry of the Bas-Rhin, an administrative sub division in eastern France (France). N = 787	M = 88.4; F = 11.6	Limited; Extensive	Use of Chemotherapy, surgery, number of hospital admissions and hospital stay.	1. Men and women generally underwent the same number and type of tests. 2. The mean use of chemotherapy, surgery and hospital admission were not significantly different by gender. Women used chemotherapy more. Conversely, men had a higher number of surgery and hospital admissions. 3. Women had significantly longer stay at hospitals than men. The mean length of stay: women 74.6 vs men 63.2, p < 0.05.
Mitchell ED et al. (2015)	MEDLINE, EMBASE, CINAHL, EBM Reviews, Science and Social Sciences Citation Indexes, Conference Proceedings Citation Index-	Not applicable	Not applicable	Risk factor for emergency presentations	1. Women are more at risk of emergency presentation for lung cancer compared to men. 2. Women showed a higher probability of being diagnosed for lung cancer following the emergency presentation.

	Science and Conference Proceedings Citation Index-Social Science and Humanities. Number of studies included = 22				
Neal and Allgar (2005)	Secondary analysis of patient-reported data from the 'National Survey of NHS patients (United Kingdom).	Not reported	Not specified	Delays in seeking care. Pre-hospital delays, referral delays and secondary care delay.	1. Women cancer patients had longer delays in seeking care. However, the findings were not statistically significant. 2. The mean delays (in days) for primary care: women 82 vs men 77, *NS.* The mean delays (in days) for referral: women 35 vs men 32, *NS.* The mean delays (in days) for secondary care: women 13 vs men 11, *NS.*
Nilssen Y et al. (2016)	Cancer Registry, Statistics Norway and the Norwegian Patient Register (Norway). N = 24,324	M = 58.47; F = 41.53	Localised; Regional; Metastatic	Treatment using surgery and radiotherapy	1. Women were significantly more likely to undergo surgery. The odds ratio of the multivariate analysis (surgery): women 1.0 vs men 0.84, $p < 0.05$. 2. No significant gender difference in the probability of receiving radiotherapy among the SCLC patients. The odds ratios (radiotherapy): women 1.0 vs men 0.93, *NS.*
Noonan K et al. (2015)	British Columbia Cancer Agency database (Canada). N = 744	M = 52; F = 48	IIIB; IV	Wait and watch approach for chemotherapy	1. Men remained significant predictors of not receiving chemotherapy or missed opportunity for chemotherapy. 2. Patient characteristics for 'wait and watch missed' and 'wait and watch lost to follow-up: men 58% vs women 42%, p <0.05.

					3. No significant difference in 'immediate' and 'wait and watch' chemotherapy: (odds ratio) men 1.0 vs women 0.88, *NS*.
Ogawa et al (2014)	Patients underwent curative resections for NSCLC from January 2000- September 2012 at the Kitasato University Hospital (Japan). N = 969	M= 63; F = 37	IA; IB; IIA; IIB; IIIA; IIIB; IV	Readmission at the hospital after surgery	1. Women had a significantly lower rate of readmission after surgery. Out of 969 lung cancer patients, 33 had readmission after surgery, and 28 of them were men, p< 0.05.
Ouellette D et al. (1998)	Patient charts at a university hospital (Canada). N = 208	M = 50; F = 50	I; II; IIIA; IIIB; IV	Utilisation of surgical resection	1. Men and women received similar treatments (surgical resection) for their disease. However, more women than men refused treatment.
Nebreda MM et al (2016)	National Epidemiological Surveillance System for hospital data (minimum basic data set [MBDS]) managed by the Ministry for Health, Social Affairs and Equality (Spain). N = 298,435	M = 86; F = 14	Not specified	Incidence rate of hospitalisation	1. Women had a higher incidence rate of hospital admissions than men. The incidence rate ratio (IRR) of hospital admission for lung cancer were: men 1.0 vs women 0.133, p < 0.05. 2. The hospitalisation rate of men with lung cancer fell significantly from 112.5 in the year 2001 to 1.07.71 in 2011, p < 0.05. The hospitalisation rate of women with lung cancer increased significantly from 11.8 in 2001 to 23.6 in 2011, p < 0.05.
Patel N et al. (2007)	The Thames Cancer Registry (United Kingdom). N = 11,215	M = 62; F = 38	I; II; III; IV	Receiving chemotherapy	1. Women were less likely to receive chemotherapy than men lung cancer patients. 2. The adjusted proportion of patients receiving chemotherapy: men 16.7 % vs women 15.4%, p < 0.05.

Potosky AL et al (2004)	National Cancer Institute's Surveillance, Epidemiology and End Results (SEER) registries (USA). N = 898	M = 56.2; F = 43.8	I; II; III; IV	Receiving surgical resection and chemotherapy as part of initial therapy.	1. Higher percentage of women received surgical resection or chemotherapy as part of initial therapy than men, although, the differences were not statistically significant. 2. Patients receiving surgical resection (adjusted percent): women 72% vs men 67%, *NS.* Patients receiving chemotherapy (adjusted percent): women 44% vs men 39%, *NS.*
Puri V et al. (2015)	The National Cancer Database (NCDB) established by the American College of Surgeons and the American Cancer Society. N = 5,624	M = 49.47; F = 50.53	I; II; III	Hospital readmission after receiving surgery	1. Women had a lower probability of unexpected hospital readmission after surgery compared to men. 2. The odds ratio of the risk of postoperative readmission within 30 days of surgery: men 1.16 vs women 1.0, $p < 0.05$.
Raine R et al. (2010)	Hospital episode statistics (HES) dataset. Inpatient treatment delivered by NHS hospitals (England). N = 186,741	M = 55; F = 45	I; II	Emergency admission and surgical treatment	1. Women were more likely than men to undergo surgery for lung cancer and emergency admissions. 2. The adjusted odds ratio for emergency admission: women 1.12 vs men 1.0, $p < 0.05$. The adjusted odds ratio of receiving surgery: women 1.22 vs men 1.0, $p < 0.05$.
Ramsey SD et al. (2004)	National Cancer Institute database of the SEER cancer registry linked to Medicare claims (USA). N= 14,875	M= 57; F= 43	IIIb; IV	Chemotherapy use	1. Women were significantly less likely to receive chemotherapy: (odds ratio) men 1.0 vs women 0.87, $p < 0.05$.

Rich AL et al. (2011)	The National Lung Cancer Audit (NLCA) linked to hospital episode statistics in (United Kingdom). N = 34,513	M = 60; F= 40	IA; IB; IIA; IIB; IIIA; IIIB; IV	Likelihood of receiving surgery.	1. Women have a higher likelihood of having surgery but not the finding was not statistically significant. 2. The adjusted odds ratio of the likelihood of receiving surgery: men 1.0 vs women 1.06, *NS.*
Shugarman LR et al. (2008)	Medicare claims file (USA). N= 13,120	M= 57.4; F= 42.6	Not specified	Inpatient, outpatient and physician visits	1. Women's adjusted odds of using inpatient care were 1.2 times that of men (95% confidence interval, 1.07–1.33), *NS.* 2. Gender was not associated with the use of outpatient services: (odds ratio), women 1.00 vs men 1.00, *NS.* 3. Use of physician services did not differ significantly by gender.
Sikka V et al. (2012)	The Michigan Tumour Registry (inpatient and outpatient claims file), a state-wide, population-based registry (USA). N=11,281	M= 56.20; F = 43.8	Early; Late	A diagnosis associated with the ED visit.	1. Women were more likely to have a diagnosis associated with an ED visit: (odds ratio) women 1.13 vs men 1.0, p < 0.05.
Skaug K et al. (2009)	Lung cancer patients in the Haugalandet area and Norwegian Cancer Registry and hospital records of Haugesund hospital (Norway). N = 271	M = 79; F= 21	I; II; III; IV	Number of hospital admissions and length of stay	1. No significant differences between the type of hospitalisation and hospital days between men and women. 2. The adjusted hazard ratio of fewer hospital days: men 1.0 vs women 1.2, *NS.*
Smith TJ et al. (1995)	Virginia Cancer Registry (VCR), Medicare Health Insurance Master File (HIM), the Medicare Annual Demographic	M= 68.6; F = 31.4	Localised; Distant	Opting for no therapy. Use of surgery, radiation therapy, surgery + radiation therapy and chemotherapy.	1. For patients with loco-regional disease, women were significantly less likely to receive radiation therapy: women 41% vs men 50%, p < 0.05. 2. For patients with loco-regional disease, women were significantly more likely to

	Files, the Medicare Provider Analysis and Review, Medicare Automated Data Retrieval System (MADRS) file, the Area Resource File (USA). N = 4,999				receive surgery: women 34% vs men 26 %, p < 0.05. 3. No significant variations in treatment utilisation among men and women were found for patients with distant disease.
Strand TE et al. (2012)	Cancer Registry (Norway). N = 2,201	M = 68; F = 38	I; II; III; IV	Utilisation of surgical resection	1. Women had a significantly lower rate of surgical resection than men. 2. The mean percentage of the patient used surgical resection in three different time periods were: women 38% vs men 62%, p < 0.05.
Starr LK et al. (2013)	The Danish Lung Cancer Register, the Central Population Register, the Integrated Database for Labour Market Research and the Danish Hospital Discharge Register (Denmark). N = 5,538	M = 56.24; F = 43.76	I; II; IIIA	Likelihood of receiving surgery	1. Women with stages I-III NSCLC had a higher probability of no receiving surgery than men. However, the findings were not statistically significant. 2. The adjusted odds ratio of not using surgical treatment: women 1.19 vs men 1.0, *NS*.
Tammemagi CM et al. (2004)	Josephine Ford Cancer Centre Tumour Registry and medical records (USA). N = 1,155	M = 59; F = 41	I; II; III; IV	Surgery in localised disease and chemotherapy in advance disease	1. A higher percentage of women had surgery in localised NSCLC and chemotherapy in advanced NSCLC and SCLC. However, the mean differences were not statistically significant. 2. In the multivariate analysis, the odds ratio of surgery in Stage I and II of NSCLC is: women 1.0 vs women 0.86, *NS*. The odds ratio of chemotherapy in Stage III and IV NSCLC and SCLC is: women 1.0 vs men 0.95, *NS*.

Visbal AL et al. (2004)	Patients diagnosed or confirmed for lung cancer in Mayo Clinic (USA). N = 4,618	M= 59; F = 41	IA; IB; IIA; IIB; IIIA; IIIB; IV	Use of radiation therapy, chemotherapy and surgery	1. There were no significant differences in treatment use between genders. 2. Rate of treatment use: (surgical resection) women 51% vs men 48%; (chemotherapy) women 33% vs men 32%; (radiation therapy) women 30% vs men 31%, *NS.*
Wright CD et al. (2008)	The Society of Thoracic Surgeons (STS) General Thoracic Surgery Database (USA). N = 4,979	M = 50; F = 50	Not specified	Hospital length of stay	1. Prolonged length of stay (>14 days) at the hospitals were significantly associated with men. 2. The estimated odds ratio of prolonged length of stay after lobectomy for lung cancer: men 1.45 vs women 1.0, $p < 0.05$.
Wouters et al (2010)	The population-based Cancer Registry (Netherlands). N = 43,544	M = 69; F= 31	I; II; III; IV	Resection rate, radiation therapy and chemotherapy or combined modality therapy (chemoradiation)	1. No significant gender differences were found in the probability of, receiving surgical resection for stage I and II and receiving combined modality therapy for stage III NSCLC. 2. The adjusted odds ratio of receiving resection: men 1.0 vs women 1.0, *NS.* The adjusted odds ratio of receiving combined modality therapy: men 1.0 vs women 0.92, *NS.*

Note: NS indicates that the findings are not statistically significant.

3.4.3 Summary of the key findings

The measures of healthcare utilisation during active lung cancer treatment period were structured into seven categories (Table 3.2). Most of the studies (n=28) investigated a single modality of treatment use.

3.4.3.1 Diagnosis

Four studies which investigated the diagnostic interval and delays in care-seeking were included (Din et al. 2015; Lyratzopoulos et al. 2012; Marshall et al. 1982; Neal & Allgar 2005). Two of these studies looked into gender-specific factors (Din et al. 2015; Marshall et al. 1982), and the rest (Lyratzopoulos et al. 2012; Neal & Allgar 2005) assessed other sociodemographic factors (including gender) that influenced cancer screening and diagnostic intervals. Diagnosis interval was defined as the time gap between the first incidence of a lung cancer symptom and the date of cancer diagnosis (Din et al. 2015; Neal & Allgar 2005). Two studies reported that longer diagnostic intervals were significantly associated with women (Din et al. 2015; Neal & Allgar 2005). Similarly, Marshall et al. (1982) concluded that women with lung cancer diagnosis delay longer than men in obtaining care, but these results were not statistically significant. It is noteworthy that both studies (Din et al. 2015; Neal & Allgar 2005) used clinical data from the UK. According to Din et al. (2015), the mean difference in the diagnostic interval between men and women patients is 8 days (p = 0.02). Conversely, Lyratzopoulos et al. (2012) compared the stage of diagnosis between men and women with data from the UK and concluded that men are more likely to be diagnosed at a more advanced stage of lung cancer (Odds ratio: men 1.0 vs women 0.88; p = 0.003), this result was not statistically significant.

3.4.3.2 Physician visit

Two studies focused explicitly on outpatient medical services (Shugarman et al. 2008) and physician visits (Kurtz et al. 2006). These studies concluded that no significant gender differences were observed in the number of outpatient services used (Shugarman et al. 2008) or physician visits during the active and continuing period of treatment (Kurtz et al. 2006).

3.4.3.3 Emergency department visit

Six papers examined gender-specific differences in emergency department visits (Abel et al. 2015; Beatty et al. 2009; Kurtz et al. 2006; Mitchell et al. 2015; Raine et al. 2010; Sikka & Ornato 2010). Among these papers, four examined the likelihood of emergency department visits, presentation or admissions (Abel et al. 2015; Mitchell et al. 2015; Kurtz et al. 2006; Raine et al. 2010) and two studied whether gender influences the odds of a lung cancer diagnosis being associated with an emergency department visit (Beatty et al. 2009; Sikka & Ornato 2010). Three studies concluded that women patients have a significantly greater risk of having an emergency presentation than men. They are: Sikka & Ornato (2010) which used US data (Odds ratio: men 1.0 vs women 1.13; $p < 0.05$), Abel et al. (2015) used UK data (Odds ratio: men 1.0 vs women 1.06; $p < 0.05$) and Raine et al. (2010) also used UK data (Odds ratio: men 1.0 vs women 1.12, $p < 0.05$). Conversely, one study obtained data from 277 elderly (65+) patients in the USA and reported that men had a significantly higher frequency of emergency department visits during the first year following a lung cancer diagnosis (Kurtz et al. 2006). On the other hand, a study conducted with more than 20,000 older (65+) patients in the USA concluded that women lung cancer patients had a higher probability of a diagnosis associated with an emergency department visit (Odds ratio: men 1.0 vs women 1.13; $p < 0.05$) (Sikka & Ornato 2010). However, a similar study with data from New Zealand (n = 478) stated that gender was not associated with emergency department presentation.

3.4.3.4 Hospitalisation and length of stay

In total, nine studies reported different results on the association of gender and hospitalisation and length of stay for lung cancer patients. Among these, five papers studied hospital admission and readmissions, three papers studied nights' stays at the hospitals, and one reported both categories of health services. Shugarman et al. (2008) using US data concluded that women's use of inpatient care services were higher than men (Odds ratio: men 1.0 vs women 1.20; $p < 0.05$) and similarly, Nebreda et al. (2016) also identified that the incidence of hospital admissions are higher for women (incidence rate ratio: men 1.0 vs women 0.133; $p < 0.05$) using Spanish data. Conversely, Skaug et al. (2009) with Norwegian data and Mennecier et al. (2003) with French data, showed that the hospitalisation rates were comparable in both genders.

Two papers that explored the variations in postoperative readmissions were selected Ogawa et al. (2015) (in Japan) and Puri et al. (2015) (in the USA). Both studies established that being male was significantly associated with unanticipated hospital readmissions after surgery. Puri et al. (2015) presented the odds ratio of the risk of postoperative readmission within 30 days (Odds ratio: men 1.16 vs women 1.0; $p < 0.05$). Furthermore, two US-based studies concluded significant distinctions in hospital length of stays by gender for lung cancer patients. Kurtz et al. (2006) found a higher mean number of hospital nights for men (men 2.08 vs women 1.16; $p < 0.05$) and Wright et al. (2008) observed that being male is a significant determinant of prolonged (> 14 days) length of stay (Odds ratio: men 1.45 vs women 1.0; $p < 0.05$). Meanwhile, another study employed data from the National Cancer Registry of Ireland and found no statistically significant gender difference in hospital readmissions following surgery and in prolonged (> 20 days) length of stay in patients having resection for NSCLC (McDevitt et al. 2013).

3.4.3.5 Surgery

Surgery was the most frequent treatment reported for lung cancer patients ($n = 19$). These studies reported significant gender differences in undergoing surgery. Among these studies, six used data from the USA (Chirikos et al. 2008; Mehta et al. 2012; Potosky et al. 2004; Smith et al. 1995; Tammemagi et al. 2004; Visbal et al. 2004;), four from the UK (Berglund et al. 2012; McMahon et al. 2011; Raine et al. 2010; Rich et al. 2011;), two from Norway (Nilssen et al. 2016; Strand et al. 2012) and one study each from France (Mennecier et al. 2003), Switzerland (de Perrot et al. 2000), Denmark (Starr et al. 2013), Netherlands (Wouters et al. 2010), Ireland (Mahmud et al. 2003), Canada (Ouellette et al. 1998) and Australia (Currow et al. 2014). Eight out of these nineteen studies concluded that women had a higher likelihood of undergoing surgery; however, one paper from Norway concluded the opposite, and the rest found no significant gender-specific variations in surgery as a treatment option.

Raine et al. (2010) concluded that men were less likely than women to use lung cancer resection (Odds ratio: men 1.0 vs women 1.12; $p < 0.05$), Smith et al. (1995) found that for patients with loco-regional diseases women were more likely to have surgery (men 26% vs women 34%; $p < 0.05$). Nilssen et al. (2016) argued that women had a higher probability of undergoing surgery (Odds ratio: men 0.84 vs women 1.00; $p <$

0.05), Mehta et al. (2012) reported that male patients had greater probability of refusing surgery (Odds ratio: men 1.17 vs women 1.0; p < 0.05), and Currow et al. (2014) demonstrated that women with localised non-small cell lung cancer had higher resection rates than men (Odds ratio: men 1.0 vs women 1.05; p < 0.05). Similarly, Chirikos et al. (2008), Rich et al. (2011) and Berglund et al. (2012) also concluded that women patients are more probable to undergo surgery than men, but their findings were not statistically significant. In another study, de Perrot et al. (2000) found that patients in either gender were treated similarly; however, pneumonectomy was more frequently performed on men and women had a higher probability of undergoing a segmentectomy.

3.4.3.6 Chemotherapy

Thirteen papers included chemotherapy as a lung cancer treatment and the majority of them (eight) found no statistically significant difference by gender in receiving chemotherapy. Five out of these eight papers used data from the USA and the remaining three were from France, Ireland and Netherlands. Four studies found that male lung cancer patients were significantly more likely to receive chemotherapy (Berglund et al. 2012; Lee et al. 2018; Patel et al. 2007; Ramsey et al. 2004) and one concluded that being male remained a significant predictor of not receiving chemotherapy or having a missed opportunity to receive chemotherapy (Noonan et al. 2015). Berglund et al. (2012) (Odds ratio: men 1.0 vs women 0.88; p < 0.05) and Patel et al. (2007) (men 16.7% vs women 15.4%; p < 0.05) estimated that women lung cancer patients were less likely to receive chemotherapy than men. Both of these studies used data from the UK. Lee et al. (2018) (from Korea) concluded that female patients use of chemotherapy is lower than males (Odds ratio: men 1.0 vs women 0.071; p < 0.05). Likewise, another study using USA data also came to a similar conclusion (Odds ratio: men 1.0 vs women 0.87; p < 0.05) (Ramsey et al. 2004).

3.4.3.7 Radiation therapy

Nine studies examined gender differences in undergoing radiation therapy among lung cancer patients. Only one study (from the USA) concluded there was a significant difference. According to Smith et al. (1995) male lung cancer patients (loco-regional disease) had a higher probability of receiving radiation therapy than women (men 50% vs women 41%; P < 0.05). Another six studies found similar outcomes, but their

findings were not statistically significant (Chirikos et al. 2008; Hayman et al. 2007; Koning et al. 2012; Mahmud et al. 2003; Visbal et al. 2004; Wouters et al. 2010;). By comparison, two studies (from the UK and Norway) expressed opposite conclusions; nonetheless, their findings were also statistically insignificant (Berglund et al. 2012; Nilssen et al. 2016).

3.5 Discussion

This study is the first systematic review examining gender-specific differences in healthcare utilisation among lung cancer patients. There has been an increasing number of studies that looked into the treatment use of lung cancer patients in the last decade. This has increased the prospect of conducting a population-based retrospective of the factors that influence these patients' care-seeking behaviours or patterns of healthcare use. This is evident because half of the articles selected for this review was published within the last ten years. Included studies measured seven categories of treatment use: diagnosis interval and stage of diagnosis, physician visits, emergency presentation, hospital admission and length of stays, surgical resection, chemotherapy and radiation therapy. The preliminary findings show that all the included articles have employed data from developed (as classified by the World Bank) countries and the study populations were male-dominated. However, the objectives, population size, types and stages of lung cancer, measures of treatment used, statistical method and study design were heterogeneous in the selected studies. Surgery, chemotherapy and radiation therapy dominated the types of healthcare use investigated. Some contradictions in the types of treatment used have been found in the selected studies. These contradictions may have arisen owing to heterogeneity in the characteristics of the study design, study populations and healthcare systems and policies of the studied countries.

In relation to diagnosis interval and stage of cancer diagnosis, studies suggest that women tend to have longer diagnostic intervals; nonetheless, they often get diagnosed with lung cancer at an earlier stage. At first glance, these findings seem contradictory. These results should be interpreted based on gender differences in awareness, detection and reporting of symptoms and the willingness to take appropriate healthcare actions. Previous studies have reported that women are more incisive in reporting symptoms (Warner & Procaccino 2007), receiving health information (Khakbazan et

al. 2014) and seeking cancer-related information (Manierre 2015), compared to men. Henceforth, if women are identifying symptoms earlier than men, a couple of things seem likely. In early stages, health practitioners may not accurately judge symptoms as critical (Marshall et al. 1982) especially since, occupational and nicotine exposure risk factors of lung cancer are more easily attributed to men than women. Furthermore, doctors perhaps may take a wait and see approach (symptom normalization) (Brindle et al. 2012) before prescribing screening tests. This may result in a longer diagnosis interval. On the other hand, the 'masculinity effect' or a reductionist approach by males to their healthcare needs may lead them to ignore and/or remain silent about their symptoms (Galdas et al. 2005). There are also the possibilities that men have fewer available hours to have regular contact with health practitioners owing to full-time and longer hours of work (Brittle & Bird 2007). These delays result in men with lung cancer symptoms triggering an immediate screening test. This may explain why men are seen to have shorter diagnosis intervals but are more often diagnosed with an advanced stage of lung cancer, compared with women.

Several articles reported emergency department visits of lung cancer patients and the results were diverse. Three papers indicated that women were more likely to visit the emergency department; however, one of these papers (Abel et al. 2015) concluded that the odds of emergency presentation of women reduced significantly after a case-mix adjustment. Another study found that men are more likely to visit the emergency department. The evidence concerning lung cancer diagnosis through an emergency department presentation is not conclusive. These studies did not contain a suitable explanation for the reported gender difference in emergency department visits. Previous studies showed that decreased physical functioning (Kurtz et al. 2006), patients with a prior history of emergency visits (before cancer diagnosis) (Sikka & Ornato 2010), old age (Mitchell et al. 2015), experience of pain (chest and abdominal) and respiratory symptoms (nausea and vomiting, shortness of breath) (Gorham et al. 2013; Hsu et al. 2018) were strongly associated with emergency room presentations by cancer patients. Future studies are needed to investigate the demographic risk factors of emergency department presentation for lung cancer patients during the active and continuing treatment period.

Contradictory results were found for the likelihood of hospital admission, readmission after surgery and length of stay by gender. The findings indicate that women had a

higher probability of using inpatient cancer-care services (n=2). Conversely, men had higher risks of readmission after surgery (n=2) and longer length of stay (n=2). Several papers, however, found that the hospitalisation rate (n=2) and hospital length of stay (n=1) were similar for both genders. Henceforth, it is difficult to determine if there are heterogeneities in the use of hospital care for lung cancer patients by gender. The differences in findings related to hospital admission may have arisen from other demographic or socioeconomic factors. For example, men's higher likelihood of readmission after surgery could be associated with factors such as; 1) advanced stage diagnosis and 2) being a more suitable candidate for pneumonectomy, due to the locally advanced nature of their cancer, compared to segmentectomy which is less radical. Previous studies have identified these two factors as primary risk factors for readmission after surgery among lung cancer patients (Handy Jr et al. 2001; Ogawa et al. 2015). The re-hospitalisation rate of lung cancer patients might also be influenced by other comorbidities (Tammemagi et al. 2004), which partly explains the variation in the findings.

This study has identified significant gender differences in the probability of receiving surgical treatment for lung cancer patients. Approximately half of the studies that reported on surgery as the treatment modality indicated women as the probable nominee for the treatment. Several explanations are possible in support of this outcome. Sitas et al. (2014) suggested that men with lung cancer are less likely to undergo surgery because they present at the later stages of cancer and with more comorbidities, where surgical resection is no longer the recommended mode of treatment. In addition, differences in smoking habits is another likely cause of differential cancer treatment between men and women. Squamous cell carcinoma (a type of cancer tumour) which is more common in heavy smokers (often men) are challenging to detect at early stages through chest radiography (de Perrot et al. 2000). Conversely, women lung cancer patients have a higher proportion of adenocarcinomas which is commonly located in the periphery of the lung, and therefore, surgical resection, such as segmentectomy (if the disease is localised) is comparatively more frequent (Currow et al. 2014; de Perrot et al. 2000).

A substantial number of the studies (75%) in this review concluded there were no significant gender differences in the odds of receiving chemotherapy and radiation therapy. However, a few of the studies suggested that men are more likely than women

to undergo this treatment. These types of treatments are more generic at the advanced stage of lung cancer and with tumours that manifest in an immediate threat to survival (Ramsey et al. 2004). Consequently, if more women are being diagnosed at an early stage, it is natural to find a lower proportion of women receiving chemo and radiation therapy. Furthermore, there is a growing body of evidence that men and women experience different physiological reactions after chemotherapy. Women often show severe adverse effects (e.g. nausea and vomiting, cardio and neuro toxicities) which has a potential impact on their decision to receive or continue chemotherapy treatment (Benchetrit et al. 2019; Wang & Huang 2007).

This systematic literature review has some limitations. It was not possible to perform a meta-analysis with data from the selected studies due to substantial heterogeneity in the study design, statistical estimation and categories of treatment measured. In addition, no grey literature or articles (all types including peer-reviewed) published in non-English language, have been included, and studies with null findings are less likely to be published in peer-reviewed journals. Henceforth, as with many reviews, it is not possible to avoid the likelihood of publication bias. Despite the thorough and accepted approach (e.g. back-referencing), it difficult to judge if all potential studies have been included in the review. Finally, no randomised controlled trial study was identified, which is the 'gold standard' of research evidence.

3.5.1 Gaps in the evidence and future research

Despite an extensive search of the literature, no peer-reviewed published studies were identified that had a study setting of a least-developed and developing country (e.g. South and South-east Asia, Africa, South America) though nearly 58% of lung cancer incidences (2012) occur in the least developed countries (Ferlay et al. 2015). These countries suffer from lack of adequate medical resources, lung cancer awareness and experience high gender-specific health inequalities. Hence, it can only be speculated that there is a greater magnitude of gender-specific inequalities in utilisation (women using healthcare substantially less than men) of cancer treatments in these settings. Future research to address this gap in the evidence is needed. Policymakers in these countries need to develop and ensure the availability of appropriate databases to enable credible research to be conducted. Furthermore, confounding evidence was found that men are diagnosed at later and more advanced stages of lung cancer. After establishing

the causes of this phenomenon, appropriate interventions (if possible, through a randomised controlled trial) should be developed to address this problem. This could substantially reduce the cost of treatment and improve the survivorship of lung cancer patients. Further investigation is required to understand how general practitioners evaluate the symptoms of lung cancer for men and women. Also noticeable is the lack of an adequate explanation in these past studies regarding the discrepancies in lung cancer patients emergency department visits, hospital admissions and hospital night stays, by gender. It is still unclear why studies in different settings found opposing results. The question remains: what contributes to this heterogeneity? Is it patient preferences or medical practitioner's behaviour and attitudes towards processing the treatment needs of a particular subgroup or cohort? This warrants the collection of in-depth and specific data so that further research could help to understand what drives care-seeking behaviour of lung cancer patients. Is it purely biological factors (e.g. genetic, hormonal) or social (Bird & Rieker 1999), purely patient preference, or is it the health system and practices? Future research should focus on understanding these questions.

3.6 Conclusions

This systematic review contributes to understanding the gender-based differences in care-seeking behaviour of lung cancer patients. Substantial evidence of heterogeneity in the seven categories of treatment was found. Nonetheless, some clear trends are apparent from this review of the literature. Men appear to be diagnosed with more advanced stage lung cancer compared to women, which may be an indicator of men's reductionist approach to self-health concerns, as well as guided by the higher incidence of certain types of lung cancers in men than women. This impacts upon the use of cancer treatment for men, including a lower candidacy level for surgical resection due to the more advanced nature of the malignancy, higher rates of unexpected hospital readmissions after surgery because of the complex nature of the surgery and a higher propensity to receive radiotherapy (offered during advanced malignancy). These findings from this systematic review raise significant concern that inherent gender-based lung cancer care-seeking and utilisation behaviours in men may be significant contributors to lung cancer-related morbidity and mortality. The gender-specific inequality in lung cancer survivorship may be explained in part by men's tendency

towards inaction for ill health-related symptoms and a likely underutilisation of evidence-based therapies for treatment.

Within the limitations of the included studies in this systematic review (male-dominated populations), there appear some general positive trends in women's care-seeking behaviour. The higher rate of emergency department lung cancer diagnosis and longer length of inpatient hospital stay may indicate that women are taking better initiatives to address their health concerns in an urgent and holistic fashion. Women showed a lower rate of advanced-stage lung cancer diagnosis than men and higher uptake of proposed therapies such as surgery or chemotherapy. These are positive trends, but the rationale and understanding behind them are incomplete. Future studies can look to elucidate this issue so that strategies can be developed to enhance these positive healthcare utilisation behaviour for the broader population.

Lung cancer treatment is a rapidly evolving area of oncology, with changing treatment paradigms and with the latest evidence-based clinical practises continuing to challenge care-providers and patients alike. Ongoing research into gender-specific differences in treatment-seeking and healthcare utilisation of lung cancer patient (in developed and developing countries) will prove highly beneficial in establishing a guide for policymakers and clinical care providers to optimise healthcare management by promoting care utilisation amongst all lung cancer patients.

References

1. Abel, GA, Shelton, J, Johnson, S, Elliss-Brookes, L & Lyratzopoulos, G 2015, 'Cancer-specific variation in emergency presentation by sex, age and deprivation across 27 common and rarer cancers', *British Journal of Cancer*, vol. 112, pp. S129-S36.

2. Australian Institute of Health Welfare 2018, 'Cancer in Australia: Actual incidence data from 1982 to 2013 and mortality data from 1982 to 2014 with projections to 2017', *Asia-Pacific Journal of Clinical Oncology*, vol. 14, no. 1, pp. 5-15.

3. Beatty, S, Stevens, W, Stevens, G, Kolbe, J & Cox, B 2009, 'Lung cancer patients in New Zealand initially present to secondary care through the emergency department rather than by referral to a respiratory specialist', *New Zealand Medical Journal*, vol. 122, no. 1294, pp. 33-41.

4. Benchetrit, L, Torabi, SJ, Tate, JP, Mehra, S, Osborn, HA, Young, MR, Burtness, B & Judson, BL 2019, 'Gender disparities in head and neck cancer chemotherapy clinical trials participation and treatment', *Oral Oncology*, vol. 94, pp. 32-40.

5. Berglund, A, Lambe, M, Lüchtenborg, M, Linklater, K, Peake, MD, Holmberg, L & Møller, H 2012, 'Social differences in lung cancer management and survival in South East England: a cohort study', *BMJ Open*, vol. 2, no. 3, pp.10-24.

6. Bird, CE & Rieker, PP 1999, 'Gender matters: an integrated model for understanding men's and women's health', *Social Science & Medicine*, vol. 48, no. 6, pp. 745-55.

7. Bray, F, Ferlay, J, Soerjomataram, I, Siegel, RL, Torre, LA & Jemal, A 2018, 'Global cancer statistics 2018: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries', *CA: a Cancer Journal for Clinicians*, vol. 68, no. 6, pp. 394-424.

8. Brindle, L, Pope, C, Corner, J, Leydon, G & Banerjee, A 2012, 'Eliciting symptoms interpreted as normal by patients with early-stage lung cancer: could GP elicitation of normalised symptoms reduce delay in diagnosis? Cross-sectional interview study', *BMJ Open*, vol. 2, no. 6, pp. e001977.

9. Brittle, C & Bird, CE 2007, *Literature review on effective sex-and gender-based systems/models of care*, Uncommon Insights Arlington, Arlington, VA.

10. Chirikos, TN, Roetzheim, RG, McCarthy, EP & Iezzoni, LI 2008, 'Cost disparities in lung cancer treatment by disability status, sex, and race', *Disability and Health Journal*, vol. 1, no. 2, pp. 108-15.

11. Currow, DC, You, H, Aranda, S, McCaughan, BC, Morrell, S, Baker, DF, Walton, R & Roder, DM 2014, 'What factors are predictive of surgical resection and survival from localised non-small cell lung cancer?', *Medical Journal of Australia*, vol. 201, no. 8, pp. 475-80.

12. de Perrot, M, Licker, M, Bouchardy, C, Usel, M, Robert, J & Spiliopoulos, A 2000, 'Sex differences in presentation, management, and prognosis of patients with non–small cell lung carcinoma', *The Journal of Thoracic and Cardiovascular Surgery*, vol. 119, no. 1, pp. 21-6.

13. Din, NU, Ukoumunne, OC, Rubin, G, Hamilton, W, Carter, B, Stapley, S & Neal, RD 2015, 'Age and gender variations in cancer diagnostic intervals in 15 cancers: analysis of data from the UK Clinical Practice Research Datalink', *PLoS One*, vol. 10, no. 5, pp. e0127717.

14. Ferlay, J, Soerjomataram, I, Dikshit, R, Eser, S, Mathers, C, Rebelo, M, Parkin, DM, Forman, D & Bray, F 2015, 'Cancer incidence and mortality worldwide: sources, methods and major patterns in GLOBOCAN 2012', *International Journal of Cancer*, vol. 136, no. 5, pp. 359-86.

15. Galdas, PM, Cheater, F & Marshall, P 2005, 'Men and health help-seeking behaviour: literature review', *Journal of Advanced Nursing*, vol. 49, no. 6, pp. 616-23.

16. Gorham, J, Ameye, L, Berghmans, T, Sculier, JP & Meert, AP 2013, 'The lung cancer patient at the emergency department: a three-year retrospective study', *Lung Cancer*, vol. 80, no. 2, pp. 203-8.

17. Handy Jr, JR, Child, AI, Grunkemeier, GL, Fowler, P, Asaph, JW, Douville, EC, Tsen, AC & Ott, GY 2001, 'Hospital readmission after pulmonary resection: prevalence, patterns, and predisposing characteristics', *The Annals of Thoracic Surgery*, vol. 72, no. 6, pp. 1855-60.

18. Hayman, JA, Abrahamse, PH, Lakhani, I, Earle, CC & Katz, SJ 2007, 'Use of palliative radiotherapy among patients with metastatic non–small-cell lung cancer', *Int J Radiat Oncol Biol Phys*, vol. 69, no. 4, pp. 1001-7.

19. Hsu, J, Donnelly, JP, Moore, JX, Meneses, K, Williams, G & Wang, HE 2018, 'National characteristics of Emergency Department visits by patients with cancer in the United States', *The American Journal of Emergency Medicine*, vol. 36, no. 11, pp. 2038-43.

20. Hunt, K, Adamson, J & Galdas, P 2010, 'Gender and help-seeking: towards gender-comparative studies', in *The Palgrave Handbook of Gender and Healthcare*, Springer, pp. 207-21.

21. International Agency for Research on Cancer 2018, *Cancer Today*, World Health Organization, France. viewed 20 May 2019, <http://gco.iarc.fr/today/online-analysis-table?v=2018&mode=cancer&mode_population=continents&population=900&populations=900&key=asr&sex=1&cancer=39&type=1&statistic=5&prevalence=0&population_group=0&ages_group%5B%5D=0&ages_group%5B%5D=17&nb_items=5&group_cancer=1&include_nmsc=1&include_nmsc_other=1>.

22. Khakbazan, Z, Taghipour, A, Roudsari, RL & Mohammadi, E 2014, 'Help seeking behavior of women with self-discovered breast cancer symptoms: a meta-ethnographic synthesis of patient delay', *PLoS One*, vol. 9, no. 12, pp. e110262.

23. Koning, CC, Aarts, MJ, Struikmans, H, Poortmans, PM, Lybeert, ML, Jobsen, JJ, Coebergh, JW, Janssen-Heijnen, ML, Visser, O, Louwman, WJ & Burgers, JA 2012, 'Mapping use of radiotherapy for patients with non-small cell lung cancer in the Netherlands between 1997 and 2008', *Clin Oncol (R Coll Radiol)*, vol. 24, no. 2, pp. 46-53.

24. Kurtz, ME, Kurtz, JC, Given, CW & Given, B 2006, 'Predictors of use of health care services among elderly lung cancer patients: The first year after diagnosis', *Supportive Care in Cancer*, vol. 14, no. 3, pp. 243-50.

25. Lairson, DR, Parikh, RC, Cormier, JN, Chan, W & Du, XL 2015, 'Cost-utility analysis of treatments for advanced non-small cell lung cancer', *Am J Pharm*, vol. 7, no. 6, pp. 271-9.

26. Lee, Y-G, Lee, JH, Kim, S-H, Kim, YJ, Lee, H, Ahn, S, Jang, J-S, Lee, J-S & Kim, JH 2018, 'Comparative analysis between combination and single-agent chemotherapy for elderly patients with advanced non-small cell lung cancer: A nationwide population-based outcome study', *Lung Cancer*, vol. 122, pp. 88-93.

27. Levi, F, Franceschi, S, Vecchia, CL, Randimbison, L & Te, VC 1997, 'Lung carcinoma trends by histologic type in Vaud and Neuchatel, Switzerland, 1974–1994', *Cancer*, vol. 79, no. 5, pp. 906-14.

28. Lyratzopoulos, G, Abel, G, Brown, C, Rous, B, Vernon, S, Roland, M & Greenberg, D 2012, 'Socio-demographic inequalities in stage of cancer diagnosis: evidence from patients with female breast, lung, colon, rectal, prostate, renal, bladder, melanoma, ovarian and endometrial cancer', *Annals of Oncology*, vol. 24, no. 3, pp. 843-50.

29. Mahmud, SM, Reilly, M & Comber, H 2003, 'Patterns of initial management of lung cancer in the Republic of Ireland: a population-based observational study', *Lung Cancer*, vol. 41, no. 1, pp. 57-64.

30. Manierre, MJ 2015, 'Gaps in knowledge: Tracking and explaining gender differences in health information seeking', *Social Science & Medicine*, vol. 128, pp. 151-8.

31. Marshall, JR, Gregorio, DI & Walsh, D 1982, 'Sex differences in illness behavior: care seeking among cancer patients', *Journal of Health and Social Behavior*, vol. 23, no. 3, pp. 197-204.

32. McDevitt, J, Kelly, M, Comber, H, Kelleher, T, Dwane, F & Sharp, L 2013, 'A population-based study of hospital length of stay and emergency readmission following surgery for non-small-cell lung cancer', *European Journal of Cardio-Thoracic Surgery*, vol. 44, no. 4, pp. e253-e9.

33. McInnes, MD, Moher, D, Thombs, BD, McGrath, TA, Bossuyt, PM, Clifford, T, Cohen, JF, Deeks, JJ, Gatsonis, C & Hooft, L 2018, 'Preferred reporting items for a systematic review and meta-analysis of diagnostic test accuracy studies: the PRISMA-DTA statement', *Jama*, vol. 319, no. 4, pp. 388-96.

34. McMahon, M, Barbiere, JM, Greenberg, DC, Wright, KA & Lyratzopoulos, G 2011, 'Population-based trends in use of surgery for non-small cell lung cancer in a UK region, 1995-2006', *Thorax*, vol. 66, no. 5, pp. 453-5.

35. Mehta, RS, Lenzner, D & Argiris, A 2012, 'Race and health disparities in patient refusal of surgery for early-stage non-small cell lung cancer: a SEER cohort study', *Ann Surg Oncol*, vol. 19, no. 3, pp. 722-7.

36. Mennecier, B, Lebitasy, MP, Moreau, L, Hedelin, G, Purohit, A, Galichet, C & Quoix, E 2003, 'Women and small cell lung cancer: social characteristics, medical history, management and survival: a retrospective study of all the male and female cases diagnosed in Bas-Rhin (Eastern France) between 1981 and 1994', *Lung Cancer*, vol. 42, no. 2, pp. 141-52.

37. Mitchell, ED, Pickwell-Smith, B & Macleod, U 2015, 'Risk factors for emergency presentation with lung and colorectal cancers: a systematic review', *BMJ Open*, vol. 5, pp. e006965-e.

38. Neal, RD & Allgar, VL 2005, 'Sociodemographic factors and delays in the diagnosis of six cancers: analysis of data from the 'National Survey of NHS Patients: Cancer'', *British Journal of Cancer*, vol. 92, pp. 1971-82.

39. Nilssen, Y, Strand, TE, Fjellbirkeland, L, Bartnes, K, Brustugun, OT, O'Connell, DL, Yu, XQ & Mller, B 2016, 'Lung cancer treatment is influenced by income, education, age and place of residence in a country with universal health coverage', *International Journal of Cancer*, vol. 138, no. 6, pp. 1350-60.

40. Noonan, K, Tong, KM, Laskin, J, Zheng, YY, Melosky, B, Sun, S, Murray, N & Ho, C 2015, 'Evaluation of a 'watch and wait' approach for chemotherapy in patients with newly diagnosed advanced non-small cell lung cancer from a diverse community population', *Clin Oncol (R Coll Radiol)*, vol. 27, no. 9, pp. 505-13.

41. Ogawa, F, Satoh, Y, Iyoda, A, Amano, H, Kumagai, Y & Majima, M 2015, 'Clinical impact of lung age on postoperative readmission in non-small cell lung cancer', *Journal of Surgical Research*, vol. 193, no. 1, pp. 442-8.

42. Ouellette, D, Desbiens, G, Emond, C & Beauchamp, G 1998, 'Lung cancer in women compared with men: stage, treatment, and survival', *The Annals of Thoracic Surgery*, vol. 66, no. 4, pp. 1140-3.

43. Nebreda, MMP, de Miguel-Diez, J, Fernández, FRV, Fragoso, AS, Calderón, JLR & Hernández, DM 2016, 'Trends in the incidence of lung cancer hospitalizations in Spain, 2001–2011', *Archivos de Bronconeumologia*, vol. 52, no. 8, pp. 411-9.

44. Patel, N, Adatia, R, Mellemgaard, A, Jack, R & Møller, H 2007, 'Variation in the use of chemotherapy in lung cancer', *British Journal of Cancer*, vol. 96, p. 886.

45. Potosky, AL, Saxman, S, Wallace, RB & Lynch, CF 2004, 'Population variations in the initial treatment of non–small-cell lung cancer', *Journal of Clinical Oncology*, vol. 22, no. 16, pp. 3261-8.

46. Puri, V, Patel, AP, Crabtree, TD, Bell, JM, Broderick, SR, Kreisel, D, Krupnick, AS, Patterson, GA & Meyers, BF 2015, 'Unexpected readmission after lung cancer surgery: A benign event?', *The Journal of Thoracic and Cardiovascular Surgery*, vol. 150, no. 6, pp. 1496-505.

47. Raine, R, Wong, W, Scholes, S, Ashton, C, Obichere, A & Ambler, G 2010, 'Social variations in access to hospital care for patients with colorectal, breast, and lung cancer between 1999 and 2006: Retrospective analysis of hospital episode statistics', *BMJ (Online)*, vol. 340, no. 7741, p. 302-11.

48. Ramsey, SD, Howlader, N, Etzioni, RD & Donato, B 2004, 'Chemotherapy use, outcomes, and costs for older persons with advanced non–small-cell lung cancer: evidence from surveillance, epidemiology and end results– Medicare', *Journal of Clinical Oncology*, vol. 22, no. 24, pp. 4971-8.

49. Rich, AL, Tata, LJ, Free, CM, Stanley, RA, Peake, MD, Baldwin, DR & Hubbard, RB 2011, 'Inequalities in outcomes for non-small cell lung cancer: the influence of clinical characteristics and features of the local lung cancer service', *Thorax*, vol. 66, no. 12, pp. 1078-84.

50. Shugarman, LR, Bird, CE, Schuster, CR & Lynn, J 2008, 'Age and gender differences in Medicare expenditures and service utilization at the end of life for lung cancer decedents', *Women's Health Issues*, vol. 18, no. 3, pp. 199-209.

51. Siegel, R, Ma, J, Zou, Z & Jemal, A 2014, 'Cancer statistics, 2014', *CA: a Cancer Journal for Clinicians*, vol. 64, no. 1, pp. 9-29.

52. Sikka, V & Ornato, JP 2010, 'Cancer diagnosis and outcomes in Michigan EDs vs other settings', *The American Journal of Emergency Medicine*, vol. 30, no. 2, pp. 283-92.

53. Sitas, F, Weber, MF, Egger, S, Yap, S, Chiew, M & O'Connell, D 2014, 'Smoking cessation after cancer', *Journal of Clinical Oncology*, vol. 32, pp. 3593-5.

54. Skaug, K, Eide, GE & Gulsvik, A 2009, 'Hospitalisation days in patients with lung cancer in a general population', *Respiratory Medicine*, vol. 103, no. 12, pp. 1941-8.

55. Smith, TJ, Penberthy, L, Desch, CE, Whittemore, M, Newschaffer, C, Hillner, BE, McClish, D & Retchin, SM 1995, 'Differences in initial treatment patterns and outcomes of lung cancer in the elderly', *Lung Cancer*, vol. 13, no. 3, pp. 235-52.

56. Starr, LK, Osler, M, Steding-Jessen, M, Frederiksen, BL, Jakobsen, E, Østerlind, K, Schüz, J, Johansen, C & Dalton, SO 2013, 'Socioeconomic position and surgery for early-stage non-small-cell lung cancer: a population-based study in Denmark', *Lung Cancer*, vol. 79, no. 3, pp. 262-9.

57. Strand, T-E, Bartnes, K & Rostad, H 2012, 'National trends in lung cancer surgery', *European Journal of Cardio-Thoracic Surgery*, vol. 42, no. 2, pp. 355-8.

58. Sullivan, R, Peppercorn, J, Sikora, K, Zalcberg, J, Meropol, NJ, Amir, E, Khayat, D, Boyle, P, Autier, P & Tannock, IF 2011, 'Delivering affordable cancer care in high-income countries', *The Lancet Oncology*, vol. 12, no. 10, pp. 933-80.

59. Tammemagi, CM, Neslund-Dudas, C, Simoff, M & Kvale, P 2004, 'In lung cancer patients, age, race-ethnicity, gender and smoking predict adverse comorbidity, which in turn predicts treatment and survival', *Journal of Clinical Epidemiology*, vol. 57, no. 6, pp. 597-609.

60. Thun MJ, Henley SJ & WD, T 2018, 'Lung cancer', in Thun MJ, et al. (eds), *Cancer Epidemiology and Prevention*, Oxford University Press, New York, vol. 4, pp. 519-42.

61. Visbal, AL, Williams, BA, Nichols, FC, III, Marks, RS, Jett, JR, Aubry, MC, Edell, ES, Wampfler, JA, Molina, JR & Yang, P 2004, 'Gender differences in non-small-cell lung cancer survival: an analysis of 4,618 patients diagnosed between 1997 and 2002', *The Annals of Thoracic Surgery*, vol. 78, no. 1, pp. 209-15.

62. Von Elm, E, Altman, DG, Egger, M, Pocock, SJ, Gøtzsche, PC & Vandenbroucke, JP 2007, 'The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting

observational studies', *Annals of Internal Medicine*, vol. 147, no. 8, pp. 573-7.

63. Wang, J & Huang, Y 2007, 'Pharmacogenomics of sex difference in chemotherapeutic toxicity', *Current Drug Discovery Technologies*, vol. 4, no. 1, pp. 59-68.

64. Warner, D & Procaccino, JD 2007, 'Women seeking health information: distinguishing the web user', *Journal of Health Communication*, vol. 12, no. 8, pp. 787-814.

65. Wouters, MWJM, Siesling, S, Jansen-Landheer, ML, Elferink, MAG, Belderbos, J, Coebergh, JW & Schramel, FMNH 2010, 'Variation in treatment and outcome in patients with non-small cell lung cancer by region, hospital type and volume in the Netherlands', *European Journal of Surgical Oncology (EJSO)*, vol. 36, pp. S83-S92.

66. Wright, CD, Gaissert, HA, Grab, JD, O'Brien, SM, Peterson, ED & Allen, MS 2008, 'Predictors of prolonged length of stay after lobectomy for lung cancer: a society of thoracic surgeons general thoracic surgery database Risk-Adjustment Model', *The Annals of Thoracic Surgery*, vol. 85, no. 6, pp. 1857-65.

CHAPTER 4

CHAPTER 4: **Introductory note: Relationship between Chapter 4, and Chapters 1 and 2**

Section 1.3.1 in Chapter 1 provides a brief discussion of the Australian healthcare system. The Australian government promotes private health insurance (via tax rebates on premiums) while providing universal healthcare for all. Several studies have concluded that private health insurance results in unequal access to and utilisation of healthcare. Chapter 2 confirmed this hypothesis as it showed similar results indicating that cancer patients with private health insurance had a higher number of specialist doctor visits and higher number of nights in hospitals than those without insurance. Hence, Chapter 4 examines the healthcare utilisation of patients with private health insurance in Australia. Moreover, this chapter also analysed the factors that impact the decision to use public hospital care despite having private health insurance in Australia. The findings of this study were presented at the 'International Health Economics Association (iHEA) Conference 2019 in Basel, Switzerland and it is currently under review in the 'BMC Health Services Research' journal.

4.0 Selection of private or public hospital care: examining the care-seeking behaviour of patients with private health insurance

4.1 Abstract

Objective: This study aimed to examine the healthcare-seeking (hospital, primary and preventive care) and healthcare utilisation behaviour of patients with private health insurance (PHI) in Australia. This in a country with universal health coverage, which is free for all (Medicare). The article also aimed to examine the socioeconomic, demographic and lifestyle factors that influence the choice of hospital care in Australia. **Method:** A logistic regression model with repeated measure t-test and Pearson's Chi-square test were used. Data from waves 9 (2009) and 13 (2013) of the nationally representative Household, Income and Labour Dynamics in Australia (HILDA) survey were used for analysis.

Results: Patients with private health insurance had a higher number of hospital nights stay despite having a lower number of hospital admissions than those without cover. Significant disparities were identified in preventive and specialist care use between patients with cover and without cover. No significant variations were observed in healthcare utilisation for PHI patients before and after dropping their private health cover. Finally, one in four patients chooses to use public hospitals despite holding PHI cover. Those insured from lower socioeconomic backgrounds (e.g. lower incomes and lower education levels) and those who are younger and without long-term health conditions have a higher probability of selecting public rather than private care.

Conclusions: It is evident that PHI cover encourages people to use private care. However, the considerable number of patients not consuming private care when they are eligible may indicate consumer information asymmetry and the perceived higher quality and specialisation of public hospitals over private hospitals in Australia.

Key Words: Healthcare use; private health insurance; hospitals; HILDA; Australia

4.2 Introduction

In the emergency department of public hospitals, Australian patients with private health insurance (PHI) are asked to decide whether they want to be public patients or private patients. Interestingly, for people with PHI cover, the answer is not always obvious. The policies[1] promoting PHI in Australia often focus on increasing enrolment into PHI rather than emphasising the effectiveness and efficiency of the PHI system and the type of services available therein (Podger 2016). A recent report published by the 'Senate Community Affairs Reference Committee' (2014) found that patients are often unaware of the potential out-of-pocket treatment costs in the private health system. Consequently, many patients with PHI cover do not opt for private hospital care but instead end up in public hospitals undermining the policy aim of redirecting public hospital demand to the private sector. Higher enrolment rates for PHI cover will not save scarce public resources unless the PHI system encourages those patients to use private hospitals solely. In addition, a PHI system that promotes unequal access to care is also undesirable. Hence, to improve the overall outcomes in the health care system, it is imperative to understand the factors influencing the choice and use of medical care services of patients with PHI cover in Australia.

Previous studies related to PHI in Australia mainly focused on the factors determining patients' decision to purchase PHI cover (Barros & Siciliani 2012; Buchmueller et al. 2013), the adverse selection problem[2] (Barrett & Conlon 2003) and whether PHI increases utilisation of hospital care (Eldridge et al. 2017) and other medical treatments (Srivastava et al. 2017). Others argued for (Buchmueller et al. 2013; Eldridge et al. 2017) and against (Cheng & Vahid 2011; Podger 2016) the justification of providing public subsidies to the PHI system via tax rebates and other fiscal incentives to patients and companies. Little is known regarding the degree of heterogeneity between the hospital and preventive care-seeking attitudes of patients with or without PHI cover in Australia. Moreover, it is still unclear what socioeconomic and demographic factors influence patients with PHI cover to access public hospitals as a public patient despite paying for and having the availability of private hospital care. Lastly, to the best of authors' knowledge, no study has yet examined the differences in healthcare utilisation

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[1] See the article of Butler, J (2002) for a detail description of these policies.

[2] At a given premium high-risk individuals will have more incentive to purchase PHI than low-risk individuals.

for patients who held and then dropped PHI cover. A nationally representative survey data set will be used to examine these issues.

To address these gaps in the literature, this paper aims to quantify the disparity in healthcare use of individuals with and without PHI cover and to identify the socioeconomic, demographic, geographic, and lifestyle characteristics that influence the choice of hospital care (public vs private) between cohorts of patients with PHI cover. Equality of access is a major goal of the Australian health system. Yet public resources are directed towards individuals and organisations to promote private healthcare, which is in conflict with that aim. In addition, there is little justification for promoting PHI if it does not reduce public sector demand considerably. The findings of this study will assist in understanding the factors influencing the choice of care for patients with PHI, to address these issues.

This study will add to the existing literature by answering the following research questions: i) to what extent does the hospital care-seeking attitudes and use of secondary preventive and specialist care vary between public and patients with PHI cover?; ii) what factors influence the choice of the type of hospital care (public vs private) among patients with PHI cover? Also, iii) does healthcare use differ significantly for a cohort of individuals before and after dropping PHI cover?

These are particularly important concerns for countries where universal public healthcare is supplemented by a privately funded health system (e.g. Australia, Ireland, Canada and the UK). The findings will assist policymakers to realise whether the current healthcare policy of promoting PHI is effective in reducing the demand for public hospital care. Further, does PHI cover encourage people to consume additional healthcare services? Moreover, understanding the factors influencing hospital care-seeking behaviour of patients with PHI cover will offer policy guidance based on consumer demand and actual use of health services.

The rest of this study is structured as follows. After a brief conceptual framework, the next section explains the data and method. Section three consists of the results of the study, followed by a detailed discussion of the findings. The final section provides a brief conclusion to the study.

4.2.1 The conceptual framework

This study seeks to understand the relationship between PHI status and the medical care-seeking attitude of patients with PHI cover in Australia. Having PHI cover in Australia is desirable as it provides patients with more options regarding doctors, type of services

and waiting times, while protecting patients from additional healthcare expenditures not covered by 'Medicare' (Buchmueller et al. 2013; Eldridge et al. 2017). Hence, following Van Gameren (2010), the consumption of health services by a patient (with PHI cover) from a utility maximisation perspective can be divided into two parts: consumption of publicly (H_{pb}) and privately funded healthcare (H_{pt}). If C is the consumption of all other goods and M is the total income then, the utility maximisation function restricted by income (total expenses are not higher than income) is,

$$Max \ U \ (C, H_{pb}, H_{pt})$$

$$M \geq P_{pb}H_{pb} + P_{pt}H_{pt} + P_cC$$

where P_{pb} is the price of public health services, P_{pt} is the price of private health services, and P_c is the price of all other consumption goods. Although the demand for health services are unique in nature (which depends on an individuals' stock of health and their health problems), it is assumed to be a normal good, which means that holding other things constant, increasing price decreases the quantity demanded for health services (Folland et al. 2007).

Eldridge et al. (2017) showed that in a hypothetical scenario, if everyone has PHI cover, it reduces the effective price of private healthcare for all the patients; therefore, the demand for private hospitals will increase, and demand for public hospitals will reduce. This switching of demand from the public to private is logical for a country which does not offer public health insurance for all. However, in Australia, private health services could be seen as duplicate, complementary and supplementary to public health services (Colombo & Tapay 2004). Therefore, the choice of the type of services consumed by patients with PHI cover vary considerably, and increasing the enrolment rate in PHI may not divert demand from the public sector to the private sector at the desired level. If the type and quality of services are the same between private and public hospitals, the price elasticity of demand for private hospital services will be high. In other words, when public healthcare services are free, and as private health services become costlier, quantity demanded for private care will decrease at a higher rate than the increases in costs. As services in public hospitals can be consumed at low or no cost, patients will avoid private hospital care, if there is an expectation of higher out-of-pocket costs (current) and higher premiums in the future. Moreover, the availability of publicly funded health coverage increases the opportunity cost (the relative price P_{pt}/P_{pb}) of using the privately funded services as there are no out-of-pocket healthcare expenses for using

public care. Hence, a patient will be more inclined to consume public hospital care (Van Gameren 2010).

The model focuses on the impact of having PHI on the utilisation of secondary preventive and primary care, and the type of hospital care choices made while taking into account several compounding variables (e.g. age, income, and BMI) which might influence the demand for healthcare services.

4.3 Methods

4.3.1 Data source and study population

Data were drawn from the 'Household Income and Labour Dynamics in Australia' (HILDA) survey Wave 9 (2009 from hereon) and Wave 13 (2013 from hereon). HILDA is a nationally representative longitudinal survey collected annually since 2001 and both the selected waves had special additional questions related to the health and personality of respondents[3]. The total number of persons, in the 7,234 responding households in 2009 were 17,632 and 23,299 from 7,463 responding households in 2013 (Summerfield et al. 2017). The number expanded from 2009 to 2013 due to a higher number of households and for the inclusion of Top-Up samples (Summerfield et al. 2017). Data were collected via face-to-face interviews and through a self-completed questionnaire from each household. The detailed methodology of the HILDA survey is outlined in (Wooden & Watson 2007). Along with the general survey data, the health-focused waves of 2009 and 2013 accumulated data on healthcare utilisation (GP and hospital visits), general health and well-being (self-assessed health), lifestyle (physical activity, smoking), the prevalence of chronic disease and PHI status. A person with PHI cover was identified with the following question, 'apart from Medicare, are you currently covered by private health insurance?' A total of 13,244 (after excluding missing values) individuals (yes = 7,001, no = 6,243) had valid responses in 2009 and for 2013 the total number of valid responses were 17,425 (after excluding missing values) (yes = 9,676, no = 7,749).

4.3.2 Statistical analysis

Four types of statistical analyses were performed. First, unadjusted descriptive analyses were conducted to estimate the heterogeneity in the type of hospital care and preventive care utilisation based on PHI status. The level of preventive care utilisation was

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[3] DSS, & Melbourne Institute of Applied Economic and Social Research. (2017). The Household, Income and Labour Dynamics in Australia (HILDA) Survey, RESTRICTED RELEASE 16 (Waves 1-16) (Publication no. doi/10.4225/87/QFUIBM). Available from Australian Data Archive Dataverse http://dx.doi.org/10.4225/87/QFUIBM

measured using answers for screening for pap smear, breast cancer, prostate cancer, bowel cancer and cholesterol by insured adults in the previous 12 months (Pagán et al. 2007). Respondents with PHI cover were further categorised into the three types of PHI cover. Second, repeated measure t-tests were performed for selected sub-groups of participants to examine whether a change in PHI status significantly impacts healthcare utilisation. Using the 'xwaveid' indication in the survey data, a cohort of people were selected who were common to both waves. Next, a sub-group of 193 respondents were identified who had PHI cover in 2009, but had dropped it in 2013. Then, the repeated measure t-tests were used to compare the healthcare utilisation of the sub-group while characterising the dropping of PHI cover as an intervention. Third, Pearson's chi-square test was used to compare whether the choice of hospital service varied depending on the socio-economic, demographic, health status and lifestyle characteristics of patients in both waves. Finally, logistic regression was employed to determine the factors influencing the hospital choice type of patients. This approach is common (Jowett et al. 2003; Zhang et al. 2018) to predict a categorical (mainly dichotomous) variable with a mix of continuous and categorical predictor variables (Field 2013). The regression model here predicts the probability of preferring to get admitted as a public patient whilst holding PHI cover. The estimation was performed with patients with PHI cover and who had overnight hospital admissions in 2013. The following binary logistic regression model was used,

$$\log \frac{Y_p}{(1 - Y_p)} = a_0 + \sum_{n=1}^{q} (\beta_n x_{pn}) + u_p$$

where Y is the binary dependent variable and Y_p is the probability of a patient with PHI cover choosing the option of being a public patient in a public hospital. x_{pn} are the predictor variables for p^{th} observations, β_n are the estimated coefficients and u_p indicates error-terms. Tests statistics were calculated using bootstrap methods based on 1000 draws, which reduce biases from lack of normality and homoscedasticity (Field 2013; Wright et al. 2011).

4.3.3 Variable selections and measures

Two key independent variables were identified: the PHI status of an individual and their choice of hospital admission type. For the logistic regression, the dependent variable is measured as follows (for a respondent with PHI cover): hospital admission type = 1 if a public patient in a public hospital and 0 otherwise. In the survey, respondents with

current PHI cover were also questioned regarding the type of PHI cover purchased. There are three types of coverage; hospital only (covers for the cost of treatments as private patients at the hospitals), ancillary/extras only (covers cost of services outside of hospitals such as visiting a psychologist) or both. Also, individuals with PHI and who had an overnight hospital stay in the previous 12 months were asked about the 'hospital overnight admission type'. They had to choose from three options; i) public (Medicare) patient in a public hospital, ii) private patient in a private hospital, iii) private patient in a public hospital. For simplification of the analysis a binary variable (hospital admission type) was created where a person with PHI and selected to be a public patient (treated as a patient without PHI) in a public hospital was coded as 1 and 0 otherwise (private patient in a public hospital or private patient in a private hospital).

Several additional variables were used to examine variations in healthcare utilisation between respondents with PHI cover and those without cover. These include the number of doctor visits, number of hospital admissions, and the number of nights per hospital admission. In addition, some other variables were also included such as whether during the last 12 months respondents had visited a hospital doctor, a specialist doctor or a mental health professional and whether they had health check-ups for breast screening, prostate, bowel cancer, cholesterol and blood pressure during this period. These were also designated as binary variables (yes = 1, no = 0).

Respondents' (individual) annual expenditure on pharmaceuticals and fees paid to health practitioners were used to measure out-of-pocket health expenditure. To understand the current state of an individual's health, three variables were included. Self-assessed health used a Likert scale in five categories (excellent, very good, good, fair and poor) and prevalence of long-term health conditions (yes=1, no=0) and the mental health status was measured with the Kessler psychological distress scale (low, moderate, high and very high) (Dismuke & Egede 2011). Lifestyle variables consisted of physical activity (less than once a week, 1-3 times a week, more than three times per week) and smoking status (non-smoker, occasional smoker, regular smoker). Any personal experience of health shocks or financial distress can influence the choice of healthcare utilisation. Therefore, health shocks and financial distress were measured with the variables, serious personal illness (yes =1, no = 0) and major worsening in finances (yes =1, no = 0), in the last twelve months. See Appendix A (Table 4.7) for further variable definition.

The regression model also controlled for other key variables that have a confounding influence on health and healthcare utilisation such as age, gender, education level, income, BMI, marital status, remoteness from hospital and birthplace. These variables are identical to those used in earlier, similar studies (Cheng 2014; Eldridge et al. 2017; Jeon & Kwon 2013;). Moreover, Booth-Kewley & Vickers Jr (1994) concluded that personality is a key determinant of health behaviour. Based on the discussion of the 'Theory of Care-seeking Behaviour', the variables included in the model represents clinical and sociodemographic factors, social factors, as well as the facilitating factors that influence utilisation of care (Lauver 1992). To add to the previous literature, this study examined whether financial risk-taking behaviour (a measure of personality) impacts on the healthcare-seeking attitude of individuals with PHI cover. Lastly, a dummy variable for full-time students was used to estimate whether respondents who were not part of the labour force had an affected on the selection of the type of healthcare services.

4.4 Results

4.4.1 PHI status and healthcare utilisation

Table 4.1 shows the percentage of respondents who used different types of hospital care and had health check-ups (secondary preventive care) in 2009 and 2013. Overall, around 75% of patients with PHI cover selected the private patient option, and the rest consumed public hospital services as a public patient. Hence, almost a quarter of the respondents preferred publicly funded services despite having PHI cover. Conversely, around 7% to 9% of patients without PHI cover preferred to be a private hospital patient. As expected, there are significant differences in the type of hospital care consumed for patients with only ancillary/extras cover and those with a hospital cover. Patients with PHI preferring public patient care and no cover patients preferring private care reduced by 3% and 2%, respectively, but the rate of health check-ups remained the same between the two waves.

Table 4.1 Public vs private care utilisation by health insurance status, type of cover and membership (%)

	Public patient in public hospital	*Private patient in private hospital*	*Private patient in public hospital*	*Total percentage (Row)*	*Health check-up in last 12 months*
YEAR			***2009***		
PHI status					
Yes	25.3	58.3	16.4	100	75.2
No	90.7	6.7	2.4	100	67.6
PHI cover type					
Hospital only	26.3	56.2	17.5	100	77.0
Extras only	91.9	6.5	1.6	100	74.6
Both	18.9	63.3	17.8	100	75.4
Membership type					
Family	25.2	60.2	14.6	100	69.8
Couple	19.8	62.1	18.1	100	87.2
Single	29.2	53.0	17.8	100	78.3
	Public patient in public hospital	*Private patient in private hospital*	*Private patient in public hospital*	*Total percentage (Row)*	*Health check-up in last 12 months*
YEAR			***2013***		
PHI status					
Yes	22.7	59.5	17.8	100	75.7
No	92.8	4.9	2.3	100	68.6
PHI cover type					
Hospital only	21.7	59.0	19.3	100	78.5
Extras only	90.5	3.2	6.3	100	68.8
Both	18.3	63.2	18.5	100	76.3
Membership type					
Family	24.3	59.8	15.9	100	70.0
Couple	18.8	60.4	20.8	100	87.1
Single	22.3	59.3	18.4	100	78.3

Note: Values in percentage. 2009 and 2013 are data from Wave 9 and Wave 13, respectively. Services used in the last 12 months prior to the date interviewed. Public patient in public hospital means a person with no PHI using public hospital services; private patient in private hospital means a person with PHI using private hospital services; private patient in public hospital means a person with PHI using public hospital services.

Figure 4.1 shows the choice of hospital care type by age group and the trends in the number of persons insured in Australia. As expected, as age increases, so does the use of all types of hospital care. The propensity of the selection of private care over public care increases at an increasing rate, after the age of 50 (Figure 4.1). On the other hand, Figure 4.1 also indicates the current decreasing trend of the total number of people enrolling into PHI cover in Australia.
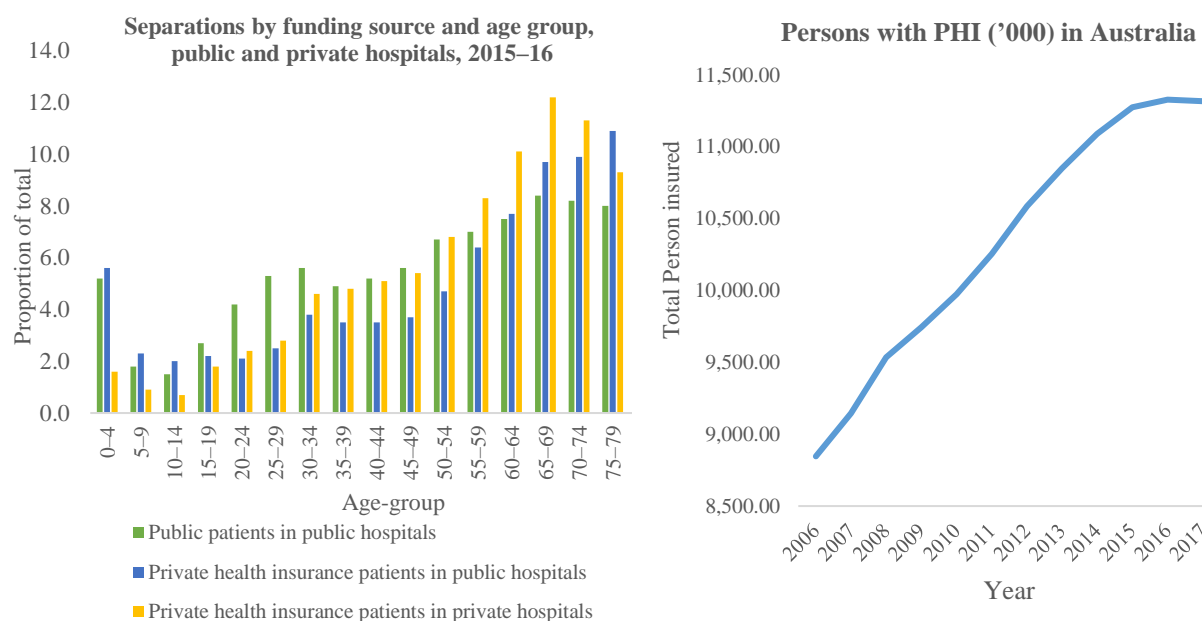
Source: AIHW (2018)[4].

Figure 4.1 Trends in the number of persons with PHI cover and choice of hospital care in Australia

Table 4.2 presents the data on healthcare use and health screening by respondents with PHI cover (excluding ancillary cover only) and no cover. On average, patients with PHI cover had slightly longer overnight stays despite having a significantly lower number of hospital admissions and doctor visits than those with no cover. Having PHI cover is also significantly related to a higher number of specialist doctor visits. Noticeably, respondents with PHI cover reported a higher level of health screening compared to no cover respondents and the mean differences are significant at a 5% confidence interval.

Table 4.2 Differences in healthcare use between individuals with PHI and no PHI

Variables	2009		2013	
Healthcare use (last 12 months)	*Cover*	*No cover*	*Cover*	*No cover*
Number of doctor visits	5.63* (.102)	8.51 (.187)	5.55* (.081)	8.54 (.163)
Number of hospital admissions	0.26* (.010)	0.45 (.028)	0.28* (.011)	0.50 (.049)
Patient in a hospital overnight	1.82* (.006)	1.74 (.008)	1.85* (.005)	1.76 (.007)
Specialist doctor visits	0.51* (.008)	0.48 (.009)	0.52* (.006)	0.47 (.008)
Mental health professional	0.08* (.004)	0.11(.006)	0.10* (.004)	0.15 (.006)
Health screening				
Pap smear	0.29* (.006)	0.25 (.008)	0.28* (.006)	0.24 (.007)
Breast screening	0.21* (.007)	0.14 (.006)	0.20* (.005)	0.14 (.006)
Prostate check	0.16* (.006)	0.12 (.006)	0.14* (.005)	0.12 (.005)

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[4] AIHW (2018). Australian Institute of Health and Welfare. Data available from: https://www.aihw.gov.au/reports/hospitals/private-health-insurance-use-hospitals/data

Screening for bowel cancer	0.16* (.006)	0.12 (.006)	0.17* (.005)	0.13 (.006)
X-rays	0.25* (.007)	0.32 (.007)	0.26* (.006)	0.32 (.008)
Blood pressure	0.75 (.007)	0.75 (.007)	0.77 (.005)	0.76 (.007)
Cholesterol test	0.52* (.008)	0.45 (.009)	0.52* (.006)	0.48 (.008)

Notes: Respondents with cover = 5,263 and without cover = 4,215 in 2009 and with cover = 5915 and without cover = 3739 in 2013. Values in percentage of total responded population. * means the mean difference is significant at the 5% confidence interval.

4.4.2 Mean (unadjusted) healthcare utilisation before and after dropping PHI cover

Table 4.3 reports the unadjusted average of individual health status and healthcare utilisation for a cohort of respondents before and after dropping PHI cover. The cohort of 193 respondents had PHI cover in 2013 but discontinued it by the time they were interviewed in 2017. Respondents who were diagnosed with chronic diseases in 2013 (but had no chronic diseases in 2009) were excluded to reduce biases. No other confounding factors that might influence the health status or health care use were taken into account. Hence, the results should be interpreted with caution as a number of unobserved elements may influence the mean healthcare use between two time periods. The repeated measure t-test results indicate that except for the number of health check-ups, their overall healthcare utilisation did not vary significantly before and after dropping PHI cover. Interestingly, self-assessed health and satisfaction with health are significantly lower in 2013 compared to 2009. One probable reason could be age as these respondents were four years older in 2013 than in 2009. Lastly, consistent with the findings of Table 4.2, this cohort of respondents had, on average, a lower number of specialist doctor visits and hospital night stays after dropping their PHI cover.

Table 4.3 Healthcare utilisation (sub group) before and after dropping private health cover

Healthcare utilisation	Obs	Mean (2009)	Mean (2013)	p- value
Self-assessed health (1 = excellent; 2 = very good; 3 = good; 4 = fair; 5 = poor)	193	2.39 (0.07)	2.62 (0.08)	0.034
Satisfaction - Your health (0 = totally dissatisfied; 5 = indifferent; 10 = totally satisfied)	192	7.52 (0.12)	7.21 (0.13)	0.086
Respondent annual expenditure - Fees paid to health practitioners (AUD)	193	845.97 (95)	635.15 (111)	0.182
Respondent annual expenditure - Medicines, prescriptions, pharmaceuticals (AUD)	193	380.49 (33.8)	345.15 (36)	0.535
For most recent doctor visit - any out of pocket expenses for consultation (1 = yes; 2 = no)	160	1.53 (0.04)	1.69 (0.04)	0.002
Number of doctor visits	192	4.6 (0.44)	5.25 (0.61)	0.390
Number of hospital admissions	192	0.11 (0.03)	0.19 (0.04)	0.110
Number of nights in hospital	192	0.34 (0.11)	0.79 (0.21)	0.063
Number of times have you seen your family doctor or GP in the last 12 months	160	5.36 (0.5)	6.30 (0.7)	0.273
Seen during last 12 months - A hospital doctor (i.e., in outpatients or casualty) (0= no; 1 = yes)	126	0.27 (0.04)	0.31 (0.04)	0.465
Seen during last 12 months - A specialist doctor (excluding in outpatients or casualty of a hospital) (0 = no; 1 = yes)	126	0.42 (0.04)	0.37 (0.04)	0.473
Seen during last 12 months - A mental health professional (0 = no; 1 = yes)	126	0.10 (0.03)	0.19 (0.03)	0.048
During the last 12 months, have you ever been a patient in a hospital overnight? (1 = yes; 2 = no)	192	1.91 (0.02)	1.85 (0.03)	0.081
Had check-up or test in last 12 months - Breast screening (0 = no; 1 = yes)	137	0.20 (0.04)	0.09 (0.03)	0.016
Had check-up or test in last 12 months - Prostate check (0 = no; 1 = yes)	137	0.09 (0.02)	0.07 (0.02)	0.656
Had check-up or test in last 12 months - for bowel cancer (0 = no; 1 = yes)	137	0.06 (0.02)	0.12 (0.03)	0.099
Had check-up or test in last 12 months - Cholesterol test (0 = no; 1 = yes)	137	0.37 (0.04)	0.44 (0.04)	0.000
Had check-up or test in last 12 months - Blood pressure (0 = no; 1 = yes)	137	0.62 (0.04)	0.67 (0.04)	0.082

Obs = number of observations. Standard errors in parenthesis.

4.4.3 Patient background and choice of hospital care

In Table 4.4, a comparison between the type of hospital care consumed by patients with PHI cover based on their socio-economic, demographic and lifestyle characteristics is presented. The outcomes of Pearson's Chi-square tests illustrate that the decision (choice of hospital admission type) varies significantly between age groups, gender, income levels, and marital status. According to the estimated results of both 2009 and

2013, older people, individuals from high-income households, or those who are currently married were less likely to opt for the public patient option. Moreover, the results of 2009 also indicate that females, patients with lower BMI, patients without long-term health conditions, smokers, patients with higher than average risk-taking attitude, and patients in South Australia were more likely to select public patient care compared to males, patients with higher BMI, those with long-term health conditions, non-smokers, lower risk-taking attitude and patients in other states, respectively. Experiencing serious personal illness and financial distress also influences the patients' choices of hospital care significantly.

Lastly, patients with PHI in 2013 were less likely to choose public care at the hospitals irrespective of income, education, birth origin, gender, marital status and area of residence than patients in 2009. Moreover, the percentage of patients (with PHI) selecting public care reduced considerably for all the states from 2009 to 2013, except for South Australia.

Table 4.4 Pearson's Chi square test (public patient vs private patient type admission) for respondents with private health cover

Factors	Valid cases	Private patients (in Public & Private hospital)	Public patient in a public hospital	Pearson Chi-sq	Valid cases	Private patients (in Public & Private hospital)	Public patient in a public hospital	Pearson Chi-sq
			2009				**2013**	
Age	863			15.75	1196			41.57
Age<45		69.1	30.9	(0.000)		67.5	32.5	(0.000)
Age 45-65		74.6	24.5			83.1	16.9	
Age>65		83.8	16.2			84.0	16.0	
Education level	863			1.06	1196			0.70
> High school		76.0	24.0	(0.170)		78.6	21.4	(0.402)
≤ High school		72.9	27.1			76.5	23.5	
Household DY	863			10.01	1196			19.92
Low income		74.0	26.0	(0.018)		79.2	20.8	(0.000)
Lower middle		70.8	29.2			65.9	34.1	
Higher middle		71.8	28.2			79.0	21.0	
High income		83.4	16.6			81.0	19.0	
Birth place	863			2.42	1187			1.39
Australia		75.0	25.0	(0.120)		76.5	23.5	(0.237)
Other country		61.5	38.5			80.2	19.8	
Gender	863			0.88	1196			6.27
Female		75.8	24.2	(0.347)		74.9	25.1	(0.012)
Male		73.0	27.0			81.2	18.8	
Marital status	863			8.88	1196			10.01
Currently married		78.1	21.9	(0.003)		80.4	19.6	(0.002)
All other situations		69.0	31.0			72.5	27.5	
BMI	863			2.58	1196			10.27
BMI=<18.5		70.6	29.4	(0.460)		70.7	29.3	(0.016)
BMI 18.6-24.9		73.5	26.5			74.7	25.3	
BMI 25-29.9		75.4	24.6			81.6	18.4	
BMI=>30		78.0	22.0			79.1	20.9	
Remoteness	863			4.21	1196			0.06
Major city		76.9	23.1	(0.040)		77.5	22.5	(0.805)
Other places		70.6	29.4			76.8	23.2	
Urban		75.5	24.5	2.19		78.8	21.2	0.28
Rural		69.2	30.8	(0.139)		77.0	23.0	(0.599)
Long-term health conditions	862			0.52 (0.471)	1195			7.98 (0.005)
No		73.6	26.4			74.1	25.9	
Yes		75.8	24.2			80.9	19.1	
Physical activity per week	764			6.05 (0.048)	1067			0.52 (0.770)
Less than once		73.0	27.0			78.7	21.3	
1-3 times		79.8	20.2			76.5	23.5	
More than 3		71.2	28.8			77.1	22.9	
Smoking frequency	860				1052			7.27
Non-smoker						78.6	21.4	(0.026)
Occasional smoker						63.0	37.0	
Regular smoker						68.2	31.8	
Self-assessed health	760			2.04	1065			9.36
Excellent		78.8	21.2	(0.727)		63.9	36.1	(0.530)
Very good		78.2	21.8			76.6	23.4	
Good		73.3	26.7			78.0	22.0	
Fair		74.5	25.5			80.6	19.4	
Poor		75.9	24.1			80.0	20.0	

	N	%	%	χ² (p)	N	%	%	χ² (p)
Kessler PDS risk	768			6.14	1063			3.29
Low		77.6	22.4	(0.105)		79.3	20.7	(0.350)
Moderate		73.0	27.0			75.7	24.3	
High		73.2	26.8			75.0	25.0	
Very high		61.9	38.1			71.7	28.3	
Financial risk taking attitude					1045			16.04 (0.003)
Never takes risk						74.5	25.4	
Takes average risks						86.9	13.0	
Takes sizeable risks						53.8	46.2	
Full-time student	863			0.06	1196			15.31
Yes		76.3	23.7	(0.806)		57.1	42.1	(0.000)
No		74.5	25.5			78.4	21.6	
State	863			5.05	1196			17.24
NSW		75.6	24.4	(0.653)		79.3	20.7	(0.016)
VIC		78.5	21.5			81.9	18.1	
QLD		72.7	27.3			75.3	24.7	
SA		69.1	30.9			69.1	30.9	
WA		74.2	25.8			79.7	20.3	
Health shocks	574			4.39	1054			12.03
Yes		73.2	26.8	(0.036)		84.9	15.1	(0.001)
No		80.1	19.9			88.3	11.7	
Financial distress	574			0.14	1065			35.52
Yes		75.2	24.8	(0.71)		73.8	26.2	(0.000)
No		77.6	22.4			88.1	11.9	

Note: Data from HILDA survey 2009 and 2013. P-values are in the parenthesis. Values in percentage. Here, DY means disposable income. Low income is DY<$63746), lower middle income is DY = $63746 to $100757, higher middle income is $100758 to $144848) and high income is DY>$144849. The variable financial risk taking attitude was not available in 2009. Tasmania, Northern Territory and Australian Capital Territory had patient count less than 25. Hence, these data are not reported in the table. PDS means psychological distress scale. Identical questions regarding smoking habit and financial risk taking attitude are not available between 2009 and 2013.

4.4.4 Determinants of selection of hospital care

The results of the logistic regression model are presented in Table 4.5. The factors that influence the probability of selecting public hospital care for respondents with PHI cover from 2013 are shown. The reference category for each variable is in parenthesis.

Table 4.5 Key determinants of hospital care-seeking behaviour of patients with private insurance cover

Factors (reference category)	Beta	Wald	S.E.	P-value	Odds ratio
Self- assesses health (Poor)					
Excellent	0.039	0.005	0.572	0.942	1.039
Very good	-0.267	0.360	0.460	0.527	0.766
Good	0.031	0.006	0.418	0.937	1.032
Fair	-0.327	0.611	0.445	0.410	0.721
Household disposable income (High)					
Low income	0.341	1.324	0.301	0.056	1.407
Lower-middle income	0.591	4.883	0.284	0.032	1.806
Higher-middle income	-0.353	1.718	0.29	0.195	0.703
BMI (BMI=>30)					
BMI <=18.5	0.681	2.666	0.439	0.101	1.976
BMI 18.6-24.9	-0.039	0.026	0.247	0.858	0.961
BMI 25.29.9	-0.333	1.828	0.253	0.168	0.717
Age (Age>65)					
Age<45	0.772	6.601	0.302	0.005	2.165
Age 45-65	0.167	0.332	0.282	0.531	1.182
Type of health cover (Both)					
Hospital only	0.195	0.506	0.275	0.463	1.215
Extras only	4.053	15.548	2.271	0.001	7.55
Physical activity (> 3 times a week)					
< once a week	0.119	0.233	0.255	0.629	1.127
1-3 times a week	-0.119	0.281	0.247	0.614	0.888
Financial risk taking attitude (Never)					
Substantial risks	1.281	3.514	1.616	0.081	3.60
Above average risks	1.56	3.924	5.956	0.04	1.21
Average risks	-0.114	0.148	0.313	0.702	0.892
Not willing	0.026	0.008	0.309	0.922	1.026
Other compounding variables					
Born outside Australia (In Australia)	-0.352	1.878	0.267	0.163	0.704
Female (Male)	0.175	0.722	0.21	0.39	1.191
No long-term health condition (Yes)	0.295	1.63	0.245	0.201	1.343
Not a full-time student (Full-time student)	-0.712	3.502	0.417	0.039	0.491
Currently not married (Married)	0.148	0.547	0.22	0.459	1.16
Rural (Urban)	-0.219	0.60	0.326	0.47	0.804
Education more than High school (Otherwise)	-0.447	4.419	0.221	0.033	0.64
Hospital doctor visit (No visit)	-0.567	8.415	0.209	0.002	0.567
Specialist doctor visits (No visit)	1.183	33.211	0.213	0.001	3.265
Constant	-1.31	3.326	0.769	0.076	0.27
	Chi-sq		*P-value*		*R-sq*
Omnibus test model coefficients	252.78		0.000		
Hosmer & Lemeshow	12.99		0.112		
-2 Log likelihood[a]	790.81				
Cox & Snell					0.223
Nagelkerke					0.345

Note: Data from Wave 13. Bootstrap standard errors and p-values. Results are based on 1000 bootstrap samples. Reference category presented in the parenthesis. Dependent variable hospital admission type = 1 if public patient in a public hospital and 0 otherwise.
[a] estimation terminated at iteration number 0.5 because parameter estimates changed by less than 0.001.

After adjusting for socioeconomic and demographic characteristics and other key factors, this study found that income level, age, level of education, type of health insurance cover and type of doctor visits have a significant impact on the selection of the type hospital care. According to the findings, young patients (age < 45) are 2.2 times more likely to select public care compared to older patients (age > 65). Hence, patients with advanced age are more likely to choose private patient care in Australia. In addition, patients from lower-income households are 1.4 to 1.8 times more likely to choose public patient care compared to patients from higher-income households. Conversely, patients with higher education levels are 1.56 times less likely (odds ratio=1/0.64) to opt for public patient care in comparison to a patient with lower education levels. Similarly, patients with hospital doctor visits have a lower probability of choosing public patient care (odds ratio = 1.76). However, patients with higher specialist doctor visits have a 76.55% probability of selecting public patient care[5]. Lastly, patients with higher risk-taking attitudes tend to choose public care (1.2 to 1.4 times more) over private care in comparison to patients with lower risk-taking attitudes. All these results are significant at a 5% confidence interval.

Although the following results are statistically insignificant, it is important to note that patients who are women (54%), without long-term health problem (57%), currently not married (53%) and from urban areas (55%) have a higher probability of selecting public care at hospitals compared to patients who are men, with long-term health problems, married and living in rural areas, respectively.

For robustness check a regression analysis was conducted adding state dummies (Australian Capital Territory as the reference category) in the model to control for state-wise variations in PHI policy, system and practice. The signs and significance of the coefficients persisted (results presented in Table 4.6 of Appendix A), implying the reliability of the model. The results also indicate that patients with PHI in New South Wales, Victoria and Queensland are less likely to select public care at the hospitals compared to other states. Several diagnostic tests were also conducted. The diagnostic tests presented in Table 4.5 justify the soundness of the regression model selected. The Omnibus test for model coefficient has a p-value <0.01, which indicates that additional explanatory variables improved the accuracy of the model. The Hosmer and Lemeshow test results suggest that the model is a good fit (p-value>0.05). The R-square values of

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[5] The probability has been calculated using the following formula, Pr (Y_p>0) = Odds ratio / (1+Odds ratio).

Cox and Snell test and Nagelkerke test illustrate that the model explains 22.3% and 34.5% of the variations in the outcome variable, respectively.

4.5 Discussion

This paper provides an estimate of the impact of PHI cover on overall healthcare usage and type of hospital care selection among Australian adults using a nationally representative data set. There are significant disparities in secondary preventive care, overnight hospital stay and specialist care utilisations between patients with and without PHI cover. Similar to earlier literature, this study also found that private hospital cover encourages and facilitates patients to consume private care. Respondents with PHI used private hospital care and specialist care significantly more than those without PHI. However, the type of PHI cover plays an important role in determining the nature of care used. Patients with extras only PHI cover use public hospital care, and patients with hospital only PHI cover have the tendency to use private hospital care. This behaviour of patients with PHI cover is reasonable as individuals treated as private patients have shorter waiting for treatments, the ability to choose physicians and enjoy better amenities (e.g. private rooms) (Buchmueller et al. 2013). Yet, the results also indicate that around one in four adults in Australia with PHI cover prefers to use public care. Finally, outcomes of the adjusted binary logistic regression model indicate that lower incomes, younger age, lower levels of education, specialist doctor visits and higher risk-taking attitudes increase the probability of choosing public care among patients with PHI cover. Hence, this study concludes that patients from lower socioeconomic status have a higher probability of choosing public care at the hospitals despite having PHI cover. The critical question is, why?

The Private Health Insurance Act (2007)[6] prohibits insurance providers from discriminating on premiums based on age, gender, race, religion or health status. However, under this mandatory community rating, premiums are allowed to vary based on the extent of the cover and treatments included (Cheng 2014; Ellis & Savage 2008). Therefore, more services covered instigates higher premiums. Young adults are allowed to buy PHI cover while excluding services such as coronary care, joint replacement, cataract surgery and women may decide not to include pregnancy care cover (Buchmueller 2008). People are encouraged to purchase PHI cover due to this reduction in premiums (packages with lower premiums and higher service deductibles) along with

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[6] Prepared by the Office of Parliamentary Counsel, Canberra. Available from: https://www.legislation.gov.au/Details/C2016C00911

other "carrot and stick" policies imposed by the government. This explains the findings that people who are younger, female, from low-income households, without long-term health conditions, lower BMI and with higher self-assessed health choose public patient care even though they have PHI cover. Given their comparative good-health or lower ability to pay for medical services, they have more probability of buying PHI cover with significant service deductibles compared to people without these characteristics (Ungar & Ariely 2005). On the other hand, patients with or without PHI cover may choose a private hospital to avoid long waiting times at public hospitals. The expectation of a longer waiting time is a significant determinant of a patient taking up PHI cover for private care (Dixit & Sambasivan 2018). Hence, it is justifiable that older patients, patients from high-income households, those with long-term health conditions and lower health status choose private care over public care, regardless of their PHI status. Patients with these characteristics often do not wish or cannot wait a significant time period for treatment.

It is also important to note that patients often have little say in the decision to choose the type of hospital care. As Cheng et al. (2015) indicated, private hospitals in Australia often refer complex patient cases to public hospitals. Furthermore, patients entering a hospital through emergency departments or for emergency services mostly end up being a public patient (Duckett 2005). Another important aspect is the lack of information regarding the additional out-of-pocket costs associated with being a private patient at the hospital. Senate Community Affairs References Committee (2014) concluded that patients with PHI cover using care for chronic illness from the private health system bear higher out-of-pocket costs (than those using public care) and are not adequately informed beforehand of the costs. This lack of information may significantly impact the decision of choice of care at the time of needing care. Findings of these previous studies partly explain why patients with PHI cover who experienced health shocks or have immediate financial pressure prefer public care over private care. For an accurate understanding of the issue, further studies are required to understand the care-seeking behaviour of patients who suffered major health and financial shocks.

The estimated results from the merged data of 2009 and 2013 (a cohort of 193 respondents) showed that respondents dropped their health insurance cover despite reporting significantly worsening in self-assessed health status (2013) compared to when they had PHI cover (2009). However, the findings could be highly influenced by the increasing age of the selected cohort of respondents and other unobserved variables.

Further studies are required to understand the phenomenon completely. Nonetheless, the unadjusted mean numbers of health care utilisations (e.g. hospital admission and hospital nights) were also lower in 2009 (with PHI cover) than in 2013 (dropped PHI cover). These findings differ with the adverse selection hypothesis[7] in the PHI sector in Australia as PHI coverage in Australia consists of a large pool of individuals with lower health risks. These findings are similar to the conclusions of earlier comparable studies (Barrett & Conlon 2003; Lu & Savage 2006; Cheng 2014; Eldridge et al. 2017).

The evidence also shows that individuals who have PHI cover had a significantly higher rate of health check-ups relative to individuals without it. In addition, a significant disparity was observed in the use of specialist care as patients with PHI (ancillary services cover) have lower or no out-of-pocket costs of seeing a specialist. These findings uphold the concern raised by previous studies that the PHI system is inequitable as services are not provided to those who require it, rather to those that have the ability to pay for it (Armstrong et al. 2007; Podger 2016).

Finally, the results also indicate that PHI patients who visited hospital doctors are significantly more likely to choose private care and that those who visited specialist doctors have a higher probability of selecting public hospital care. It is difficult to explain these findings from the data, and the answer to these findings are well beyond the scope of this study. Hence, future studies could look into the association between PHI status, specialist and hospital doctor visits and the choice of hospital care in Australia.

Several policy suggestions can be offered based on these results. Firstly, it is evident that PHI cover encourages people to use private care. However, the considerable number of patients not consuming private care when they are eligible may indicate a lack of coherence in the policy and/or consumer information asymmetry, higher quality, capability and specialisation of the public hospitals than private hospitals. In addition, proximity to public hospitals may also influence the decision of the patients. Over the course of time, if PHI customers with certain characteristics (e.g. young age, better health status, low-incomes) comprehend that they are continuously paying for PHI cover without consuming the services associated with it and if they do use private care then the out-of-pocket costs are higher (than those without cover), they may discontinue it. This trend is evident from the latest AIHW data (Figure 4.1). Secondly, respondents

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[7] People with higher health risk tend to purchase PHI cover more.

with PHI cover showed a notably higher level of health screening than those without coverage. Nonetheless, the rate of screening is less than 30%. PHI providers should encourage their customers to increase the rate of health screening by offering rebates in premiums or expansion in coverage with similar premiums. This preventive behaviour should generate considerable benefits for the health system (private and public) in the long-run. PHI providers need to address this issue to increase the participation rate in the prescribed health screening programmes. Thirdly, further studies are required to understand why patients from lower socioeconomic status have more probability of using public care despite having PHI cover. It is most likely the out-of-pocket cost, but that has not been proven conclusively. Fourthly, policymakers should examine methods to reduce the inequality in secondary preventive care and specialist care use between PHI patients and those with no cover. Availability of specialists who bulk-bill might help in this regard.

This study has some limitations. Firstly, it is difficult to account for any internal factors or policies that govern the PHI provider premiums and coverage policy. Given the price elasticity of healthcare demand is non-zero; therefore, changes in prices (PHI premiums even if inflation-adjusted) have a significant impact on a patient's decision. Second, the choice between public and private care may be influenced by expectations of the quality of care that will be received and closeness of the private hospitals. This study could not account for these issues. Lastly, since data on the type of disease/illness treated at each hospital for each patient was unavailable, this study could not examine the impact of the type of chronic disease on the hospital care choice decision. For example, the findings indicate that the prevalence of long-term health condition significantly influences the hospital care choice decision. But this study could not explain how and which conditions have a greater impact on healthcare use. Further studies with primary data are required to understand the relationship between the type of disease, type of doctor visits and choice of hospital care.

4.6 Conclusions

This paper investigated the healthcare use of individuals with or without PHI cover and the determinants of the choice of hospital care (private vs public) of patients with PHI cover. The results indicate that PHI status significantly impacts the use of preventive care, specialist care, and overnight stays at hospitals in Australia. Moreover, patients from lower socioeconomic status (e.g. low income and lower education level) and patients who are relatively young (age<65), without long-term health conditions, better

self-assessed health and had recent experience of serious illness or financial distress have a higher probability of selecting public care at hospital despite holding PHI cover. Except for specialist care use and the number of nights stay at the hospitals, healthcare utilisation did not vary significantly among a cohort of individuals before and after dropping PHI cover. These results are important inputs into policy discussions to enable a more equitable health system which ensures equal access to care services based on necessity rather than the ability to pay.

References:

1. Armstrong, BK, Gillespie, JA, Leeder, SR, Rubin, GL & Russell, LM 2007, 'Challenges in health and health care for Australia', *Medical Journal of Australia*, vol. 187, no. 9, p. 485.

2. Barrett, GF & Conlon, R 2003, 'Adverse selection and the decline in private health insurance coverage in Australia: 1989–95', *Economic Record*, vol. 79, no. 246, pp. 279-96.

3. Barros, PP & Siciliani, L 2012, 'Public and private sector interface', in MV Pauly, et al. (eds), *Handbook of Health Economics*, Elsevier, vol. 2, ch 15, pp. 927-1001.

4. Booth-Kewley, S & Vickers Jr, RR 1994, 'Associations between major domains of personality and health behavior', *Journal of Personality*, vol. 62, no. 3, pp. 281-98.

5. Buchmueller, T 2008, 'Community rating, entry-age rating and adverse selection in private health insurance in Australia', *The Geneva Papers on Risk and Insurance-Issues and Practice*, vol. 33, no. 4, pp. 588-609.

6. Buchmueller, T, Fiebig, DG, Jones, G & Savage, E 2013, 'Preference heterogeneity and selection in private health insurance: the case of Australia', *Journal of Health Economics*, vol. 32, no. 5, pp. 757-67.

7. Cheng, TC 2014, 'Measuring the effects of reducing subsidies for private insurance on public expenditure for health care', *Journal of Health Economics*, vol. 33, pp. 159-79.

8. Cheng, TC & Vahid, F 2011, 'Demand for hospital care and private health insurance in a mixed public-private system: empirical evidence using a simultaneous equation modeling approach', *HEDG Working Paper 10/25*, viewed 15 April 2018, <https://www.york.ac.uk/media/economics/documents/herc/wp/10_25.pdf>

9. Cheng, TC, Haisken-DeNew, JP & Yong, J 2015, 'Cream skimming and hospital transfers in a mixed public-private system', *Social Science & Medicine*, vol. 132, pp. 156-64.

10. Dismuke, CE & Egede, LE 2011, 'Association of serious psychological distress with health services expenditures and utilization in a national sample of US adults', *General Hospital Psychiatry*, vol. 33, no. 4, pp. 311-7.

11. Dixit, SK & Sambasivan, M 2018, 'A review of the Australian healthcare system: A policy perspective', *SAGE Open Medicine*, vol. 6, pp.1-14.

12. Duckett, SJ 2005, 'Living in the parallel universe in Australia: public Medicare and private hospitals', *Canadian Medical Association Journal*, vol. 173, no. 7, pp. 745-7.

13. Eldridge, DS, Onur, I & Velamuri, M 2017, 'The impact of private hospital insurance on the utilization of hospital care in Australia', *Applied Economics*, vol. 49, no. 1, pp. 78-95.

14. Ellis, RP & Savage, E 2008, 'Run for cover now or later? The impact of premiums, threats and deadlines on private health insurance in Australia', *International Journal of Health Care Finance & Economics*, vol. 8, no. 4, pp. 257-77.

15. Field, A 2013, *Discovering statistics using IBM SPSS statistics*, 5th edn, Sage publication, London.

16. Folland, S, Goodman, AC & Stano, M 2007, *The economics of health and health care*, vol. 6, Pearson Prentice Hall Upper Saddle River, NJ.

17. Frech III, H & Hopkins, S 2004, 'Why subsidise private health insurance?', *Australian Economic Review*, vol. 37, no. 3, pp. 243-56.

18. Jeon, B & Kwon, S 2013, 'Effect of private health insurance on health care utilization in a universal public insurance system: a case of South Korea', *Health Policy*, vol. 113, no. 1-2, pp. 69-76.

19. Jowett, M, Contoyannis, P & Vinh, ND 2003, 'The impact of public voluntary health insurance on private health expenditures in Vietnam', *Social Science & Medicine*, vol. 56, no. 2, pp. 333-42.

20. Lu, M & Savage, E 2006, 'Do financial incentives for supplementary private health insurance reduce pressure on the public system? Evidence from Australia', in *iHEA 2007 6th World Congress: Explorations in Health Economics Paper*, Copenhagen, Denmark, University of Technology Sydney.

21. Pagán, JA, Puig, A & Soldo, BJ 2007, 'Health insurance coverage and the use of preventive services by Mexican adults', *Health Economics*, vol. 16, no. 12, pp. 1359-69.

22. Podger, A 2016, 'Federalism and Australia's national health and health insurance system', *Asia Pacific Journal of Health Management*, vol. 11, no. 3, p. 26.

23. Senate Community Affairs References Committee, *Out-of-pocket costs in Australian healthcare,* 2014, The Senate Community Affairs Committee Secretariat, Commonwealth of Australia 2014, Canberra.

24. Srivastava, P, Chen, G & Harris, A 2017, 'Oral health, dental insurance and dental service use in Australia', *Health Economics*, vol. 26, no. 1, pp. 35-53.

25. Summerfield, M, Bevitt, A, Freidin, S, Hahn, M, La, N, Macalalad, N, O'Shea, M, Watson, N, Wilkins, R & Wooden, M 2017, *HILDA User Manual – Release 16'*, Melbourne Institute of Applied Economic and Social Research, University of Melbourne, VIC, viewed 1 November 2018, <https://melbourneinstitute.unimelb.edu.au/__data/assets/pdf_file/0006/25978 65/HILDA-User-Manual-Release-16.0_LATEST.pdf>

26. Colombo, F & Tapay, N 2004, 'Private health insurance in OECD countries: the benefits and costs for individuals and health systems', *Towards high-performing health systems: Policy studies*, Paris, pp. 265-319, viewed 5 April 2018, <https://www.oecd.org/els/health-systems/33698043.pdf>

27. Ungar, WJ & Ariely, R 2005, 'Health insurance, access to prescription medicines and health outcomes in children', *Expert Review of Pharmacoeconomics & Outcomes Research*, vol. 5, no. 2, pp. 215-25.

28. Van Gameren, E 2010, 'Health insurance and use of alternative medicine in Mexico', *Health Policy*, vol. 98, no. 1, pp. 50-7.

29. Wooden, M & Watson, N 2007, 'The HILDA survey and its contribution to economic and social research (so far)', *Economic Record*, vol. 83, no. 261, pp. 208-31.

30. Wright, DB, London, K & Field, AP 2011, 'Using bootstrap estimation and the plug-in principle for clinical psychology data', *Journal of Experimental Psychopathology*, vol. 2, no. 2, pp. e013611.

31. Zhang, L, Ding, D, Neubeck, L, Gallagher, P, Paull, G, Gao, Y & Gallagher, R 2018, 'Mobile technology utilization among patients from diverse cultural and linguistic backgrounds attending cardiac rehabilitation in australia: descriptive, case-matched comparative study', *JMIR Cardio*, vol. 2, no. 1, pp. e13.

CHAPTER 5

CHAPTER 5: **Introductory note: Relationship between Chapter 5 and Chapter 4**

In Chapter 1 (Section 1.4), it was mentioned that many empirical studies have found that income significantly impacts healthcare utilisation, as well as the decision to purchase private health insurance in Australia. Results in Chapter 4 indicated that private health insurance has an impact on healthcare utilisation. In addition, it is also evident from Chapter 4 that (Table 4.4 and 4.5) patients with private health insurance from low-income households utilise public hospital significantly more than those from higher-income households. Furthermore, patients from urban and city areas (with private health insurance) favour private hospital care more than patients from rural and remote areas. Therefore, private health insurance status plays a significant role in influencing healthcare utilisation in Australia. In this backdrop, Chapter 5 of this thesis aimed at understanding the factors that influence the decisions to buy private health insurance in Australia by using disaggregated data for 328 regions of Australia. The paper also studied whether an unequal income distribution explains the variations in the private health insurance coverage rates in those different regions of Australia. Disparities in private health insurance coverage might explain some of the variations in healthcare utilisation of patients from regional Australia.

The article is currently under review in the 'Rural and Remote Health' journal.

5.0 The impact of income inequality on private health insurance coverage: a comparison between different regions of Australia

5.1 Abstract

Objective: There is a paucity of empirical evidence about whether the impact of income inequality on private health insurance (PHI) demand is positive or negative or if even significant. The two aims of this Australian study are to investigate the determinants of PHI demand and then estimate the effect of income inequality on the PHI coverage rate.

Method: An instrumental variable (Two-Stage Least Squares) estimation approach was used to test the study questions and to control for the potential endogeneity. Several diagnostic tests and robustness checks were conducted to ensure the validity of the IVs used and the obtained estimates in this study. A concentration curve was produced to show the income-related bias of PHI coverage. Disaggregated data for 328 regions of Australia was used for estimation purpose.

Results: The results indicate that regions with higher-income inequality have a higher percentage of the population with private health cover. The rising share of the top 25% of income earners has a significant and positive relationship with PHI demand. Moreover, higher self-assessed health status, higher levels of education, a greater proportion of Australian citizenship and a higher proportion of the population over the age of 65, significantly increase the PHI coverage rate in a region. A substantial disparity was observed in PHI coverage within and across states.

Conclusion: The study findings are important if a reduction in the inequality of access to and utilisation of healthcare resulting from the disproportionate level of PHI cover across regions and income levels is to occur. In addition, the findings of this research will assist policymakers (implementing policies to increase PHI cover) and PHI providers to understand the major determinants of PHI demand, as well as the causes of unequal PHI coverage rate across the regions of Australia. Further research is required using time-series or panel data to examine whether the long-term association between PHI cover and self-assessed health is unidirectional or bidirectional.

Keywords: Income inequality; health insurance; regions; instrumental variable approach; disaggregate data; endogeneity; income share; Australia

5.2 Introduction

The Australian health system provides universal coverage for all its citizens through its public national health insurance scheme, 'Medicare'. In addition, the country has a parallel, complementary and sometimes competing private health insurance (PHI) system. In the early 2000s, the government of Australia made significant policy reforms to the private insurance market to increase PHI coverage (Buchmueller 2008; Butler 2002). These policies provided subsidies to consumer premiums (tax rebates) and were instrumental in increasing PHI coverage from 31% in 1999 to 45% by 2001, and it has since remained constant at that level (Australian Institute of Health and Welfare 2017; Australian Prudential Regulation Authority 2018). In 2017-18, the federal government of Australia spent approximately $6.4 billion on the PHI rebate (subsidises the cost of PHI premiums) to sustain the appeal of PHI coverage to Australians (Australian Tax Office 2018).

Although past studies provided arguments for (Cheng 2014; Frech III & Hopkins 2004) and against (Podger 2016; Segal 2004) the justification of subsidising PHI with public resources, past and current governments have continued the policy. The main rationale for supporting PHI uptake is to reduce dependence on public hospital emergency departments (Percheski & Bzostek 2017), improve quality of care by decreasing public hospital waiting times (Buchmueller et al. 2013; Frech III & Hopkins 2004) and promote the adoption of healthy lifestyles through additional contacts with health practitioners (Lee 2018). The Private Health Insurance Act (2007) prohibits insurance providers from discriminating on premiums based on age, gender, race, religion or health status. However, under this mandatory community rating, premiums are allowed to vary based on the extent of the cover and treatments included. A larger insurance pool with young and healthy enrolees lowers premium rates making PHI potentially affordable for all (Buchmueller 2008). Yet, the existence of national insurance programmes like Medicare has a large crowding out effect on the demand for PHI (Lee 2018). Hence, understanding the key elements that induce the demand for PHI in Australia is important for socioeconomic, political and fiscal reasons.

Numerous past studies have attempted to determine the factors that influence an individual's decision to purchase PHI (Buchmueller et al. 2013; Doiron et al. 2008; Ellis et al. 2017; Ellis & Savage 2008; Pendzialek et al. 2016). Due to the complexity

of Australia's healthcare system, it is not valid to compare demand for PHI in Australia with countries that are without universal health cover or do not incentivise PHI cover. Hence, the findings of the studies that investigated the determinants of PHI in other countries may not be pertinent to Australia. Saying that, the literature concludes that the primary determinants of PHI demand are: the cost of premium; an individual's income; their perceived health status; their attitude towards risk; age; education level; employment status; ethnicity; and household size (Doiron et al. 2008; Ellis et al. 2017; Pendzialek et al. 2016). Additionally, studies conducted in Australia and the UK concluded that favourable tax policies and subsidies, waiting times for elective surgery, the perceived quality gap between public and private care, long-term health conditions and risk aversion primarily drive the probability of purchasing PHI (Barrett & Conlon 2003; Buchmueller et al. 2013; Costa & Garcia 2003; Eldridge et al. 2017). Noticeably, none of the previous studies has considered how an unequal distribution of income in a region or an individual's position in the income distribution, might impact the probability of PHI purchase.

Income inequality is undesirable for any region, and a number of literature documents its repercussions on public health outcomes which shows that it is associated, either directly or indirectly, with differential outcomes in life expectancy, mortality, quality of life, mental health, happiness, self-assessed health and life satisfaction (Neumayer & Plümper 2016; O'Donnell et al. 2015; Okulicz-Kozaryn 2015; Subramanian & Kawachi 2006; Wagstaff & Van Doorslaer 2000). There is already evidence of unequal access to healthcare and lower health outcomes for poorer individuals and households in Australia (Schoen et al. 2000; Stavrunova & Yerokhin 2014; Van Doorslaer et al. 2008). Hence, a pertinent question arises: is there a possibility that income inequality has a negative effect on the PHI take-up rate and access to private healthcare?

There are also significant variations in PHI coverage rates across and within the six Australian states and two territories. According to 2018 estimates, Western Australia has the highest PHI cover at 54.6% and the Northern Territory the lowest at 39.7% (Australian Prudential Regulation Authority 2018). Moreover, there are disparities in PHI coverage rate among regions in each state and territory. It is, therefore, an empirical question as to whether this large disparity is a consequence of differences in waiting times, PHI premiums, health policies or institutional frameworks or is due to

some other unobserved factors, such as the unequal distribution of income. It is also unknown whether the relationship between income inequality and PHI demand in a region is positive or negative or if this is even significant. The answers to these questions are non-existent for Australia. This study attempts to fill these gaps.

A notable challenge is to realise that the behaviour and decisions of individuals are not homogenous in regions and across states due to variations in the environment, perceptions, health policies, health systems and institutional frameworks. According to Garrett (2003), if there are significant variations in the characteristics and behaviours of economic agents (the regions of Australia), using aggregate data may provide biased estimates. There is also evidence that the signs and significance of the estimated coefficients when using aggregate data can be different from analysis based on disaggregated data. A large gap exists in the literature attempting to explain the current spatial heterogeneity in PHI purchase and care-seeking behaviour. To the best of the authors' knowledge, this is the first study that has used disaggregated (Statistical Area Level 3) data to investigate the aforementioned relationship. Hence, this is a key contribution to the existing literature. There are 358 SA3 regions covering the whole of Australia; each represents a community that interacts together socially and economically and possess geographic and socioeconomic uniformities within the same administrative boundaries (Australian Bureau of Statistics 2018).
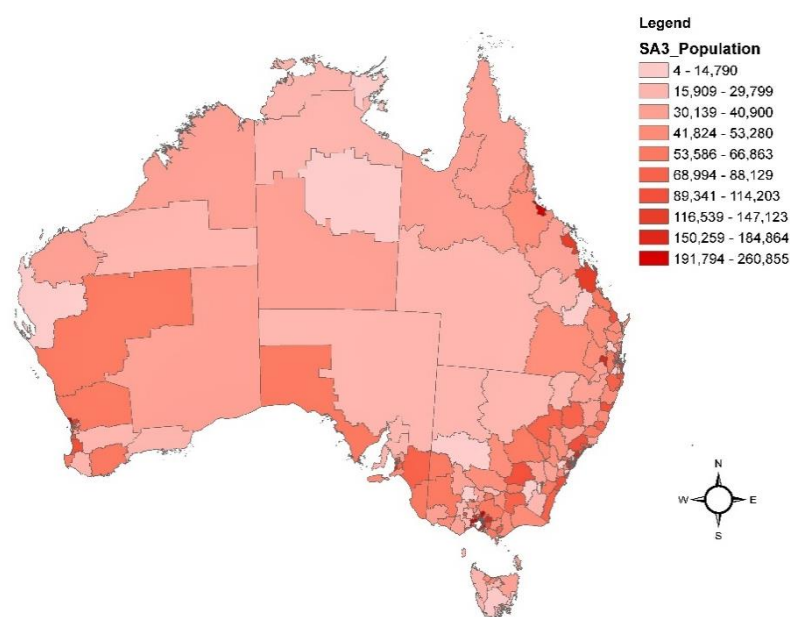
Figure 5.1 Mapping population size with GIS for 328 SA3 regions of Australia

Another important issue when investigating the determinants of PHI cover is to account for endogeneity in estimation when using a regression model (Ellis et al. 2017). There are potential reverse/simultaneous causality between the probability of PHI purchase and self-assessed health, as both variables may be simultaneously correlated to each other (Eldridge et al. 2017). Moreover, unobserved factors such as growth in insurance premiums based on the endogenous choice of health plans could influence the demand for PHI (Ellis et al. 2017). Unlike previous studies estimating the elements of PHI demand, an instrumental variable-based two-stage least squares (2SLS) approach will be used to account for this endogeneity problem (Wooldridge 2015).

Based on the above discussion, the objective is to examine the key social and demographic factors influencing the PHI enrolment rate using an instrumental variable (IV) approach for estimation using disaggregated SA3 level data. Furthermore, this study also aims to assess the relationship between PHI coverage rate and income inequality across regions. The novelty of this study is that the impact of unequal income distribution on the PHI demand in Australia will be examined for the first time. This issue is important because PHI cover is often associated with higher utilisation of healthcare (e.g. specialist care) and better health status (Lee 2018; Van Doorslaer et al. 2008). Policy implications arising from the analysis will be pertinent to other countries that provide universal health insurance coverage. There is little literature on this issue. Second, according to the best of authors' knowledge, this study is the first to use SA3 data to examine the determinants of PHI coverage in Australia. Mapping of the data through a geographic information system (GIS) will provide a clear overview of unequal PHI enrolment rates, self-assessed health and income inequality outcomes in different regions of the country. This will also illustrate the disparity in income distribution and health status across and within states. Third, unlike previous studies, four different measures of income inequality will be used to validate the estimated association. Fourth, a concentration curve has been generated to represent the income-related disparity in PHI coverage rate between the regions of Australia. Finally, the IV approach is utilised to control for any potential endogeneity problem. The findings will shed light on the heterogeneity in PHI enrolment rates across Australia and the socioeconomic, demographic and geographic characteristics that cause that to occur.

The next section describes the data and method of this study, followed by the interpretation of the results. The final parts include a detailed discussion of the findings and a brief conclusion of the study.

5.3 Methods

5.3.1 Data description

The 'Data by Region Database' (released on May 2018) and published by Australian Bureau of Statistics (ABS) (Australian Bureau of Statistics 2018) represents a set of data for a range of geographies based on the Australian Statistical Geographic Standard (ASGS). Due to the greater availability of data on key variables of interest, data from SA3 regions were used in the analysis, which divides the Australian data into 358 sections rather than usual 8 sections (by states and territories). Although 358 SA3 regions cover the whole of Australia, data on all the variables were only available for 328 SA3 regions as 30 of these regions are very remote without human occupants. Detail explanations about the data are available in the explanatory notes in (Australian Bureau of Statistics 2018). All the data used in the regression models are annual data from 2015.

5.3.2 Variables and measures

The key dependent variable is the percentage of the population with PHI cover in a region. ABS sourced the data from the Australian Tax Office (ATO) and reported the number of taxpayers who have PHI. Tax return lodgements with PHI cover are included in the data for a period of sixteen months after each financial year. In a recent study of similar nature, Stavrunova & Yerokhin (2014) used PHI coverage data for Australia from the same source, which is reliable and cross-checked to PHI member lists.

The main predictor variable is income inequality. Four different measures/proxies of income inequality have been used. These include the Gini coefficient, income share of top 10% earners, income share of the bottom (25%) quartile and income share of the highest (25%) quartile of the population, who lodged tax returns in 2015. The Gini coefficient takes values from 0 to 1 and values closer to 1 indicate higher income inequality. The other three variables have values between 0% and 100%. The first measure is widely used in the literature as a measure of income inequality (Neumayer

& Plümper 2016; Okulicz-Kozaryn 2015). Further information about the definition of the Gini coefficient (used in this study) is available in Australian Bureau of Statistics (2018).

Several control variables are used based on the literature, to account for the socioeconomic and demographic characteristics of a region that may influence PHI demand. Income level was measured by median total income (excluding government pensions and allowances) following the approach of Subramanian et al. (2003). Demographic attributes comprise the percentage of the population over the age of 65 years old and the percentage of the male population. The percentage of unemployed in the labour force was used as a proxy for employment status. Education level in a region was captured via the percentage of the population with a bachelor degree. Past studies have concluded that immigrant populations and individuals with lower English speaking abilities are less likely to purchase PHI (Percheski & Bzostek 2017; Savage & Wright 2003). Hence, Australian citizens as a percentage of the population was used as a proxy for these variables. The number of persons in each region was used to account for differences in population size. The health status of a region is measured via two variables, the percentage of the population with self-assessed health as fair or poor and the standardised death rate. This choice of variables is similar to previous studies of Barrett and Conlon (2003); Costa and Garcia (2003); Doiron et al. (2008) and Van Doorslaer et al. (2008).

5.3.3 Instrumental variables

There is substantial evidence that the PHI purchase decision is influenced by perceived health status (Buchmueller et al. 2013; Van Doorslaer et al. 2008). On the other hand, having PHI cover increases access to care and contact with the healthcare professionals and thus improves an individual's health status (Lee 2018). Hence, three instrumental variables have been used to resolve any potential endogeneity issues whilst assuming self-assessed health as an endogenous variable in the model. A sound instrumental variable will be correlated with the endogenous variable but uncorrelated with the unobserved variables or error terms in the model (Arsenijevic et al. 2016; Wooldridge 2015). Example of such unobserved variables would be waiting times and tax subsidy/rebates on PHI purchase. Based on these criteria, the percentage of the population with high and very high psychological distress and the percentage of the

population who are current smokers (male/female) are instructive instruments for analysis. Psychological distress and risky behaviours (e.g. smoking) are often associated with self-assessed health or health status (Dismuke & Egede 2011; Doiron et al. 2008; Lee 2018). All these variables have a significant positive relationship with self-assessed health which means that a higher percentage of the population with high psychological distress and smoking addiction will result in a higher percentage of the population with fair or poor self-assessed health. It is also important to understand that PHI premiums in Australia do not vary based on negative lifestyle behaviour (smoking), physical or psychological health status and other demographic characteristics. Henceforth, this study assumes that these variables (psychological distress and risky behaviours) indirectly impact PHI demand through self-assessed health and has no relation with the error terms. Although not part of the validity criteria, previous empirical studies have provided some evidence that the socioeconomic status of a region may be associated with mental health outcomes and risky behaviours of its residents (Dismuke & Egede 2011; Parslow & Jorm 2000). Hence, in order to ensure the quality and validity of the selected instrumental variables, several diagnostic tests were performed and are discussed in the next section.

5.3.4 Empirical strategy

This study considered the following structural equation model with a single endogenous variable:

$$PHI_i = \beta_0 + \beta_1 X_i + \beta_2 C_{1i} + \ldots\ldots + \beta_{1+q} C_{qi} + \varepsilon_i$$

where, i denotes individual SA3 regions, PHI_i is the dependent variable of i th observations, β is the coefficient of the associated variables, X_i denotes the endogenous explanatory variable (self-assessed health) of i th observations, C_i represents the q exogenous regressors of i th observations and ε_i is the error term. The IV solutions depend on the instruments denoted as Z_i (next equation) to estimate the two step procedure. Following Wooldridge (2010) in the first-stage equation, the reduced form of the endogenous variable (percentage of population self-assessed health fair or poor) is

$$X_i = \delta_0 + \delta_i C_i + \theta_j Z_j + \vartheta_i \qquad \text{here, j} = 1,2,3$$

The key assumption is that Z_j are exogenous in the second-stage equation if the value of one of the θ_j is nonzero. In the second-stage, PHI_i is regressed on the exogenous covariates and the resulting predicted values, $\hat{X}_i$, and the new equation is,

$$PHI_i = \beta_0 + \beta_1 \hat{X}_i + \beta_2\, C_{1i} + \ldots\ldots + \beta_{1+q}\, C_{qi} +\ \varepsilon_i$$

where the coefficient of β_0, β_1 and β_2 are the 2SLS estimators.

5.3.5 Validity of the instruments

Finding a plausible instrument for a potential explanatory variable is difficult when issues such as, under and weak identification, instrument relevance and exogeneity or over-identification of the instruments can occur (Baum et al. 2007). It is well established that using inappropriate variables as instruments will produce biased estimates. Therefore, several recognised tests were conducted to ensure the validity of the instruments and the model, while recognising their limitations. To confirm that fair or poor self-assessed health is an endogenous variable, the Dublin-Wu-Hausman chi-sq test was used (Baum et al. 2007). For weak instruments, the test suggested by Stock & Yogo (2005) was employed. In addition, under-identification and instrument redundancy have been checked with the test proposed by Kleibergen & Paap (2006). This test is robust, even if the errors in the model are heteroscedastic. The exogeneity condition of the instruments was verified with Hansen J-statistics developed by Hansen (1982), which is also robust to any potential heteroscedasticity problem. Finally, the Pegan-Hall test (Pagan & Hall 1983) and the variance inflation factor (VIF) test were performed to check for heteroscedasticity and multicollinearity in the regression model, respectively.

5.3.6 Robustness check

Several sensitivity analyses were performed to examine the robustness of the estimated results. First, the sensitivity of the results was examined by adjusting the model through the addition and subtraction of variables. Second, the sensitivity of the outcomes was checked through the exclusion and inclusion of instruments in the 2SLS model. Third, the 2SLS model was re-estimated by incorporating dummy variables (state dummies with New South Wales as the reference state) to account for PHI policy-related variations across the states of Australia. Lastly, the sensitivity of the results was checked using different estimation options such as two-step feasible

efficient generalised method of moments (EGMM) and a continuous-updating estimator (CUE).

5.4 Results

5.4.1 Graphical results

Figures 5.1 and 5.2 illustrate several key variables of interest of this study for 328 SA3 regions. Mapping is a modest means to present the complex and disparate data set for various geography and location, and it encourages a consistent approach to decision making. There is considerable variation in the population size, percentage of the population with PHI, average incomes, self-assessed health and income share of the top 10% earners, across the regions of Australia. Expectedly, coastal and urban areas of Australia have higher income and percentage of the population with PHI. Regions in the Northern Territory have the lowest percentage of the population with PHI and the highest percentage of the population with lower self-assessed health. Conversely, people in Western Australia have a lower percentage of people with poor and fair self-assessed health relative to the rest of the country. Interestingly, the maps showing people with PHI cover and income share of the top 10% of earners are almost identical, indicating a relationship between unequal income distribution and PHI coverage.
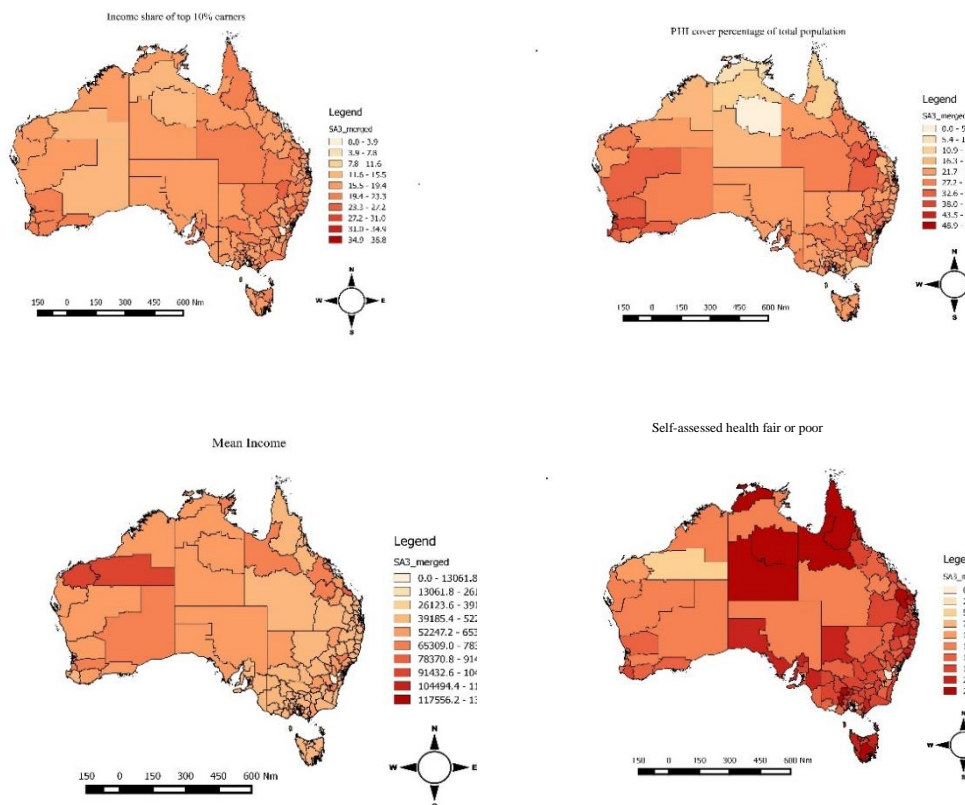
Figure 5.2 Mapping key variables with GIS for 328 SA3 regions of Australia- a) PHI as percentage of total population; b) average income; c) percentage of people with self-assessed health as fair or poor and d) income share of the top 10% earners. (Authors own calculation using ARCH GIS software).

The concentration index defines the degree of health inequality related with the socioeconomic conditions (e.g. income) and the concentration curve plots the cumulative portion of the population (regions) in terms of the cumulative proportion of a health variable (population with PHI) (Konings et al. 2010; Wagstaff et al. 1991).

Figure 5.3 represents a concentration curve where the health variable (e.g. illness, mortality) has been replaced by the population with PHI. If the concentration curve lies below the diagonal, the concentration index is defined as positive (Wagstaff et al. 1991). Not surprisingly, the figure below shows that PHI coverage is concentrated more toward the wealthiest regions of Australia.

Concentration curve
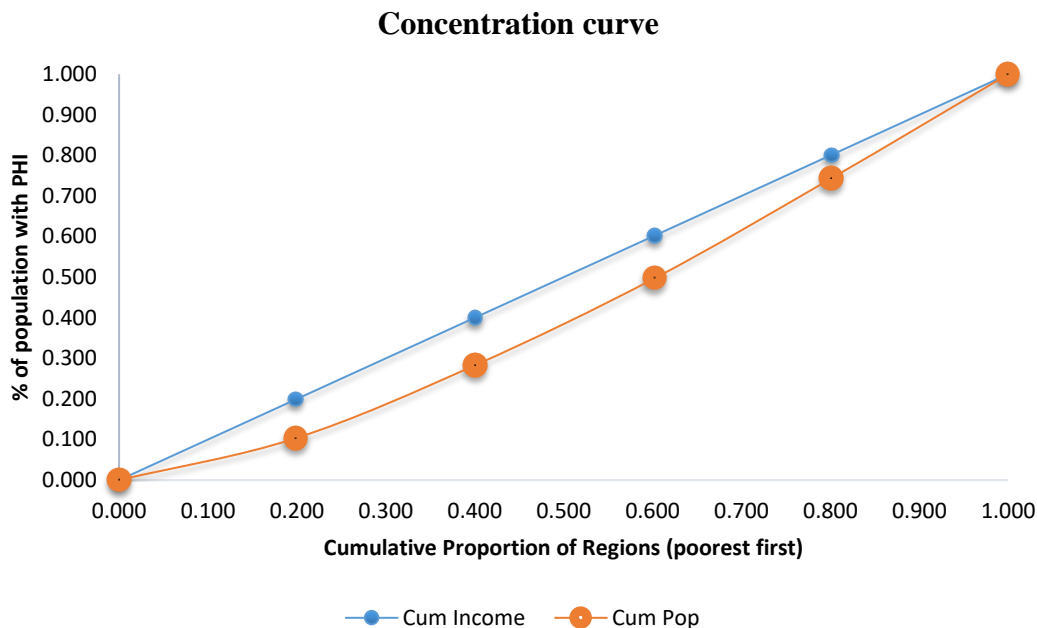

Figure 5.3 Concentration curve for PHI coverage

Figure 5.4 demonstrates PHI coverage by mean income and income inequality. The 328 SA3 regions were divided into four groups based on their mean income and three clusters based on the value of Gini coefficient. Although there are considerable variations within each group, it is evident that PHI coverage increases with a rise in mean income and income inequality.
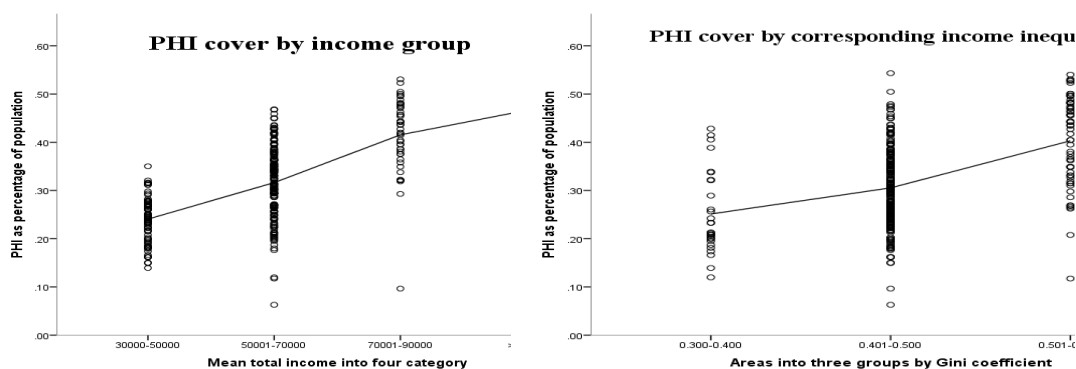

Figure 5.4 Mean PHI coverage rate by four income groups and three clusters based on income inequality for SA3 regions

Figures 5.5 and 5.6 display the relationship between the Gini coefficient and the number of taxpayers with PHI, and income share of the top 10% and the number of taxpayers with PHI for SA3 regions, respectively. Both figures include a regression fitted line. These lines indicate a positive relationship between the variables which

means regions with higher unequal income contains a higher number of the population with PHI coverage.

Gini coefficient and Number of tax payers with PHI
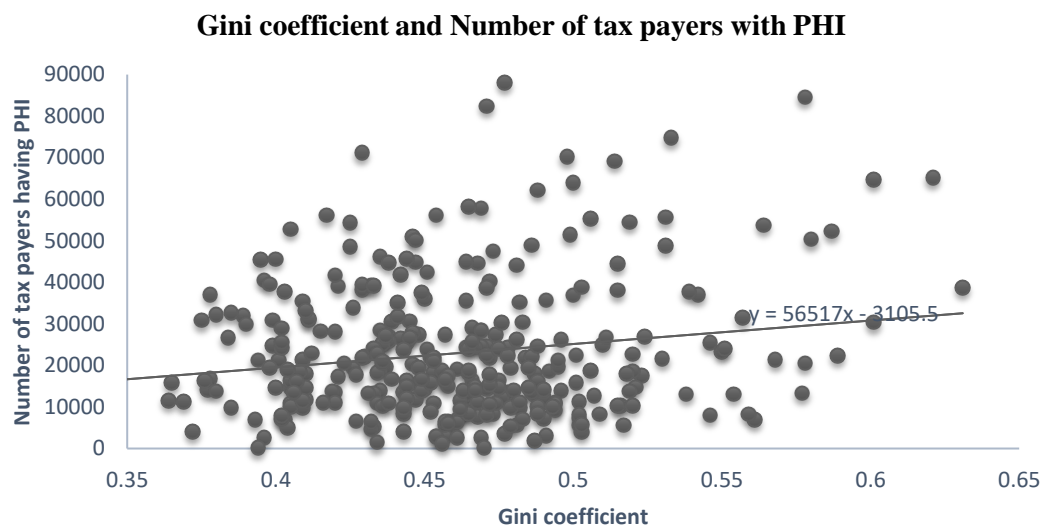
Figure 5.5 Scattered plot for number of tax payers with PHI and corresponding Gini coefficient for each SA3 region

Income share of top 10% of the population and Number of tax payers with PHI
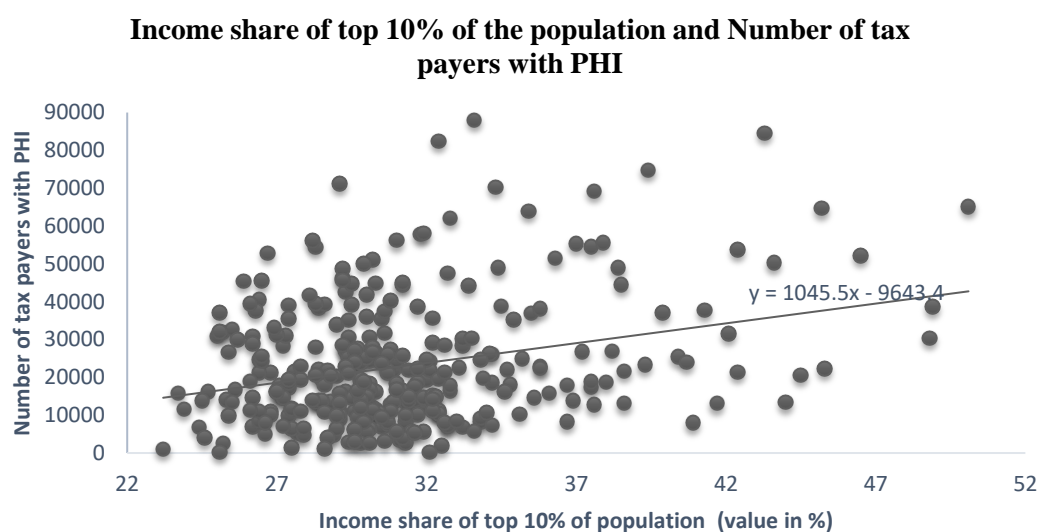
Figure 5.6 Scattered plot for number of tax payers with PHI and corresponding income share of top 10% of the population for each SA3 region

In short, the findings from the five figures above indicate that PHI coverage in Australia is not only concentrated towards the more socio-economically well-off regions but also towards regions with higher income disparities.

5.4.2 Regression results

At first, the regression model results were checked for their validity by examining for homoscedasticity of the error terms, the degree of multicollinearity within the explanatory variables, whether self-assessed health is an endogenous variable and whether the selected instrumental variables are valid instruments for self-assessed health. The Pegan-Hall test statistics ($\chi^2 = 17.31$, p <0.05) indicates that the disturbance is not homoscedastic and the variance inflation factor (VIF) test results show that multicollinearity is not an issue for the estimated models. The Durbin-Wu-Hausman test rejects the null hypothesis that self-assessed health is an exogenous regressor ($\chi^2 = 20.69$, p <0.05). Lastly, the Kleibergen-Paap Rank LM test statistics and Hansen J-statistics substantiate the validity of the instruments. (Baum et al. (2007) and Bascle (2008) showed a detail description of these diagnostic tests.

Table 5.1 presents the results of the ordinary least square (OLS) and the 2SLS regression model. The findings show the key factors determining the demand for PHI in Australia. Nearly 80% of the variations in the outcome variable can be explained by the models ($R^2 = 79.82$). Noticeably, the signs of all the variables are identical between the OLS and the 2SLS models.

Table 5.1 Factors associated with PHI coverage in SA3 regions of Australia (Models 1, 2, 3)

| | Gini coefficient | | | | Income share of the top 10% earners Model 3 | | |
| | Model 1 | | | Model 2 | | | |
Variable	OLS	2SLS	CUE	CUE	OLS	2SLS	CUE
Income inequality	33.89* (7.7)	26.53* (9.0)	24.09* (9.4)	3.53 (11.17)	0.35* (.09)	0.23* (.11)	0.17 (.12)
Self-assessed health (%)	-0.71* (.16)	-1.11* (.44)	-1.35* (.45)	-1.70* (.78)	-0.72* (.17)	-1.24* (.46)	-1.54* (.47)
Median income	.00038*(.00)	.00031*(.00)	.00032*(.00)	0.0004*(.00)	.00036*(.00)	.0003*(.00)	.0003*(.00)
Unemployment rate (%)	-0.38** (.21)	-0.21 (.32)	-0.35 (.32)	-0.14 (.44)	-0.35 (.21)	-0.13 (.33)	0.07 (.33)
Male population (%)	4.25 (23)	20.46 (29)	36.38 (28)	128.71* (49)	16.68 (21)	35.14 (27)	52.39 (28)
Bachelor's degree (%)	0.37* (.08)	0.36* (.08)	0.33* (.08)	0.29* (.15)	0.36* (.07)	0.37* (.07)	0.34* (.07)
Australian citizen (%)	0.27* (.06)	0.29* (.07)	0.31* (.07)	0.28* (.07)	0.29* (.06)	0.31* (.07)	0.33* (.08)
Persons over 65 years old (%)	0.38* (.10)	0.47* (.12)	0.53* (.13)	0.78* (.21)	0.41* (.10)	0.54* (.13)	0.61* (.14)
Death rate (per 1000 people)	-0.94** (.50)	-0.50 (.71)	-0.32 (.76)	-0.09 (1.04)	-0.94**(.49)	-0.35 (.73)	-0.14 (.80)
Population		-0.00 (0.00)	-0.00 (0.00)			-0.00 (0.00)	-0.00 (0.00)
State dummies							
Victoria				0.06 (1.30)			
Queensland				1.58* (.58)			
Australian Capital Territory				-3.20 (2.84)			
Northern Territory				-3.19 (4.40)			
South Australia				3.81* (.81)			
Tasmania				4.57* (1.49)			
Western Australia				4.80* (1.58)			
Observations	328	328	328	328	328	328	328
Heteroscedasticity-robust SE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of instruments		3	3	3		3	3
KP Rank LM-statistics (Chi-sq)		40.54 [.000]	40.54 [.000]	27.26 [.000]		40.46 [.000]	40.46 [.000]

KP Wald F-statistics		28.52	28.52	17.96	29.64	29.64
Hansen J-statistics		1.16 [.55]	0.96 [.62]	5.57 [.061]	1.46 [.48]	1.18 [.55]
R-sq	79.82	79.15	77.97	70.86	79.49	78.35	76.60
Mean VIF	2.97			328	3.04		

Note: * and ** indicates significance at 5% and 10%, respectively. Robust standard errors in the parenthesis. KP denotes the Kleibergen-Paap statistics. The critical values for Stock-Yogo weak identification test at 5% maximal IV relative bias is 13.91. Third bracket contains corresponding p-values. The estimated coefficients of the variable population (per person in the model) is too small and no significant values could be generated after multiplied by 10,000 (for ease of explanation). Model 1 used Gini coefficient as dependent variable; Model 2 included state dummy variables with Model 1; and Model 3 used income share of top 10% earners as the dependent variable. Instrumental variables are psychological distress level and risky behaviours (smoking). OLS is Ordinary Least Square approach; 2SLS indicates the Two-stage Least Square approach and CUE is the continuous-updating estimator. According to Australian Bureau of Statistics (Data by region) (2018a) Gini coefficient is a summary indicator between 0 and 1 which measures the degree of inequality of total income within a region. A value of 0 indicates that all earners reported the same amount of income in that region, and higher values represent relatively higher income inequality.

All the variables have expected signs except the two measures of income equality. The 2SLS column in Table 5.1 shows the results of the (preferred) model that addressed the endogeneity issue. The results indicate that income inequality has a positive and significant impact on the percentage of the population with PHI coverage. The findings imply that (converting 'Gini coefficient' into a percentage term) a region with a 10% higher Gini value, on an average, also has approximately 2.65% more of the population with PHI. Areas with a greater percentage of people with fair or poor self-assessed health show significantly lower PHI coverage rate (Coef. = -1.11). Moreover, a 10% increase in the percentage of the population with a bachelor's degree, Australian citizenship and percentage of older age (>65) people, on average, increases PHI coverage in a geographic location by 3.6%, 2.9%, 4.7%, respectively. These results are significant at the 95% confidence interval. Conversely, regions with higher unemployment and death rates have a lower level of PHI coverage; however, these results are statistically insignificant. Expectedly, a higher income level impacts PHI demand positively. As median income increases by AUD$1000, the PHI coverage rate, on average, grows approximately by 0.3%.

In Model 2, 'Gini' was replaced with the income share of the top 10% earners as the primary variable of interest. The findings for the endogenous and other control variables are similar to Model 1. In addition, the results show that a rising income share of the top earners increases demand for PHI. A 10% income increase is associated with a 4.4% growth in PHI coverage (on average) and it is significant at a 95% confidence interval.

Next, seven state dummies were included with New South Wales as the reference category in Model 3 to examine the state-wise heterogeneity in PHI cover. The findings provide strong evidence that holding other key variables constant, SA3

regions in Western Australia, Tasmania, South Australia and Queensland have higher percentages of the population with PHI cover compared to New South Wales.

For a robustness check, the 2SLS models were estimated with the continuous-updating estimation (CUE) option, which provides efficient estimation when the model is over identified (Bascle 2008). Consistency in the coefficient signs indicates the robustness of the estimated model.

In the next two models (Models 4 and 5) the income share of the bottom quartile and highest quartile are included as key explanatory variables in place of 'Gini'. The aim is to understand how the rise in the share of income of different quartiles of population influences PHI demand. Median total income was dropped in these regression models as it showed a high correlation with the income share of the bottom and top quartiles of the earning populations.

Table 5.2 Factors associated with PHI coverage in SA3 regions of Australia (Models 4 & 5)

	Income share of the bottom 25% earners Model 4			Income share of the highest 25% earners Model 5		
Variable	_OLS_	_2SLS_	_CUE_	_OLS_	_2SLS_	_CUE_
Income share (%)	-0.64* (0.1)	-0.49* (.12)	-0.45* (.12)	0.49* (.05)	0.44* (.08)	0.43* (.08)
Self-assessed health (%)	-1.03* (.16)	-1.78* (.34)	-2.1* (.36)	-0.66* (.16)	-0.88** (.47)	-1.12* (.45)
Unemployment rate (%)	-0.07 (.21)	0.22 (.29)	0.43 (.31)	-0.44* (.21)	-0.34 (.33)	-0.17 (.32)
Male population (%)	75.31* (20)	81.13* (24)	97.84* (27)	3.34 (22)	5.65 (.29)	20.63 (27)
Bachelor's degree (%)	0.61* (.06)	0.47* (.08)	0.43* (.08)	0.38* (.07)	0.37* (.08)	0.33* (.07)
Australian citizen (%)	0.31* (.05)	0.33* (.07)	0.36* (.08)	0.21* (.05)	0.23* (.07)	0.25* (.07)
Persons over 65 years old (%)	0.78* (.10)	0.88* (.11)	0.88* (.11)	0.52* (.07)	0.54* (.09)	0.58* (.09)
Death rate (per 1000 people)	-0.81 (.51)	0.10 (.73)	0.42 (.79)	-0.76 (.48)	-0.53 (.68)	-0.37 (.72)
Population		-0.00 (.00)**	-0.00 (.00)**		-0.00 (.00)	-0.00(.00)
Observations	328	328	328	328	328	328
Heteroscedasticity-robust SE	Yes	Yes	Yes	Yes	Yes	Yes
Number of instruments		3	3		3	3
KP Rank LM-statistics (Chi-sq)		51.22 [.000]	51.22 [.000]		33.61 [.000]	33.61 [.000]
KP Wald F-statistics		52.06	52.06		26.93	26.93
Hansen J-statistics		2.63 [.27]	2.12 [.34]		1.05 [.59]	0.86 [.64]
R-sq	78.46	75.53	72.44	80.98	80.76	79.97
Mean VIF	2.74			2.84		

Note: * and ** indicates significance at 5% and 10%, respectively. Robust standard errors in the parenthesis. KP denotes the Kleibergen-Paap statistics. The critical values for Stock-Yogo weak identification test at 5% maximal IV relative bias is 13.91. Third bracket contains corresponding p-values. Model 4 used income share of the bottom 25% earners as the dependent variable and Model 5 used the income share of highest 25% earners as the dependent variable. Instrumental variables are psychological distress level and risky behaviours (smoking).

The outcomes of Model 4 and 5 complement the earlier results. The coefficient signs remain constant which further validates the strength of the model. The total income share of the lowest quartile is adversely, and of the highest quartile is favourably, associated with the percentage of the population with PHI cover. A one unit increase

in the income share of the lowest quartile reduces PHI coverage by 0.49 units. On the contrary, a one unit increase in the income share of the highest quartile increases PHI coverage by 0.44 units. This indicates that the income elasticity of demand for PHI between poor and well-off populations differs in Australia.

5.5 Discussion

The results of the OLS and 2SLS models indicate that income inequality has a positive and significant impact on the percentage of the population with PHI in Australia. The regions of Australia with higher levels of income inequality and with a higher income share of the top 25% of the earners have a higher level of PHI cover. On the contrary, regions where income is more equally distributed and have a higher percentage of the bottom 25% income earners have a lower rate of PHI cover. The most likely explanation for this outcome is the existence of a tax penalty, titled the Medicare Levy Surcharge (MLS) for high-income individuals. The MLS is levied on Australian taxpayers who do not have PHI hospital cover and who earn above a certain income. The base income threshold is $90,000 to $105,000 for singles and $180,000 to $210,000 for families. The levy starts at 1% of annual income (single $105,001 to $140,000 and family $210,001 to $280,000) and increases to 1.5% for extremely high income earners (single $140,001 or more and family $280,001 or more) (Australian Tax Office 2018). The MLS is designed to encourage individuals to take out private hospital cover, and where possible, to use the private hospital system to reduce demand on the public Medicare system. Previous research also suggests that richer taxpayers may purchase PHI cover to reduce their tax burden (Stavrunova & Yerokhin 2014) as they have a higher incentive to buy PHI cover (Cheng 2014). Van Doorslaer et al. (2008) and Eldridge et al. (2017) also found that households with higher income are more likely to buy PHI cover and use private patient care in hospitals. Poorer people (without health issues) have fewer incentives (a lower expected utility) to buy PHI. Therefore, the income growth of wealthy individuals or households impacts the PHI coverage rate more than the income growth of the less well-off.

Another interesting explanation of the findings could be the theory of 'Social Rank Hypothesis' and 'Positional Goods'. According to this hypothesis individuals living in an area with higher income inequality tend to consume more positional goods that serve as a measure of social status (Walasek et al. 2018). In a universal healthcare

system, private hospital care is not an 'Absolute necessity good' rather something people consume to avoid risk and to enjoy shorter waiting times, the choice of doctors and (claimed) better hospital amenities. Hence, regions where the income gap between rich and poor is larger, may consume PHI as a 'Positional good'.

The results show that regions with a higher percentage of the population with fair or poor self-assessed health have a lower level of PHI coverage. This contradicts the idea that people with poor self-assessed health are more likely to buy PHI, the adverse selection hypothesis. Similar conclusions for Australia are available in the studies of Buchmueller et al. (2013) and Eldridge et al. (2017) which concluded that individuals with fair and poorer health are less likely to take PHI cover. The results provide further evidence that government policies (e.g. Lifetime Health Cover and Medicare Levy Surcharge) might be successful in encouraging many Australians with relatively higher self-assessed health or health status to purchase PHI cover. This finding is constant across all the regions of the country.

It was also found that higher average income has a positive and significant impact on PHI coverage rate in a geographic location. Several previous studies have supported the positive impact of income on demand for PHI (Cheng 2014; Costa & Garcia 2003). The percentage of the population in a region with higher education (bachelor's degree), Australian citizenship and aged above 65, all demonstrate a significant and positive influence on the PHI coverage rate. These findings are identical to the conclusions of Barrett and Conlon (2003) and Eldridge et al. (2017). Highly educated individuals often have higher incomes and are more risk-averse and older age individuals have higher medical needs; hence, their positive association with PHI cover is logical.

Finally, the results also highlighted significant variations in PHI coverage rate between the states of Australia. SA3 regions in Western Australia, Tasmania, South Australia and Queensland show significantly higher coverage rates relative to New South Wales and other states. This is a likely reflection of PHI premium differences, waiting times, policy and institutional variations across the states (Barrett & Conlon 2003).

The findings of this research will assist policymakers (implementing policies to increase PHI cover) and PHI providers to understand the major determinants of PHI demand, as well as the causes of unequal PHI coverage rate across the regions of

Australia. Further research is required using time-series or panel data to examine whether the long-term association between PHI cover and self-assessed health is unidirectional or bidirectional. Moreover, future research should also focus on the key factors that contribute to the heterogeneity in PHI coverage rate across the states of Australia. There is strong evidence of inequality in access to healthcare, private health insurance and health outcomes in Australia based on incomes and location (Doiron et al. 2008; Van Doorslaer et al. 2008). Several authors have commented that Australian PHI policies are unfair (Vaithianathan 2002) and favour those with higher incomes (Segal 2004). Again, Van Doorslaer et al. (2008) cautioned that inequality in access to PHI might result in an unequal mix of healthcare services for the wealthy and the less well-off population in Australia. Therefore, it is imperative for policymakers to understand the association between rising income share of the bottom 25% of the income earners and PHI coverage rate in an area. Further study as to why regions with higher and more unequal distribution of income show a higher willingness to purchase PHI cover is needed, if possible, using longitudinal data.

There are several limitations associated with this study. Due to data unavailability, the models could not include key variables such as PHI premiums, waiting times, chronic health conditions and quality of public hospital care, which may influence PHI demand. It was also not possible to estimate the urban-rural bias in PHI coverage as some SA3 regions comprise either urban-regional or regional-remote areas. The instruments used are not completely expunged of potential correlation with errors which influence the decision to purchase PHI. It is acknowledged that waiting times, premiums, and policies vary between states but not within states. Therefore, the findings may be more applicable in explaining the intrastate variations in PHI demand. It is also important to mention that a key hypothesis of this study was that an unequal distribution of income plays an important role in shaping health outcomes (e.g. mortality and life expectancy), health risk behaviours (e.g. smoking) and healthcare consumption and that it also influence the decision to purchase PHI, holding all other things constant. Lastly, due to unavailability of data some SA3 regions (mostly uninhabited) were excluded from the data analysis.

5.6 Conclusions

In this paper, the factors influencing PHI demand and the effect of income inequality on the PHI coverage rate in Australia were examined. The findings provide new evidence on the factors responsible for inter and intrastate variations in the PHI coverage rate in a unique healthcare system where the government encourages PHI purchase via subsidies, while also providing public health insurance for all. The IV approach used for analysis leads to estimates consistent with previous studies but may be applicable only for countries with identical healthcare settings. Several diagnostic tests and robustness checks were conducted to ensure the validity of the IVs used and the obtained estimates in this study.

The results indicate that regions in Australia with higher income inequality have a greater percentage of the population with PHI cover. Correspondingly, areas with larger income share for the bottom 25% of income earners show a lower PHI coverage rate. The findings also support the advantageous selection hypothesis as regions with larger populations of higher self-assessed health tend to have more PHI cover. Other factors such as higher median income, more educated population, more residents with Australian citizenship and a higher percentage of old age population also significantly increase PHI coverage.

References

1. Arsenijevic, J, Pavlova, M, Rechel, B & Groot, W 2016, 'Catastrophic health care expenditure among older people with chronic diseases in 15 European countries', *PloS one*, vol. 11, no. 7, pp. 1-18.

2. Australian Bureau of Statistics 2018a, *Data by Region, 2012-17* 2018, created by Australian Bureau of Statictics, viewed 10 March 2019, <http://stat.abs.gov.au/itt/r.jsp?databyregion>

3. Australian Bureau of Statistics 2018, ' Estimates of personal income for small areas, 2011-2016, created by Australian Bureau of Statictics, viewed 10 November 2019, <https://www.abs.gov.au/ausstats/abs@.nsf/mf/6524.0.55.002>

4. Australian Institute of Health and Welfare 2017, *Private health insurance usein Australian hospitals, 2006–07 to 2015–16: Australian hospital*

statistics, Health Services Series no. 81. Cat. no. HSE 196. Australian Institute of Health and Welfare Canberra: AIHW, Viewed 12 March 2019, <https://www.aihw.gov.au/getmedia/f95e7fc9-db3f-4e7e-a5f5-38f2f69cd539/aihw-hse-196.pdf.aspx?inline=true>.

5. Australian Prudential Regulation Authority 2018, *Private health insurance membership and coverage September 2018:* The Australian Prudential Regulation Authority, Australia, viewed 12 March 2019, <https://www.apra.gov.au/publications/private-health-insurance-membership-and-coverage>.

6. Australian Tax Office 2018, *Medicare levy surcharge*, Australian Tax Office, Australian Government, Canberra, viewed 12 March 2019, <https://www.ato.gov.au/individuals/medicare-levy/medicare-levy-surcharge/>.

7. Barrett, GF & Conlon, R 2003, 'Adverse selection and the decline in private health insurance coverage in Australia: 1989–95', *Economic Record*, vol. 79, no. 246, pp. 279-96.

8. Bascle, G 2008, 'Controlling for endogeneity with instrumental variables in strategic management research', *Strategic Organization*, vol. 6, no. 3, pp. 285-327.

9. Baum, C, Schaffer, M & Stillman, S 2007, 'IVENDOG: Stata module to calculate Durbin-Wu-Hausman endogeneity test after ivreg', *Statistical Software, Components S494401*. Boston College Department of Economics, Boston, USA.

10. Baum, CF, Schaffer, ME & Stillman, S 2007, 'Enhanced routines for instrumental variables/GMM estimation and testing', *Stata Journal*, vol. 7, no. 4, pp. 465-506.

11. Buchmueller, T 2008, 'Community rating, entry-age rating and adverse selection in private health insurance in Australia', *The Geneva Papers on Risk and Insurance-Issues and Practice*, vol. 33, no. 4, pp. 588-609.

12. Buchmueller, TC, Fiebig, DG, Jones, G & Savage, E 2013, 'Preference heterogeneity and selection in private health insurance: the case of Australia', *Journal of Health Economics*, vol. 32, no. 5, pp. 757-67.

13. Butler, JR 2002, 'Policy change and private health insurance: did the cheapest policy do the trick?', *Australian Health Review*, vol. 25, no. 6, pp. 33-41.

14. Cheng, TC 2014, 'Measuring the effects of reducing subsidies for private insurance on public expenditure for health care', *Journal of Health Economics*, vol. 33, pp. 159-79.

15. Costa, J & Garcia, J 2003, 'Demand for private health insurance: how important is the quality gap?', *Health Economics*, vol. 12, no. 7, pp. 587-99.

16. Dismuke, CE & Egede, LE 2011, 'Association of serious psychological distress with health services expenditures and utilization in a national sample of US adults', *General Hospital Psychiatry*, vol. 33, no. 4, pp. 311-7.

17. Doiron, D, Jones, G & Savage, E 2008, 'Healthy, wealthy and insured? The role of self-assessed health in the demand for private health insurance', *Health Economics*, vol. 17, no. 3, pp. 317-34.

18. Eldridge, DS, Onur, I & Velamuri, M 2017, 'The impact of private hospital insurance on the utilization of hospital care in Australia', *Applied Economics*, vol. 49, no. 1, pp. 78-95.

19. Ellis, RP & Savage, E 2008, 'Run for cover now or later? The impact of premiums, threats and deadlines on private health insurance in Australia', *International Journal of Health Care Finance & Economics*, vol. 8, no. 4, pp. 257-77.

20. Ellis, RP, Martins, B & Zhu, W 2017, 'Health care demand elasticities by type of service', *Journal of Health Economics*, vol. 55, pp. 232-43.

21. Frech III, H & Hopkins, S 2004, 'Why subsidise private health insurance?', *Australian Economic Review*, vol. 37, no. 3, pp. 243-56.

22. Garrett, TA 2003, 'Aggregated versus disaggregated data in regression analysis: implications for inference', *Economics Letters*, vol. 81, no. 1, pp. 61-5.

23. Hansen, LP 1982, 'Large sample properties of generalized method of moments estimators', *Econometrica: Journal of the Econometric Society*, pp. 1029-54.

24. Kleibergen, F & Paap, R 2006, 'Generalized reduced rank tests using the singular value decomposition', *Journal of Econometrics*, vol. 133, no. 1, pp. 97-126.

25. Konings, P, Harper, S, Lynch, J, Hosseinpoor, AR, Berkvens, D, Lorant, V, Geckova, A & Speybroeck, N 2010, 'Analysis of socioeconomic health inequalities using the concentration index', *International Journal of Public Health*, vol. 55, no. 1, pp. 71-4.

26. Lee, J 2018, 'Effects of health insurance coverage on risky behaviors', *Health Economics*, vol. 27, no. 4, pp. 762-77.

27. Manning, WG & Marquis, MS 1996, 'Health insurance: the tradeoff between risk pooling and moral hazard', *Journal of Health Economics*, vol. 15, no. 5, pp. 609-39.

28. Neumayer, E & Plümper, T 2016, 'Inequalities of income and inequalities of longevity: a cross-country study', *American Journal of Public Health*, vol. 106, no. 1, pp. 160-5.

29. O'Donnell, O, Van Doorslaer, E & Van Ourti, T 2015, 'Health and inequality', in *Handbook of Income Distribution*, Elsevier, vol. 2, pp. 1419-533.

30. Okulicz-Kozaryn, A 2015, 'Income inequality and wellbeing', *Applied Research in Quality of Life*, vol. 10, no. 3, pp. 405-18.

31. Pagan, AR & Hall, AD 1983, 'Diagnostic tests as residual analysis', *Econometric Reviews*, vol. 2, no. 2, pp. 159-218.

32. Parslow, RA & Jorm, AF 2000, 'Who uses mental health services in Australia? An analysis of data from the National Survey of Mental Health and Wellbeing', *Australian and New Zealand Journal of Psychiatry*, vol. 34, no. 6, pp. 997-1008.

33. Pendzialek, JB, Simic, D & Stock, S 2016, 'Differences in price elasticities of demand for health insurance: a systematic review', *The European Journal of Health Economics*, vol. 17, no. 1, pp. 5-21.

34. Percheski, C & Bzostek, S 2017, 'Public health insurance and health care utilization for children in immigrant families', *Matern Child Health J*, vol. 21, no. 12, pp. 2153-60.

35. Podger, A 2016, 'Federalism and Australia's national health and health insurance system', *Asia Pacific Journal of Health Management*, vol. 11, no. 3, p. 26.

36. Savage, E & Wright, DJ 2003, 'Moral hazard and adverse selection in Australian private hospitals: 1989–1990', *Journal of Health Economics*, vol. 22, no. 3, pp. 331-59.

37. Schoen, C, Davis, K, DesRoches, C, Donelan, K & Blendon, R 2000, 'Health insurance markets and income inequality: findings from an international health policy survey', *Health Policy*, vol. 51, no. 2, pp. 67-85.

38. Segal, L 2004, 'Why it is time to review the role of private health insurance in Australia', *Australian Health Review*, vol. 27, no. 1, pp. 3-15.

39. Stavrunova, O & Yerokhin, O 2014, 'Tax incentives and the demand for private health insurance', *Journal of Health Economics*, vol. 34, pp. 121-30.

40. Stock, JH & Yogo, M 2005, 'Testing for weak instruments in linear IV regression. Chapter 5 in Identification and Inference in Econometric Models: Essays in Honor of Thomas J. Rothenberg, edited by DWK Andrews and JH Stock', in Cambridge University Press, Cambridge, pp. 80-108.

41. Subramanian, S & Kawachi, I 2006, 'Whose health is affected by income inequality? A multilevel interaction analysis of contemporaneous and lagged effects of state income inequality on individual self-rated health in the United States', *Health & Place*, vol. 12, no. 2, pp. 141-56.

42. Subramanian, S, Delgado, I, Jadue, L, Vega, J & Kawachi, I 2003, 'Income inequality and health: multilevel analysis of Chilean communities', *Journal of Epidemiology & Community Health*, vol. 57, no. 11, pp. 844-8.

43. Vaithianathan, R 2002, 'Will subsidising private health insurance help the public health system?', *Economic Record*, vol. 78, no. 242, pp. 277-83.

44. Van Doorslaer, E, Clarke, P, Savage, E & Hall, J 2008, 'Horizontal inequities in Australia's mixed public/private health care system', *Health Policy*, vol. 86, no. 1, pp. 97-108.

45. Wagstaff, A & Van Doorslaer, E 2000, 'Income inequality and health: what does the literature tell us?', *Annual Review of Public Health*, vol. 21, no. 1, pp. 543-67.

46. Wagstaff, A, Paci, P & Van Doorslaer, E 1991, 'On the measurement of inequalities in health', *Social Science & Medicine*, vol. 33, no. 5, pp. 545-57.

47. Walasek, L, Bhatia, S & Brown, GD 2018, 'Positional goods and the social rank hypothesis: Income inequality affects online chatter about high-and low-

status brands on Twitter', *Journal of Consumer Psychology*, vol. 28, no. 1, pp. 138-48.

48. Wooldridge, JM 2010, *Econometric analysis of cross section and panel data*, 2nd edn, MIT press, London, England.

49. Wooldridge, JM 2015, *Introductory Econometrics: A Modern Approach*, 4th edn, Nelson Education, Massachusettse, USA.

CHAPTER 6

Chapter 6: Conclusions, policy implications and future research

6.0 Conclusion

Healthcare utilisation is an essential feature to understand and evaluate the soundness of a healthcare system. Studying healthcare utilisation is particularly important to measure and understand the variations in required treatment use, avoidance of prescribed treatments and inappropriate or overuse of treatments. Further, understanding of healthcare utilisation and its determinants are crucial to healthcare planning and implementation. Past evidence indicates significant discrepancies in healthcare use spatially, from one country to another, as well as within countries despite having similar morbidity patterns or life expectancy. Improving the health, access to healthcare and its utilisation should be an important goal for every healthcare system, especially for households from lower socioeconomic backgrounds. Developed countries such as Australia, have implemented many policies and programmes to create a healthcare system which is easily accessible and inclusive. In spite of those initiatives, inequality in healthcare utilisation and health outcomes still prevails.

This thesis aimed to understand the role of chronic diseases (e.g. cancer) and PHI in influencing the healthcare decisions of Australian patients from different socioeconomic, demographic and geographic backgrounds. Four research studies were conducted to examine the healthcare utilisation of cancer patients, gender-specific differences in healthcare use of lung cancer patients, healthcare utilisation pattern of patients with PHI and the determinants of the demand for PHI. The context of the study was Australia.

The first article of this thesis investigated the heterogeneity in healthcare utilisation of individuals with cancer using Wave 13 of the HILDA survey data. Results of the study indicated that demographic and sociocultural factors such as advancing age, gender, low income, low education status, rurality, lack of PHI coverage, increased psychological distress and less access to specialist care are associated with lower healthcare utilisation among cancer patients. The second study conducted a systematic review of the literature to provide a narrative synthesis of the current evidence of variations in the use of lung cancer treatments among men and women. Substantial evidence of gender-specific heterogeneity in the seven categories of treatments was found. This thesis also examined the healthcare-seeking (hospital, primary and

preventive care) behaviour of patients with PHI, along with the socioeconomic, demographic and lifestyle factors that influence the choice of hospital and preventive care in Australia. This particular study used Waves 9 and 13 of the HILDA survey data and provided new evidence on demand for public hospital care for the patients with PHI cover. Finally, an instrumental variable (IV) estimation approach was used to examine the impact of income inequality on PHI coverage rate for 328 selected regions of Australia with disaggregated data. In addition, the study also estimated the key determinants of PHI cover in Australia. The results indicate that regions with higher income inequality have a higher percentage of the population with private health cover.

6.1 Summary of the key findings and contribution to the literature

6.1.1 Study 1

What was known in the literature?

Higher cancer-related mortality for patients from lower socioeconomic backgrounds, and rural and remote areas.

What the current study added to the literature?

1. Older (>65) cancer patients use more hospital care compared to the young (<45). On the other hand, younger cancer patients utilise more GP-led cancer care.

2. Male cancer patients use significantly less healthcare compared to women, except for specialist care services.

3. Cancer patients from lower socioeconomic backgrounds use more GP services and less hospital-based and specialist care services compared to those from higher-income households.

4. Rural patients reported a lower number of hospital admissions but a higher length of hospital stay compared to patients from urban areas, which reflects the lack of appropriate local cancer care in rural areas.

5. Higher psychological distress was associated with educated and urban cancer patients. Those with higher psychological distress reported significantly higher healthcare utilisation; however, they often failed to seek required mental healthcare services.

6. Cancer patients born outside Australia showed a higher rate of healthcare utilisation than Australian born patients.

7. Higher usage of specialist care is significantly related to lower utilisation of hospital care among cancer patients in Australia.

6.1.2 Study 2

What was known in the literature?

There are variations in lung cancer mortality rates between men and women.

Women generally use healthcare more than men.

Women responded faster (in getting treatment) to lung cancer symptoms than men.

What the current study added to the literature?

To the best of the author's knowledge, this study is the first to conduct a systematic literature review to examine the outcomes of the existing literature regarding gender-specific differences in the use of lung cancer treatments.

1. All the studies eligible to include in the review were from developed countries. No peer-reviewed published research was available for lower-income countries.

2. Women were more likely to get diagnosed at an early stage of lung cancer compared to men; however, they had longer diagnostic intervals (the time gap between the first incidence of a lung cancer symptom and the date of cancer diagnosis)

3. No significant differences in outpatients' visits or GP visits were observed.

4. Evidence of emergency department visits was mixed.

5. Women lung cancer patients had a higher probability of hospital admission and longer length of stay; however, men had a higher number of unexpected hospital re-admission after surgery.

6. There is evidence that women had a higher likelihood of undergoing surgery.

7. No significant difference was observed in the probability of using chemo and radiation therapy.

6.1.3 Study 3

What was known in the literature?

Patients with PHI had lower waiting times for several elective surgeries in Australia.

Patients with PHI use specialist care more than those without it.

What the current study added to the literature?

1. Individuals with PHI had a significantly higher rate of health check-ups than patients with no PHI coverage.

2. Patients from lower-income households or non-urban areas preferred to use public hospital care despite having PHI.

3. Younger patients with PHI had a higher likelihood, and relatively more educated patients had a lower probability, of using public care.

4. Visiting a specialist doctor significantly lowered the probability of using hospital care of patients with PHI coverage.

6.1.4 Study 4

What was known in the literature?

Income, age and employment status are significantly related to the demand for PHI in Australia.

Perceived waiting times for surgeries and long-term health conditions also influence the decision to purchase PHI.

Significant variations in PHI coverage rates across the regions of Australia.

Australian government promotes private health insurance with rebates on premiums.

What the current study added to the literature?

1. Income inequality is associated with PHI coverage rate in different regions of Australia.

2. Regions in Australia where income is more equally distributed (or has a lower percentage of the population in the top 25% of earners) had lower private insurance coverage rates.

3. Regions with a higher percentage of the population with poor or fair self-assessed health had lower PHI coverage rates.

6.1.5 Assessment of the suitability of the theory

As mentioned in Chapter 1, this thesis aims to assess the validity of the 'Care-seeking Behaviour Theory' for Australian patients. The results showed that clinical and institutional factors, as suggested by the theory, have a significant impact on healthcare utilisation decisions in Australia. This study has also found substantial heterogeneity within subgroups of patients (with cancer or private insurance coverage) based on their socioeconomic, demographic and geographic characteristics. Further analysis also revealed that the interaction terms between these factors also have a significant impact. For example, a cancer patient has higher healthcare utilisation than someone without cancer, holding other things constant. However, cancer patients' with PHI coverage use healthcare differently than cancer patients' without cover. Furthermore, the choice of care fluctuates significantly due to PHI status between patients from lower and higher socioeconomic backgrounds.

6.2 Recommendations and policy implications

Several key recommendations can be drawn from the findings of this research for policymakers as well for health professionals.

First, findings suggested that cancer patients from rural and remote areas are spending more nights in hospital. This can put an additional financial burden on their families. Policymakers should take every possible step to lower this burden by improving their access to and utilisation of, cancer treatments. According to the National Rural Health Alliance (2019), patients in rural Australia need a greater amount of time and expense to visit a primary or specialist care doctor; moreover, the capacity of a rural hospital to deal with complex cases is often questionable as it is often difficult to attract and retain qualified health professionals in rural areas. Moreover, due to lower socioeconomic status, many patients from rural areas are unable to access required specialist care. These factors may explain their extended night stay in hospital. Addressing these issues might reduce geographical disparities in cancer mortality. Policymakers need to identify priority needs to promote appropriate actions and disseminate relevant information to those who can make a difference in rural and remote health. Lastly, facilitating eHealth to improve rural healthcare could be a

partial solution to the problem (Sudhahar et al. 2010). However, further research is required to understand how to design and execute a successful eHealth programme for the rural and remote regions of Australia.

Second, the findings of this study concluded that cancer patients suffering from psychological distress use significantly more healthcare services. However, their use of mental healthcare services was particularly low. Health practitioners need to identify and respond to symptoms of psychological distress among cancer patients at the earliest stage of diagnosis. However, availability and affordability of mental health care services is a key issue. According to a report published by the Australian College of Psychological Medicine (2006), the services of a private psychiatrist are unobtainable for many patients due to high cost (few psychiatrists bulk-bill), most are practising in urban areas and there is a lack of publicly employed psychiatrists. Hence, the shortage often creates longer waiting times for patients. Yet, the Australian Medical Workforce Advisory Committee (2005) concluded that psychiatry is the only medical specialisation that is showing declining demand trend and the number of medical professionals being trained is lower than that had been recommended. The Australian health system should address this issue without further delay. Appropriate policies should be designed to provide an incentive for psychiatrists to practice in rural and regional areas of Australia while making their services affordable for all. Lastly, as discussed in the Health belief Model, patients' past experience plays an important role in their healthcare utilisation decision (Valois et al. 1988), thus, it is also important to improve this feature of the mental health treatment in Australia.

Third, an encouraging finding of this research is that a higher number of visits to the specialist was linked to lower hospitalisation rate. However, the results also indicate disparities in use specialist care services based on income and PHI coverage. In many rural areas of Australia, specialist care at public hospitals is unavailable and many specialists do not bulk-bill. Visiting a private specialist often costs more than the patient's expectation (Haney and Hopkins 2012). Therefore, cancer patients from lower socioeconomic background often find it difficult to access specialist care. Moreover, patients with PHI coverage may not put specialist care as a deductible option to keep their premiums low. This situation warrants further research. Hence, future research should examine the potential to use specialist care (for cancer patients) in reducing unavoidable hospital admissions. Establishing this nexus will allow

policymakers to develop policies to make specialist care services more available and affordable for patients with chronic diseases. This might reduce the demand for avoidable hospital care. Further, research is also needed on why, where and what type of cancer treatment pathway is most effective for the Australian healthcare system.

Fourth, this study also found that men and women use lung cancer treatments differently. There was clear evidence that men had a higher probability of advanced-stage lung cancer diagnosis and women showed longer diagnosis intervals. It is pivotal to examine whether primary care practitioners are neglecting men's lung cancer symptoms and policymakers should design appropriate interventions (such as community-based Bowel cancer screening in Australia) to identify signs of lung cancer at the earliest. No doubt getting diagnosed at an earlier stage will significantly reduce the lung cancer mortality rate and lower the financial burden of cancer care. It is important that the Australian healthcare system raises awareness of symptoms of lung cancer, in particular, among men. Health practitioners need to re-evaluate their actions when a patient who smokes displays symptoms related to lung cancer. On the other hand, further investigation is required to understand the longer diagnosis intervals for women lung cancer patients. Primary care practitioners need to play a key role in evaluating lung cancer symptoms and take required actions to ensure an early stage of cancer screening/diagnosis.

Fifth, it is also evident from the findings that the rate of health screening is less than optimal. In the past, the government has tried to encourage health screening with social awareness programmes and primary care practitioners. This study further investigated the issue and found that patients with PHI coverage have higher screening rates. Early diagnosis of chronic diseases increases survival rates while reducing the cost of treatment. Private health insurance providers might play an important role in encouraging their customers (by offering discounts on premiums for such actions) to identify chronic diseases symptoms and undergo health screening immediately. Extensive research should be conducted to examine costs (e.g. offering a premium rebate, health screening costs) and benefits (e.g. early screening) of such policies (evidence-based health screening) for PHI providers in Australia.

Sixth, the findings of this thesis also suggested that one in four patients choose to use public hospital care despite holding PHI coverage. Moreover, PHI holders from lower-

income households and rural and remote areas showed a higher preference for public care. Public hospitals in Australia offer more services and possess better facilities to care for complex medical treatments than many private hospitals. In addition, public hospitals are generally the first point of care for medical emergencies. It is also important to understand the probability of occurring and patients expectation about out-of-pocket costs when utilising private hospital care. Policymakers need to realise that if PHI holders continue to use public care, the government's goal of lessening demand for public hospital resources will be unsuccessful. Increasing the availability and capabilities of private hospitals in Australia might increase the choices of private care. Further research is required to understand if factors such as perceived quality and availability of care (private vs public), supplier induced demand or distance to care facility are influencing choices in Australia, irrespective of private insurance status. Lastly, if PHI providers offer insurance with many deductibles (to reduce premium levels), patient probability of using private care reduces significantly, while the impact on public resources will be negative as they (private insurance holders) will enjoy premium rebates and avoid paying Medicare levy surcharge (because they purchased private coverage).

Seventh, despite an extensive literature search, no study was available which looked into how men and women use lung cancer treatments in developing and lower-income countries. The healthcare utilisation pattern of men and women vary significantly between lower-income and high-income countries. Lower-income countries often have a higher prevalence of smoking and tobacco use, lack of awareness regarding symptoms of chronic diseases, fewer facilities for cancer diagnosis and treatment, and a lack of public finance for healthcare. These challenges contribute to high cancer-related mortality in these countries. Unavailability of a peer-reviewed published paper investigating the care-seeking behaviour of cancer patients in lower-income countries indicates a lack of research awareness and urgency to explore and discuss the issue to facilitate effective cancer care management in these countries. Besides, the lack of studies also indicates the unavailability of quality data to investigate the issue. Further research is required in this regard so that these countries can plan and implement a lung cancer treatment pathway suited to their healthcare system.

Eighth, one of the biggest challenges faced by this study was the paucity of data availability, especially for rural and urban regions of Australia. Policymakers should

design and implement policies to collect and disseminate large panel databases while collecting information on all aspects of healthcare. Availability of a database similar to the Medical Expenditure Panel Survey (MEPS) of the US, will improve the quantity and quality of research related to the Australian healthcare system and outcomes. Moreover, Australia lacks a clear policy regarding the issue and meaning of de-identification of data collected during the survey. Due to the absence of clarity of the meaning of the word de-identification, the National Statement on Ethical Conduct in Human Research Australia proposed that the data may be collected, stored or disclosed as individually identifiable, re-identifiable and non-identifiable form (OˈKeefe et al. 2010). In comparison, there are effective legislative tests in the US that provide a clear guidance regarding the de-identification issue, which is immensely helpful for the research community.

6.3 Future research

Understanding the care-seeking behaviour or healthcare utilisation pattern of individuals is important to achieve equality in healthcare utilisation, reduce avoidance of necessary healthcare services, control avoidable hospital care use, develop better chronic diseases management, and to improve the overall healthcare system and outcome. The current study aimed to understand the impact of a clinical factor (cancer) and a facilitating factor (PHI) in healthcare utilisation behaviour of Australian patients. Although the current study has identified several key issues, future research is required to determine a number of unanswered questions.

First, future research should investigate the potential causal relationship between chronic diseases and healthcare utilisation nexus, and PHI coverage and healthcare utilisation nexus with longitudinal and time-series data from Australia. Second, future research might also examine why cancer patients born outside Australia use healthcare significantly more than those born in Australia and how this excess healthcare use is related to their higher cancer-survival rate. Third, further studies are required to understand the state-based differentials in healthcare use, which could explain the variations in health outcomes across Australia. Fourth, researchers should also determine whether PHI coverage is facilitating inequality in the access to and utilisation of healthcare in Australia, and what policies to undertake to avoid such problem. Fifth, further studies are required to understand which of the following

factors impacts upon a patient's decision to use healthcare most. Is it a patient's preference or past experiences or biological factors or the health system and practices? Importance should be given to understanding the influence of the interaction between psychosocial and institutional as well as psychosocial and clinical factors in care-seeking behaviour. Sixth, it is well known that GPs have a role to play in reducing avoidable emergency department presentation and hospital admissions. It is time to extend the research to examine how the Australian healthcare system might use specialist care services in reducing hospital admissions of patients with chronic diseases. Lastly, past studies mainly focused on examining horizontal inequality in healthcare access and utilisation. However, in the literature, little attention has been paid to vertical equity in healthcare delivery, access and utilisation. Patients with different level of needs should use healthcare accordingly. The exploration of vertical equality in healthcare use needs to estimate the appropriate method by which healthcare use should differ for patients with different levels of needs.

6.4 Limitations of the study

This study has some limitations. The studies included in this thesis examined general or commonly used services rather than some distinctive services often used by people with chronic disease. As mentioned earlier, there are three different measures of healthcare utilisation: if care was used at all, how often the services were used and the delay in using the services. Majority of past studies examined only one approach of healthcare utilisation. Although this study estimated both non-use and number of utilisation of healthcare, the cross-sectional studies included in this thesis did not focus on the delay in seeking care. There was also the problem of inadequate information. Even the health-specific waves of the HILDA survey data did not include a specific question to identify the type of cancer a respondent has. There were also restrictions on using address or postcodes of respondents. This reduced the ability to estimate the impact of distance to care facilities on healthcare utilisation. These are important factors that might explain some of the variations in healthcare utilisation observed in the estimated results of this study. Furthermore, there was also limited information on disease type and patients' perception of private and public care and the availability of or distance to private care facilities. These variables might have played an important role in the choice of public care over private care. The instrument used in Paper 4 may not be completely uncorrelated with error terms which are related to waiting time, PHI

premium and chronic health condition (variables that also influence the private insurance purchase decision). In the systematic literature review, only peer-reviewed published papers written in English were included. Some key findings might have been missed as articles written in other languages and grey literature were excluded. Lastly, due to the cross-section nature of the data, this study did not or could not attempt to examine the causal relationship between the relevant variables. Hence, the study has all the limitations (especially methodological) of any cross-sectional study.

References

1. Australian College of Psychological Medicine 2006 , *Submission 411*, in First Report: A national approach to mental health – from crisis to community, pp. 6–7, viewed 5 August 2019, <https://www.aph.gov.au/~/media/.../mentalhealth_ctte/report/report_pdf.ashx>

2. Australian Medical Workforce Advisory Committee 2003, *Annual Report 2002–03*, AMWAC Report 2003, pp. 15–19, viewed 6 August 2019, <http://www.health.nsw.gov.au/amwac/amwac/pdf/amwannual_20034.pdf>

3. Haney, P & Helen, H 2012, "Targeting rural inequities: current priorities for rural health." *HIV Australia,* vol. 10, no. 2, pp. 9-20.

4. OˈKeefe, CM & Chris, J 2010. 'Privacy and the use of health data for research', *Medical Journal of Australia,* vol. 193, no. 9, pp 537-41.

5. Sudhahar, S, Vatsalan, D, Wijethilake, D, Wickramasinghe, Y, Arunathilake, S, Chapman, K, & Seneviratna, G 2010, *Enhancing Rural Healthcare in Emerging Countries through an eHealth Solution,* Paper presented at the 2010 Second International Conference on eHealth, Telemedicine, and Social Medicine, St. Maarten, Netherlands Antilles, pp. 23-28, viewed 10 February 2019, <https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=5432865>

6. Valois, P, Desharnais, R & Godin, G 1988, 'A comparison of the Fishbein and Ajzen and the Triandis attitudinal models for the prediction of exercise intention and behaviour', *Journal of Behavioral Medicine*, vol. 11,no. 5, pp. 459-472.

APPENDIX A

Appendix A: Supplementary material (Chapter 2)
Results from the GLM regression model

Table S1 Factors influencing healthcare utilization of cancer patients (Generalised linear model)

	LnDrV		LnHsN	
	Cancer	No Cancer	Cancer	No Cancer
LnDY	−0.002 (0.02)	−0.109*(0.01)	−0.000 (0.05)	−0.114*(0.02)
Age	−0.000 (0.00)	0.000 (0.00)	0.000 (0.001)	0.000 (0.001)
Gender	−0.006 (0.04)	−0.058*(0.01)	−0.025 (0.16)	−0.060*(0.001)
Edu1	0.071 (0.05)	0.013 (0.01)	0.080*(0.18)	0.014 (0.06)
BMI	0.008*(0.00)	0.005*(0.00)	0.007*(0.01)	0.005*(0.000)
MaritalStatus	−0.039 (0.04)	0.009 (0.01)	−0.026 (0.17)	0.008 (0.05)
Urb Dummy	−0.059 (0.05)	−0.018 (0.01)	−0.066 (0.17)	−0.018 (0.051)
Hln Dummy	0.091*(0.05)	0.106*(0.01)	0.077 (0.18)	0.106*(0.06)
Int Access	0.079 (0.05)	0.015 (0.01)	0.089 (0.19)	0.020 (0.01)
Lng Health	−0.274*(0.04)	−0.150*(0.01)	−0.311*(0.20)	−0.155*(0.06)
PshyCo	0.078*(0.02)	0.078*(0.006)	0.087*(0.11)	0.080*(0.006)
DrV				
SDr			−0.079 (0.04)	−0.145* (0.01)
HNght	0.009*(0.00)	0.004*(0.002)		
Intercept	−0.509*(0.33)	0.084*(0.11)	−0.468 (0.32)	0.121 (0.11)
Dev/df	0.351	0.581	0.159	0.159
Adj R-Sq	0.595	0.420	0.709	0.515

Note: *P<0.05. Standard error in the parenthesis.

Abbreviations: LnDY, log of annual household total disposable income; Gender, (male,1 and female,0); Edu1, Education level dummy; BMI, Body mass index; Hld size, Household size; Urb Dummy, Urban resident dummy; Hln Dummy, Health insurance dummy; Int Access, Internet access at home; Lng Health, Long term health conditions; PshyCo, risk category score of Kessler Psychological Distress scale; DrV, Number of doctor visits of participants; SDr, Seen a specialist doctor in the last 12 months; HNght, Number of nights at hospital participants. Dev/df= Deviance divided by the degrees of freedom and this is used to measure the goodness of fit.

Two outcome variables have been used to measure healthcare utilization: the log of the number of doctor visits (LnDrV) and a log of the number of nights stay in the hospital (LnHsN). For cancer patients, a one unit increase in BMI leads to a growth in number of doctor visits by 0.8% and for non-cancer patients, it increases by 0.5% and the results are significant. Cancer patients with other long-term health conditions have on average 24.7% more doctor visits compared to cancer patients with no long-term health conditions. A cancer patient with higher psychological distress has 7.8% more doctor

visits compared to those without the condition. Again, having private health insurance increases the doctor visits by 9.1% for cancer patients and 10.6% for non- cancer patients. The factors that significantly influence the number of nights stay at the hospital are other long- term health conditions, BMI and level of psychological distress. However, for non-cancer patients having pri- vate health insurance increases the nights' stay at the hospital by 10.6%. Lastly, for non-cancer patients higher visits to specialist doctors reduces nights stay in the hospital by 14.5%.

Appendix A (Chapter 4)

Table 4.6 Key determinates of hospital care seeking behaviour of patients with PHI cover (including states).

Factors (reference category)	Beta	Wald	S.E.	P-value	Odds ratio
Self- assesses health (Poor)					
Excellent	.199	.134	.545	.715	1.220
Very good	-.218	.229	.455	.633	.804
Good	0.031	.008	.420	.929	1.038
Fair	-.293	.471	.426	.492	.746
Household disposable income (High)					
Low income	.394	1.661	.306	.197	1.483
Lower-middle income	.661	5.773	.275	.016	1.937
Higher-middle income	-.314	1.315	.274	.251	.730
BMI (BMI=>30)					
BMI <=18.5	.739	2.950	.430	.086	2.094
BMI 18.6-24.9	-.024	.009	.249	.923	.976
BMI 25.29.9	-.353	1.980	.251	.159	.702
Age (Age>65)					
Age<45	.768	6.258	.307	.012	2.155
Age 45-65	.189	.411	.296	.521	1.209
Type of health cover (Both)					
Hospital cover only	.310	1.180	.286	.277	1.364
Extra cover only	4.098	8.360	.589	.000	6.204
Physical activity (> 3 times a week)					
< once a week	.126	.249	.252	.618	1.134
1-3 times a week	-.159	.476	.230	.490	.853
Financial risk taking attitude (Never)					
Substantial risks	.867	1.605	.685	.205	2.381
Above average risks	-1.76	4.848	.801	.028	.171
Average risks	-.196	.422	.302	.516	.822
Not willing	-.095	.108	.290	.742	.909
Other compounding variables					
Born outside Australia (In Australia)	-.469	3.213	.262	.073	.626
Female (Male)	.136	.420	.210	.517	1.145
No long-term health condition (Yes)	.315	1.770	.237	.183	1.370
Not a full-time student (Full-time student)	-.615	2.552	.385	.110	.541
Currently not married (Married)	.216	1.124	.204	.289	1.241
Rural (Urban)	-.128	.201	.285	.654	.880
Education more than High school (Otherwise)	-.459	4.537	.215	.033	.632
Hospital doctor visit (Otherwise)	-.556	7.830	.199	.005	.574
Specialist doctor visits (Otherwise)	1.238	34.843	.210	.000	3.450
State (Capital Territory)					
New South Wales	-1.01	4.874	.455	.027	.366
Victoria	-1.46	9.572	.474	.002	.231
Queensland	-1.31	7.490	.479	.006	.270
South Australia	-.392	.592	.510	.441	.675
Western Australia	-.940	3.538	.500	.060	.390
Tasmania	-1.46	3.550	.780	.060	.230
Northern Territory		.248	.940	.619	1.596
Constant	-.358	.187	.828	0.076	0.699
		Chi-sq		*P-value*	*R-sq*
Omnibus test model coefficients		272.462		0.000	
Hosmer & Lemeshow		10.724		0.218	
-2 Log likelihood[a]		771.135			
Cox & Snell					0.24
Nagelkerke					0.37

Note: Data from Wave 13. Bootstrap standard errors and p-values. Results are based on 1000 bootstrap samples. Reference category presented in the parenthesis. Dependent variable hospital admission type = 1 if public patient in a public hospital and 0 otherwise.

[a] estimation terminated at iteration number 0.5 because parameter estimates changed by less than 0.001.

Table 4.7: Variable definition (Chapter 4))

Variable	Variable type	Measurement
Independent variables (Logistic regression)		
For respondents with PHI: Hospital admission type	Binary	1 if a public patient in a public hospital and 0 otherwise
For respondents with PHI: Who had an overnight hospital stay	Binary	Selected to be a public patient (treated as a patient without PHI) in a public hospital was coded as 1 and 0 otherwise (private patient in a public hospital or private patient in a public hospital).
Other explanatory variables		
Number of doctor visits Number of hospital admissions Number of nights per hospital admission	Continuous	Positive values from 0 to upwards.
Whether during the last 12 months, respondents had: Visited a hospital doctor Visited a specialist doctor Visited a mental health professional Health check-ups or screening	Binary	Yes = 1 No = 0
Household annual expenditure on pharmaceuticals Fees paid to health practitioners	Continuous	Positive values from 0 to upwards.
Household disposable income (DY)	Ordinal	Four categories: Low income is DY<$63746), lower middle income is DY = $63746 to $100757, higher middle income is $100758 to $144848) and high income is DY>$144849.

		Calculated based on the income level of the respondents of the respective waves.
Age	Ordinal	Three categories: age<45; age 45-65; age >65
Education level	Binary	Two categories: > High school; ≤ High school
Body Mass Index (BMI)	Ordinal	Four categories based on the respondents BMI: BMI=<18.5; BMI 18.6-24.9; BMI 25-29.9 BMI=>30
Self-assessed health	Scale	Five categories (excellent, very good, good, fair and poor) using scale 1-5.
Prevalence of long-term health conditions	Binary	Yes = 1 No = 0
Mental health status	Scale	Kessler psychological distress scale (low, moderate, high and very high) using values 1-4.
Physical activity	Ordinal	Three categories: less than once a week, 1-3 times a week, more than three times per week
Smoking status (Smokes cigarettes or other tobacco products)	Ordinal	Three categories: non-smoker= I have never or no longer smoke; regular smoker = Yes, I smoke; occasional smoker= all other answers,
Health shocks (Serious personal illness in the last 12 months)	Binary	Yes = 1 No = 0
Financial distress (Major worsening of finances)	Binary	Yes = 1 No = 0
Remoteness	Binary	Two categories: Urban and rural.

Using 'ASGC 2001 Section of State' variable in the HILDA data as suggested by the Australian Bureau of Statistics.

Appendix A (Published review protocol of the systematic literature review) (Chapter 3)

UNIVERSITY *of York*
Centre for Reviews and Dissemination

Systematic review

1. * Review title.

Give the working title of the review, for example the one used for obtaining funding. Ideally the title should state succinctly the interventions or exposures being reviewed and the associated health or social problems. Where appropriate, the title should use the PI(E)COS structure to contain information on the Participants, Intervention (or Exposure) and Comparison groups, the Outcomes to be measured and Study designs to be included.

Gender-specific differences in care-seeking behaviour among lung cancer patients: a qualitative systematic literature review

2. Original language title.

For reviews in languages other than English, this field should be used to enter the title in the language of the review. This will be displayed together with the English language title.

3. * Anticipated or actual start date.

Give the date when the systematic review commenced, or is expected to commence. 15/02/2019

4. * Anticipated completion date.

Give the date by which the review is expected to be completed. 31/07/2019

5. * Stage of review at time of this submission.

Indicate the stage of progress of the review by ticking the relevant Started and Completed boxes. Additional information may be added in the free text box provided.

Please note: Reviews that have progressed beyond the point of completing data extraction at the time of initial registration are not eligible for inclusion in PROSPERO. Should evidence of incorrect status and/or completion date being supplied at the time of submission come to light, the content of the PROSPERO record will be removed leaving only the title and named contact details and a statement that inaccuracies in the stage of the review date had been identified.

This field should be updated when any amendments are made to a published record and on completion and publication of the review. If this field was pre-populated from the initial screening questions then you are not able to edit it until the record is published.

The review has not yet started: No

Review stage	Started	Completed
Preliminary searches	No	No
Piloting of the study selection process	No	No
Formal screening of search results against eligibility criteria	Yes	No
Data extraction	No	No
Risk of bias (quality) assessment	No	No
Data analysis	No	No

Provide any other relevant information about the stage of the review here (e.g. Funded proposal, protocol not yet finalised).

Identified relevant search terms for each key concepts. Identified relevant search terms for each key concepts.

6. * Named contact.

The named contact acts as the guarantor for the accuracy of the information presented in the register record. Rezwanul Hasan Rana

Email salutation (e.g. "Dr Smith" or "Joanne") for correspondence:

Rana

7. * Named contact email.

Give the electronic mail address of the named contact. rezwanul.rana@usq.edu.au

8. Named contact address

Give the full postal address for the named contact.

T 230, Faculty of BELA, University of Southern Queensland, Toowoomba Campus, Qld-4350

9. Named contact phone number.

Give the telephone number for the named contact, including international dialling code. +610420433463

10. * Organisational affiliation of the review.

Full title of the organisational affiliations for this review and website address if available. This field may be completed as 'None' if the review is not affiliated to any organisation.

University of Southern Queensland

Organisation web address:

www.usq.edu.au

11. * Review team members and their organisational affiliations.

Give the title, first name, last name and the organisational affiliations of each member of the review team. Affiliation refers to groups or organisations to which review team members belong.

Mr Rezwanul Rana. PhD Fellow, School of Commerce, University of Southern Queensland Professor Khorshed Alam. Professor, School of Commerce, University of Southern Queensland Professor Jeff Gow. Professor, School of Commerce, University of Southern Queensland

Dr. Fariha Alam. Medical Registrar, Toowoomba Hospital, Queensland Health.

12. * Funding sources/sponsors.

Give details of the individuals, organizations, groups or other legal entities who take responsibility for initiating, managing, sponsoring and/or financing the review. Include any unique identification numbers assigned to the review by the individuals or bodies listed.

No funding received from any organisation

13. * Conflicts of interest.

List any conditions that could lead to actual or perceived undue influence on judgements concerning the main topic investigated in the review.

None

14. Collaborators.

Give the name and affiliation of any individuals or organisations who are working on the review but who are not listed as review team members.

15. * Review question.

State the question(s) to be addressed by the review, clearly and precisely. Review questions may be specific or broad. It may be appropriate to break very broad questions down into a series of related more specific questions. Questions may be framed or refined using PI(E)COS where relevant.

To identify the gender-specific differences in the health care-seeking behaviour or healthcare utilisation of Lung cancer patients.

16. * Searches.

Give details of the sources to be searched, search dates (from and to), and any restrictions (e.g. language or publication period). The full search strategy is not required, but may be supplied as a link or attachment.

Sources to be used: PubMed

EBSCOhost library (includes, Academic search ultimate; CINAHL; EconLit; PsycINFO) (1977 to 2019 February) OVID nursing

Web of Science (1985-2019) Scopus

Limits applied:

Language: English

Publication type: Peer reviewed published
papers Age: 19+ (all adults)
Human

17. URL to search strategy.

Give a link to a published pdf/word document detailing either the search strategy or an example of a search strategy for a specific database if available (including the keywords that will be used in the search strategies), or upload your search strategy.Do NOT provide links to your search results.

https://www.crd.york.ac.uk/PROSPEROFILES/124672_STRATEGY_20190213.pdf
Alternatively, upload your search strategy to CRD in pdf format. Please note that by doing so you are consenting to the file being made publicly accessible.
Do not make this file publicly available until the review is complete

18. * Condition or domain being studied.

Give a short description of the disease, condition or healthcare domain being studied. This could include health and wellbeing outcomes.
Influence of gender on care-seeking behaviour or healthcare utilisation among population diagnosed with cancer of the Lungs.

19. * Participants/population.

Give summary criteria for the participants or populations being studied by the review. The preferred format includes details of both inclusion and exclusion criteria.
Adults (age 19+) diagnosed with Lung cancer

Inclusion criteria: Any peer reviewed study that reports the variations in care-seeking behaviour or health care utilisation of male and female Lung cancer patients.

Exclusion criteria:
Studies with primary focus on Lung cancer incidence/ mortality/ survival rate/ risk of cancer/ risk factors/ permanent survivors/ diseases occurrence/ disease management/ care pathways/ care management programme/ patient satisfaction
Studies conducted on patients aged 19
Studies conducted on any other type of cancer. Unless specific data are reported separately for Lung cancer patients
Studies focused on home care, residential care, home help, social care.

20. * Intervention(s), exposure(s).

Give full and clear descriptions or definitions of the nature of the interventions or the exposures to be reviewed.

Health care use= screening, primary and specialist care, hospitalisation, ICU and ED visits, number of Surgery and ~~Chemo/Immunation~~ ~~Clusters, Population~~ ~~therapy/~~mental ~~health care~~ ~~diagnosed~~with any kind of cancer of the Lungs excluding those who are permanent survivors.

21. * Comparator(s)/control.

Where relevant, give details of the alternatives against which the main subject/topic of the review will be compared (e.g. another intervention or a non-exposed control group). The preferred format includes details of both inclusion and exclusion criteria.

Not applicable

22. * Types of study to be included.

Give details of the types of study (study designs) eligible for inclusion in the review. If there are no restrictions on the types of study design eligible for inclusion, or certain study types are excluded, this should be stated. The preferred format includes details of both inclusion and exclusion criteria.

All types of study designs (in peer reviewed published articles) including other potential literature reviews.

23. Context.

Give summary details of the setting and other relevant characteristics which help define the inclusion or exclusion criteria.

24. * Main outcome(s).

Give the pre-specified main (most important) outcomes of the review, including details of how the outcome is defined and measured and when these measurement are made, if these are part of the review inclusion criteria.

The study will focus on the frequency of different types of health care utilisation by Lung cancer patients and whether the outcomes will be ~~The they the come suilsben~~ equal among male and female populations.

1. Health screening rate and possibly the median age of first Lung cancer screening.
2. Frequency of visits to primary care doctor, specialist care doctor and mental health care doctor
3. Number of hospital admission (inpatient care) and median length of stays.
4. Utilisation of radiotherapy, chemotherapy and immunotherapy.
5. Number of visits to ICU or emergency department.
6. Number of surgery.
7. Number of visits to a mental health care professional.

Timing and effect measures

None

25. * Additional outcome(s).

List the pre-specified additional outcomes of the review, with a similar level of detail to that required for main outcomes. Where there are no additional outcomes please state 'None' or 'Not applicable' as appropriate

to the review

None.

Timing and effect measures

None

26. * Data extraction (selection and coding).

Give the procedure for selecting studies for the review and extracting data, including the number of researchers involved and how discrepancies will be resolved. List the data to be extracted.

Data extraction will be conducted by two independent investigators. The process will be done by RR and FA. The full text of all the relevant articles will be retrieved and read to extract information on the first author, date, journal and country of publications, population characteristics, study design, type of health care utilisation reported and how it was measured and key findings or outcomes. This will be done by two reviewers independently, followed by a detail discussion to compare and come to an agreement regarding the decision of article selection. In case of any disagreements, the final decision will be made by a third investigator. The references of the included articles will be further investigated to identify potential relevant citations. The details of the findings will be tabulated using a MS Excel file.

27. * Risk of bias (quality) assessment.

State whether and how risk of bias will be assessed (including the number of researchers involved and how discrepancies will be resolved), how the quality of individual studies will be assessed, and whether and how this will influence the planned synthesis.

Two reviewers will assess the quality of the studies included in the review. The assessment will be completed using relevant items from the 'Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines. and Critical Appraisal Skills Programme (CASP) checklist. Both reviewers will evaluate the quality of the selected papers based on the aforementioned guidelines and checklist to reduce risk of bias.

28. * Strategy for data synthesis.

Give the planned general approach to synthesis, e.g. whether aggregate or individual participant data will be used and whether a quantitative or narrative (descriptive) synthesis is planned. It is acceptable to state that a quantitative synthesis will be used if the included studies are sufficiently homogenous. For this study a narrative synthesis has been planned due to the potential heterogeneity in study designs and measures of the key outcome variable (care seeking behaviour or healthcare utilisation). The reviewers will assess the available evidence from the selected studies and tabulate the empirical results at country level. The structure of the results will be subject to the nature of the studies included.

29. * Analysis of subgroups or subsets.

Give details of any plans for the separate presentation, exploration or analysis of different types of participants (e.g. by age, disease status, ethnicity, socioeconomic status, presence or absence or co-

morbidities); different types of intervention (e.g. drug dose, presence or absence of particular components of intervention); different settings (e.g. country, acute or primary care sector, professional or family care); or different types of study (e.g. randomised or non-randomised).
Not yet planned.

30. * Type and method of review.

Select the type of review and the review method from the lists below. Select the health area(s) of interest for your review.

Type of review

Cost effectiveness
No
Diagnostic
No
Epidemiologic
No
Individual patient data (IPD) meta-analysis *No*
Intervention
No
Meta-analysis
No
Methodology
No
Narrative synthesis
Yes
Network meta-analysis *No*
Pre-clinical
No
Prevention
No
Prognostic
N*o*
Prospective meta-analysis (PMA) *No*
Review of reviews
No
Service delivery
N*o*
Synthesis of qualitative studies *No*
Systematic review *Yes*
Other *No*

Health area of the review
Alcohol/substance
misuse/abuse *No*

Blood and immune system *No*

Cancer
Yes

Cardiovascular
No

Care of the elderly
No

Child health
No

Complementary therapies *No*

Crime and justice
No

Dental
No

Digestive system
No

Ear, nose and throat
No

Education
No

Endocrine and metabolic disorders *No*

Eye disorders
No

General interest
No

Genetics
No

Health inequalities/health equity *Yes*

Infections and infestations *No*

International development *No*

Mental health and behavioural conditions *No*

Musculoskeletal *No*

Neurologicl *No*

Nursing
No

Obstetrics and gynaecology *No*

Oral health
No
Palliative care
No
Perioperative care
No

Physiotherapy
No
Pregnancy and
childbirth *No*
Public health (including social determinants of
health) *No*
Rehabilitation *No*
Respiratory
disorders *No*
Service
delivery *Yes*
Skin disorders
No
Social care
No
Surgery
No
Tropical
Medicine *No*
Urologica
l *No*
Wounds, injuries and
accidents *No*
Violence and abuse
No

31. Language.

Select each language individually to add it to the list below, use the bin icon to remove any added in error. English
There is not an English language summary

32. Country.

Select the country in which the review is being carried out from the drop down list. For multi-national collaborations select all the countries involved.
Australia

33. Other registration details.

Give the name of any organisation where the systematic review title or protocol is registered (such as with The Campbell Collaboration, or The Joanna Briggs Institute) together with any unique identification number assigned. (N.B. Registration details for Cochrane protocols will be automatically entered). If extracted data will be stored and made available through a repository such

as the Systematic Review Data Repository (SRDR), details and a link should be included here. If none, leave blank.

34. Reference and/or URL for published protocol.

Give the citation and link for the published protocol, if there
is one Give the link to the published protocol.

Alternatively, upload your published protocol to CRD in pdf format. Please note that by doing so you are consenting to the file being made publicly accessible.

No I do not make this file publicly available until the review is complete

Please note that the information required in the PROSPERO registration form must be completed in full even if access to a protocol is given.

35. Dissemination plans.

Give brief details of plans for communicating essential messages from the review to the appropriate audiences.

Through publication of the review.

Do you intend to publish the review on completion?

Yes

36. Keywords.

Give words or phrases that best describe the review. Separate keywords with a semicolon or new line. Keywords will help users find the review in the Register (the words do not appear in the public record but are included in searches). Be as specific and precise as possible. Avoid acronyms and abbreviations unless these are in wide use.

care-seeking behaviour; health care utilization; patient acceptance of health care; gender-specific difference; male and female; men and women; lung cancer; lung neoplasm; lung malignancy

37. Details of any existing review of the same topic by the same authors.

Give details of earlier versions of the systematic review if an update of an existing review is being registered, including full bibliographic reference if possible.

38. * Current review status.

Review status should be updated when the review is completed and when it is published. For newregistrations the review must be Ongoing.

Please provide anticipated
publication date

Review_Ongoing

39. Any additional information.

Provide any other information the review team feel is relevant to the registration of the review.

40. Details of final report/publication(s).

This field should be left empty until details of the completed review are available. Give the link to the published review.

APPENDIX B

Appendix B contains the first page of the published papers that were written during the PhD but not included in this thesis.

PAPER 1

Health expenditure and gross domestic product: causality analysis by income level

Rezwanul Hasan Rana[1,3] · Khorshed Alam[1] · Jeff Gow[1,2]

Abstract

The empirical findings on the relationship between gross domestic product (GDP) and health expenditure are diverse. The influence of income levels on this causal relationship is unclear. This study examines if the direction of causality and income elasticity of health expenditure varies with income level. It uses the 1995–2014 panel data of 161 countries divided into four income groups. Unit root, cointegration and causality tests were employed to examine the relationship between GDP and health expenditure. Impulse-response functions and forecast-error variance decomposition tests were conducted to measure the responsiveness of health expenditure to changes in GDP. Finally, the common correlated effects mean group method was used to examine the income elasticity of health expenditure. Findings show that no long-term cointegration exists, and the growth in health expenditure and GDP across income levels has a different causal relationship when cross-sectional dependence in the panel is accounted for. About 43% of the variation in global health expenditure growth can be explained by economic growth. Income shocks affect health expenditure of high-income countries more than lower-income countries. Lastly, the income elasticity of health expenditure is less than one for all income levels. Therefore, healthcare is a necessity. In comparison with markets, governments have greater obligation to provide essential health care services. Such results have noticeable policy implications, especially for low-income countries where GDP growth does not cause increased health expenditure.

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PAPER 2

The Impact of Immigration on Public and Out-of-Pocket Health Expenditure in OECD Countries

Rezwanul Hasan Rana[1] · Khorshed Alam[1] · Jeff Gow[2]

Abstract

This paper examined the impact of the inflow of new immigrants on public and out-of-pocket health expenditure in 33 Organisation for Economic Cooperation and Developments (OECD) countries over the period of 2000–2015. Dynamic panel data analysis is carried out using the one-step system 'Generalised Method of Moments' and the instrumental variable (IV) estimation approach whilst controlling for potential endogeneity. The inflow of new immigrants is modelled as a determinant of health expenditure. The results are robust to both static and dynamic models. The results show that an increasing inflow of immigrants is significantly related to out-of-pocket, but, surprisingly, not with public health expenditure. Moreover, the findings are similar for countries that primarily have publicly funded healthcare systems or those more dominated by private financing of healthcare. It can be concluded that new immigrants do not seek publicly funded healthcare at least at the initial years of their relocation and that their arrival does not trigger a significant rise in public healthcare expenditure in the OECD countries.

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PAPER 3

RESEARCH ARTICLE

Open Access

Health expenditure, child and maternal mortality nexus: a comparative global analysis

Rezwanul Hasan Rana[1*], Khorshed Alam[1] and Jeff Gow[1,2]

Abstract

Background: This paper provides empirical evidence on how the relationship between health expenditure and health outcomes varies across countries at different income levels.

Method: Heterogeneity and cross-section dependence were controlled for in the panel data which consist of 161 countries over the period 1995–2014. Infant, under-five and maternal mortality along with life expectancy at birth were selected as health outcome measures. Cross-sectional augmented IPS unit root, panel autoregressive distributed lag, Dumitrescu-Hurlin and Toda-Yamamoto approach to Granger causality tests were used to investigate the relationship across four income groups. An impulse response function modelled the impact on health outcomes of negative shocks to health expenditure.

Results: The results indicate that the health expenditure and health outcome link is stronger for low-income compared to high-income countries. Moreover, rising health expenditure can reduce child mortality but has an insignificant relationship with maternal mortality at all income levels. Lower-income countries are more at risk of adverse impact on health because of negative shocks to health expenditure. Variations in child mortality are better explained by rising health expenditure than maternal mortality. However, the estimated results showed dissimilarity when different assumptions and methods were used.

Conclusion: The influence of health expenditure on health outcome varies significantly across different income levels except for maternal health. Policymakers should recognize that increasing spending has a minute potential to improve maternal health. Lastly, the results vary significantly due to income level, choice of assumptions (homogeneity, cross-section independence) and estimation techniques used. Therefore, findings of the cross-country panel studies should be interpreted with cautions.

Background

Over the past few decades the world has seen substantial improvements in health outcomes (HO). This has coincided with rising health expenditure (HE). Global per capita HE has increased from US$587 in 2000 to US$1299 in 2015 in real terms [1]. Globally, since 1990 to 2013, the under-five mortality rate (U5MR) decreased by 49%, the reduction in maternal mortality ratio was 45% and life expectancy at birth (LFE) increased from 64 years to 71 years [2].

A large literature has examined the variations in HO and HE across countries [3–6]. Despite these efforts the causal relationship between HE and HO is still not clear. Researchers are yet to confirm whether income plays a key moderating role in deciding the direction of causality. Moreover, past empirical studies have overlooked the impact on HO due to a negative shock to HE. The question remains: how much variation in HO can be explained by HE? Equally important is to understand the effect of the assumptions of homogeneity and cross-section independence on the empirical findings of earlier studies. Lastly, wide disagreement regarding the variables which most accurately measure HO exists [7, 8].

It is usually assumed that rising HE will automatically improve HO. Nonetheless, the evidence for a causal

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PAPER 4

Globalization and Health

RESEARCH   **Open Access**

Development of a richer measure of health outcomes incorporating the impacts of income inequality, ethnic diversity, and ICT development on health

Rezwanul Hasan Rana[1*], Khorshed Alam[1] and Jeff Gow[1,2]

Abstract

Background: In the literature, measuring health outcomes usually entails examining one dependent variable using cross-sectional data. Using a combination of mortality and morbidity variables, this study developed a new, richer measure of health outcome. Using the health outcome index, this study investigated the impacts of income inequality, levels of ethnic diversity and information and communication technology (ICT) development on health using panel data.

Methods: Partial least squares regression based on a structural equation model is used to construct a health outcome index for 30 OECD countries over the period of 2004 to 2015 using SmartPLS software. Then, panel corrected standard errors estimation and pooled ordinary least square regression with Driscoll and Kraay standard errors approaches were used to investigate the key determinants of health outcomes. Both methods are efficient when the panel data is heteroscedastic and the errors are cross-sectional dependent.

Results: Income inequality, level of ethnic diversity and development in ICT access and use have an adverse effect on health outcomes, however, development in ICT skills has a significant positive impact. Moreover, OECD countries with a higher percentage of publicly funded healthcare showed better public health compared to countries where the percentage is smaller. Finally, rising incomes, development of technologies and tertiary education are key determinants for improving health outcomes.

Conclusions: The results indicate that countries with higher levels of income inequality and more ethnically diverse populations have lower levels of health outcomes. Policymakers also need to recognise the adverse effect of ICT use on public health and the benefits of public healthcare expenditure.

Keywords: Health outcomes, Income inequality, Ethnic diversity, ICT development, Public health expenditure, SmartPLS, Panel data, OECD

JEL classifications: I10, I31, H51, C33, C43

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PAPER 5

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Health outcome and expenditure in low-income countries: does increasing diffusion of information and communication technology matter?*

Rezwanul Hasan Rana [a], Khorshed Alam [a] and Jeff Gow [a,b]

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ABSTRACT

This paper examines whether increasing diffusion of ICTs has the potential to improve healthcare use and access to better health outcome and higher spending on health in 38 low-income countries with a panel data for the period of 1995 to 2015. The panel corrected standard error, and fixed effect Driscoll-Kraay methods were used to account for unobserved heterogeneity and cross-section dependence in the panel data. A healthoutcome index was developed using partial least square based on a structural equation model with SmartPLS (version 2) software package. The estimated results indicate that increasing diffusion of ICT impacts both the health outcome and expenditure, positively and significantly. The association is stronger when the diffusion of ICT takes place in rural areas. In conclusion, ICT is not only a means for providing better healthcare services but also an essential instrument for popularizing healthcare access and use for all.

1. Introduction

The widespread availability of mobile phone and associated technologies (internet) has increased significantly in recent years. These advancements have increased the adoption of internet and mobile phone-based technology (ICT from hereon) in various industries including healthcare. Medical know-how, collectively with upgraded communication devices have improved healthcare services through better distribution of information, diagnostics, medical research, telemedicine and health interventions (Bastawrous & Armstrong, 2013). Kahn, Yang, and Kahn (2010) found that the use of ICT can vastly improve healthcare service provision and outcomes in low-income countries (LICs) where resources and infrastructure are often inadequate. For example, in some rural areas of Zambia, it takes 30 days for blood samples from newborn babies to reach laboratories for a HIV test. However, with the help of text messages, it requires just a few seconds to deliver the test results to a doctor, improving the child's chances of survival (Arie, 2015). Likewise, Qureshi (2016) concluded that the use of ICT (e.g. mobile phone and internet) was instrumental in preventing the spread of Ebola virus in Africa. Shuaib et al. (2017) showed that use of mobile phone technology combined with the 'Geographic Position System' improved information dissemination (including laboratory results) and monitoring and management of personnel in the 'Emergency Operation Centre' Other studies also found that increasing ICT usage was influential in reducing child mortality (Lee, Liu, & Lio, 2016; United Nations Develpment Programme, 2004). Again, patients living in remote and

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END OF THESIS