ORIGINAL RESEARCH

Regular Primary Care Plays a Significant Role in Secondary Prevention of Ischemic Heart Disease in a Western Australian Cohort

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BACKGROUND: Secondary prevention for established ischaemic heart disease (IHD) involves medication therapy and a healthier lifestyle, but adherence is suboptimal. Simply having scheduled regular appointments with a primary care physician could confer a benefit for IHD patients possibly through increased motivation and awareness, but this has not previously been investigated in the literature.

OBJECTIVE: To estimate the association between regular general practitioner (GP) visitation and rates of all-cause death, IHD death or repeat hospitalisation for IHD in older patients in Western Australia (WA).

DESIGN: A retrospective cohort design.

PARTICIPANTS: Patients aged≥65 years (n=31,841) with a history of hospitalisation for IHD from 1992–2006 were ascertained through routine health data collected on the entire WA population and included in the analysis.

MAIN MEASURES: Frequency and regularity of GP visits was determined during a three-year exposure period at commencement of follow-up. A regularity score (range 0–1) measured the regularity of intervals between the GP visits and was divided into quartiles. Patients were then followed for a maximum of 11.5 years for outcome determination. Hazard ratios and 95% confidence intervals were calculated using Cox proportional hazards models.

KEY RESULTS: Compared with the least regular quartile, patients with greater GP visit regularity had significantly decreased risks of all-cause death (2nd least, 2nd most and most regular: HR=0.76, 0.71 and 0.71); and IHD death (2nd least, 2nd most and most regular: HR=0.70, 0.68 and 0.65). Patients in the 2nd least regular quartile also appeared to experience decreased risk of any repeat IHD hospitalisation (HR=0.83, 95%CI 0.71–0.96) as well as emergency hospitalisation (HR=0.81, 95%CI 0.67–0.98), compared with the least regular quartile.

CONCLUSIONS: Some degree of regular GP visitation offers a small but significant protection against morbidity and mortality in older people with established IHD. The findings indicate the importance of scheduled, regular GP visits for the secondary prevention of IHD.

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INTRODUCTION

Ischemic heart disease (IHD) is the leading cause of death in Australia[1] and worldwide[2], with ischaemic heart disease affecting 637,000 Australian residents and accounting for 23,570 deaths in 2005[1]. The condition was also responsible for the majority of the national cardiovascular disease burden when assessed in 2003[3]. The prevalence of this condition increases markedly with age, exceeding 33% in those aged≥ 75 years[4]. Despite declining incidence and mortality rates from ischaemic heart disease over recent years in developed countries including Australia[5,6], the associated economic burden remains high[7].

Treatments for established ischaemic heart disease include lifestyle modification (e.g., smoking cessation, increased physical activity, caloric restriction), pharmacotherapy (e.g., aspirin, beta-blockers, statins, ACE inhibitors, nitrates, anti-thrombin regime) and surgical revascularisation procedures[8,9]. After discharging their patients from hospital in Australia, primary care physicians share ischaemic heart disease management with specialist cardiologists[10]. The treatments usually involve medication therapy, promoting changes to a healthier lifestyle and participation in a cardiac rehabilitation (CR) program[9]. These secondary prevention strategies have been shown to be critical to management of the underlying disease and prevention of recurrent hospital admission and death[11–13]. In spite of the evidence, existing literature indicates that adherence to secondary prevention strategies is suboptimal[12–14]. In particular, only about 30% of eligible patients access CR programs in Australia and the United States (US)[15,16]. Since older age is one of the reasons for poor compliance[17,18], finding optimal secondary prevention strategies in older people with ischaemic heart disease is important. An Irish intervention trial found that up to four primary care visits annually improved cardiovascular outcomes[19]. It, however, remains to be investigated whether simply having scheduled regular appointments with a primary care physician confers a secondary prevention benefit for ischaemic heart disease. Such appointments

are a proxy for proactive, planned primary care; a main feature of The Chronic Care Model, which has been found to improve patient care and health outcomes[20].

We studied this important issue in Western Australia (WA) using linked, whole-population routine health/medical data. In Australia, primary medical care is delivered predominantly through general practice, where the Australian general practitioner (GP) is equivalent to a US family physician certified by the American Board of Family Medicine[21]. In this study, we used a visitation regularity score previously developed by our group[22,23] to assess the regularity of intervals between GP visits and investigated the effects of visiting a GP regularly on repeated hospital admission and death in older ischaemic heart disease patients.

METHODS

Study Population

The WA Department of Health routinely collects administrative health/medical data on the whole WA population, which includes one-tenth of the entire Australian population, or 2.3 million people[24]. The data are linked through the WA Data Linkage System (WADLS) using computerised probabilistic matching based on full name and address, and other identifiers[25,26]. WADLS evaluations have shown that the matching procedures are 99.89% accurate[25].

We identified the study cohort using linked data on individuals aged ≥65 years from 1 January 1992 to 31 December 2006 from the Hospital Morbidity Data System (HMDS), Mortality Register, the Medicare Benefits Schedule (MBS) and the State Electoral Roll. The data included: i) all procedures performed during hospital stay; ii) one principal and 20 secondary diagnoses; iii) dates and types of admissions and separations of inpatients; iv) date and primary cause of death; and v) dates and types of services and procedures provided by GPs who qualified for government subsidy[27,28]. Registration information from the WA Electoral Roll was used to ascertain outward migration of the study population since electoral registration is compulsory for all adult Australian citizens residing in the country.

We ascertained ischaemic heart disease patients using any of the 21 diagnosis fields in the HMDS using ICD-9 and ICD-9-CM (410, 411, 412, 413, 414) and ICD-10-AM[29] (I20, I21, I22, I23, I24, I25) classifications. The study cohort included all patients ≥ 65 years who had at least one hospitalisation for ischaemic heart disease during 1992–2006 (n=70,035). After excluding 5182 patients who were not registered on the WA Electoral Roll at any time during the study period, we included 64,853 patients in the study.

The study was approved by the Human Research Ethics Committees of The University of Western Australia and the WA Department of Health.

Exposure and Outcome Ascertainment

The observation period for each individual began on the date of the patient's first ischaemic heart disease hospitalisation. Each patient was then censored at the end date of Electoral Roll registration (for outward migration), date of death, date of repeat ischaemic heart disease hospitalisation, or 31 December 2006, whichever came first. We divided the observation period into an exposure period (first three years), a separate wash-out period (next six months) and follow-up (from end of wash-out period to censoring date).

The exposure period was designated to ascertain the GP visitation pattern for each patient across a three-year period. We identified the GP visits using 127 MBS service items for clinic attendance, out-of-surgery consultation and home visits provided by a registered GP[27,28]. To assess how regular the intervals were between GP visits for each individual, we used a previously developed visitation regularity score[22,23] since entropy-related scores from other fields were unsuitable for our purpose[30]. This score was calculated as $1/[1+\mathrm{Var}(\Phi_i)]$ where Φ_i was the time interval between the $(i-1)^{th}$ and i^{th} GP visits. It ranged from 0 to 1 (with 1 representing perfect regularity between GP visits) and was divided into quartiles for all analyses. We then applied a six-month 'wash-out' period following the exposure period to minimise the likelihood of reverse causation (protopathic) bias[31,32], whereby the increased frequency of health services immediately prior to hospital admission or death can create a misleading association. During this period, no exposures or outcomes were ascertained. Person-time of follow-up began after the wash-out period with patients being followed for a maximum of 11.5 years for determination of all-cause death, ischaemic heart disease death or repeat hospitalisation.

Statistical Analyses

We estimated the effects of GP visit regularity on (a) all-cause mortality, (b) ischaemic heart disease mortality, or (c) second ischaemic heart disease hospitalisation using Cox proportional hazards models, where hazard ratios and 95% confidence intervals estimated the incidence rate ratios. All models were adjusted for gender; age at first hospitalisation; indigenous status; Charlson Index of co-morbidity[33]; area-based socio-economic status and residential remoteness (obtained from the Australian Census conducted every five years (ref)); and the best fitting second order fractional polynomial of GP visit frequency (as measured by the total number of GP visits during the three-year exposure period) to account for the non-linearity of this variable (GP visit frequency+GP visit frequency*ln(GP visit frequency)). No basis to reject proportionality was found after assessing the proportional hazards assumption for each covariate in each model. We performed all analyses using the statistical software SAS version 9.1 (SAS Institute Inc., Cary, NC, USA).

RESULTS

Our original study sample of patients who had been hospitalised for ischaemic heart disease in WA during 1992–2006 included 64,853 people. After excluding those with a too short observation period, missing information on GP visits, or who died or were hospitalised before commencement of follow-up, we included 49% (n=31,841) of the original patient sample in the mortality analysis and 20% (n=13,102) in the repeat-ischaemic heart disease hospitalisation analysis (Table 1).

Table 1. Characteristics of the WA Ischaemic Heart Disease Patients ≥65 Years 1992–2006

Original study sample	64,853
Exclusions:	
Observation period <3.5 years *	8294
Patients who died during exposure and wash-out periods	14,749
Patients with missing information on GP visits	9969
Mortality analysis	
Patients included in analysis	31,841 (49%)
Female N (%)	15,106 (47%)
Age (mean±SD) at 1st hospitalisation (years)	73.4±6.6
GP visits per person per year (mean±SD) †	9.9±6.7
GP visits per person per year (median) †	8.7
Years of follow-up (mean±SD)	4.4±3.1
Total person-years of follow-up	140,440.3
Deaths by the end of follow-up	10,191
Mortality rate (per 1,000 person-years)	72.6
IHD deaths by the end of follow-up	2958
IHD mortality rate (per 1,000 person-years)	21.1
2nd IHD hospitalisation analysis	
Further exclusions:	
Patients hospitalised during exposure and wash-out periods	18,739
Patients included in analysis (%)	13,102 (20%)
Female N (%)	6636 (51%)
Age (mean±SD) at 1st hospitalisation (years)	73,6 (6.6)
GP visits per person per year (mean±SD) †	9.0 (5.9)
GP visits per person per year (median) †	7.8
Years of follow-up (mean±SD)	3.3±2.7
Total person-years of follow-up	42,913.5
Second IHD hospitalisations by the end of follow-up	4208
Repeat hospitalisation rate (per 1,000 person-years)	98.1

* *Insufficient time to include both exposure and wash-out periods prior to commencement of follow-up*
† *During the three-year exposure period*
IHD=ischaemic heart dsease

In Table 2, we show the characteristics of the 31,841 ischaemic heart disease patients by quartiles of GP visit regularity. Female patients, non-indigenous patients, and patients living in major cities were more likely to have higher regularity of GP visitation, whereas male patients, indigenous patients, and patients from very remote areas were more likely to be in the lower regularity groups. Deaths, emergency hospital admissions, the number of GP visits, number of repeat hospitalisations and length of hospital stay were highest in the most regular visit group.

We show the associations between GP visit regularity and all-cause death, ischaemic heart disease death and repeat ischaemic heart disease hospitalisation in Table 3. Compared with the least regular quartile, patients in the other three quartiles representing more regular GP visitation all had similarly decreased rates of all-cause death (HRs: 0.76, 0.71, and 0.71) and ischaemic heart disease death (HRs: 0.70, 0.68, and 0.65). Patients in the 2nd least regular quartile also appeared to experience a lower rate of any repeat ischaemic heart disease hospitalisation (HR=0.83, 95%CI 0.71–0.96) as well as emergency hospitalisation (HR=0.81, 95%CI 0.67–0.98), compared with the least regular quartile.

DISCUSSION

This study is the first to comprehensively evaluate the benefits of regular primary care for the secondary prevention of ischaemic heart disease in older patients at the population level. The results suggest that a relatively small increase in regularity between GP visits is required in order to protect against all-cause mortality, ischaemic heart disease mortality and repeat ischaemic heart disease emergency hospitalisations in patients aged over 65 years with a history of hospitalisation for ischaemic heart disease.

Using whole-population, routinely-collected, administrative medical/health data was a strength of this study as it minimised recall bias and loss-to-follow-up. We felt confident in using WA hospital data for patient ascertainment as the WA Department of Health conducts quality audits of the ICD coding of hospital morbidity from hospital charts on a regular basis and a validation study found the accuracy of heart failure coding from this data to be exceptionally high[34]. Furthermore, all but a very small number of state-funded GPs in WA qualify for government subsidy support and it is thus unlikely that any of the patients in our study had GP visits that we missed.

Despite the number of strengths, a few limitations warrant attention. Firstly, reverse causation (protopathic) bias can occur in health services research when the increased frequency of the health care services immediately prior to a disease outcome creates a misleading association between the two factors[32]. We attempted to minimise this problem by implementing a six months wash-out period between the exposure and follow-up periods, where no exposure or outcomes were ascertained. A wash-out period of this length has been shown in similar research to adequately account for this type of bias[31]. Secondly, the severity of the initial ischaemic heart disease hospitalisation may affect the inclination of a patient to seek regular primary care once discharged from hospital. We explored adjusting all our analyses for proxy measurements of intial ischaemic heart disease severity such as: admission type at first ischaemic heart disease hospitalisation (emergency/non-emergency); concurrent acute myocardial infarction at first ischaemic heart disease hospitalisation; length of first ischaemic heart disease hospital stay; and revascularisation procedure at first ischaemic heart disease hospitalisation. None of these adjustments had any significant effect on the associations or risk estimates demonstrated in the study and we therefore excluded these variables from the Cox regression models. Thirdly, a large part of our participants died or were re-hospitalized prior to commencement of follow-up and could thus not be included in the analysis. This may have been a cause for a concern regarding the efficacy of regular GP visits. However, the people who were included in the analysis were more likely to have regular GP visits, indicating that regular GP visits point towards better health and longevity. Lastly, using this type of data did create some limitations with respect to information availability as we were unable to assess continuity of care. This was due to the fact that we did not have information on whether the patients saw the same GP at each visit.

Evidence exists indicating that hospitalisation for a number of chronic health conditions could be preventable with sufficient primary care[35]. These conditions are known as Ambulatory Care Sensitive Conditions (ACSCs) and include, as an example, diabetes, respiratory diseases, various cardiovascular diagnoses, and convulsive disorders[36]. The protective effect of GP accessibility and the pattern of GP contact against potentially preventable hospital admissions and adverse health events has been supported by several previous studies[35,37–41]. As an example, high primary care physician density appears to protect against potentially preventable hospital admissions[35], whereas lack of a

Table 2. Characteristics of 31,841 Wa Ischaemic Heart Disease Patients≥65 Years 1992–2006 by Groups of GP Visit Regularity

	Least regular	2nd least regular	2nd most regular	Most regular
Age (mean±SD)	74.7±6.2	72.2±6.2	72.8±6.4	74.4±6.8
Number of GP visits per person per year (mean±SD)	2.7±2.9	5.3±2.7	8.5±3.0	15.7±7.0
Number of deaths	1,115	1,914	2,943	4,219
Number of IHD deaths	294	523	878	1,263
Number of patients with 2nd hospitalisation	404	1,014	1,387	1403
Length of stay at first IHD hospitalisation (mean days±SD)	15.4±138.3	13.5±136.8	11.4±106.8	17.1±152.7
AMI at first IHD hospitalisation (%)	17.5	20.6	19.7	19.0
CARP at first IHD hospitalisation (%)	5.5	6.8	7.6	6.1
Emergency at first IHD hospitalisation (%)	52.0	53.2	54.8	60.2
Indigenous patients (%)	0.7	0.6	0.4	0.4
Female patients (%)	33.2	38.4	47.7	57.2
Socioeconomic status quintile (%)				
Least disadvantaged	23.2	21.6	20.7	18.8
2nd least disadvantaged	18.3	20.2	19.5	20.0
Medium disadvantaged	20.5	20.1	20.3	20.2
2nd most disadvantaged	18.9	20.0	19.8	19.9
Most disadvantaged	19.1	18.2	19.6	21.3
Residential remoteness (%)				
Major Cities	73.4	69.2	74.8	83.3
Inner Regional	11.1	15.1	14.1	9.44
Outer Regional	10.7	12.3	9.3	5.7
Remote	3.8	3.1	1.7	1.5
Very Remote	1.0	0.3	0.2	0.1
Charlson index of co-morbidity (%)				
0	8.4	16.0	13.6	7.0
1-2	23.7	33.6	31.3	24.5
3-5	33.6	29.1	32.3	37.3
6+	34.3	21.3	22.8	31.3

AMI=acute myocardial infarction
CARP=coronary artery revascularisation procedure
GP=general practitioner
IHD=ischaemic heart disease
SD=standard deviation

primary care physician[38], fewer physician visits[39], living in primary medical care shortage areas[40], and lack of access to primary care[41] appear to lead to increase in preventable hospitalisations. Also, delayed access to health care has been found to increase the risk of mortality in veterans[42].

Our results support the findings from an Irish intervention study where ischaemic heart disease patients visited their primary care physician up to four times annually[19]. The authors reported improvements in blood pressure, cholesterol levels, and smoking status despite the fact that no special interventions on diet or physical activity were implemented for the patients[19]. Rather, GPs only provided advice/encouragement on healthy eating and physical exercise in addition to taking physical and medical measurements[19]. Hence, simply visiting a GP regularly appears to play a significant role in the prevention of deteriorating cardiovascular health. In our study, we used a new measure for regularity previously developed by our group[22,23] that specifically measured regularity between GP visits per se, and found that visiting a GP regularly appears to protect against morbidity and mortality in ischaemic heart disease patients. The results suggested that only relatively small increase in regularity is required in order to be protective and that when this threshold is reached, only a small additional benefit of increased regular GP attendance is apparent. The fact that regular primary care seems protective is an important finding considering that the literature consistently reports suboptimal compliance with recommended secondary prevention strategies despite a plethora of evidence showing the importance of such strategies. For example, a recent systematic review concluded that pre-planned community pharmacist or nurse consultations, patient education and structured monitoring of medication and risk factors improved total cholesterol levels in

Table 3. Association of GP Visit Regularity with the Likelihood of all-Cause Mortality, Ischaemic Heart Disease Mortality and Repeat Ischaemic Heart Disease Hospitalisation for 31,841 (Mortality Analysis) and 13,102 (Hospital Analysis) WA Ischaemic Heart Disease Patients≥65 Years

	Least regular	2nd least regular	2nd most regular	Most regular
	HR	HR (95% CI)*	HR (95% CI)*	HR (95% CI)*
All-cause mortality	1.00	0.76 (0.69–0.83)	0.71 (0.64–0.79)	0.71 (0.63–0.82)
IHD mortality	1.00	0.70 (0.59–0.83)	0.68 (0.56–0.83)	0.65 (0.51–0.83)
2nd hospital admission	1.00	0.83 (0.71–0.96)	0.90 (0.75–1.08)	0.96 (0.77–1.19)
2nd hospital admission—emergency	1.00	0.81 (0.67–0.98)	0.88 (0.70–1.10)	0.89 (0.68–1.18)
2nd hospital admission—non-emergency	1.00	0.84 (0.65–1.08)	0.95 (0.69–1.29)	1.16 (0.79–1.71)

* *Adjusted for age, indigenous status, gender, socioeconomic status, residential remoteness, Charlson index of co-morbidity and the fractional polynomials of GP visit frequency.*
IHD=Ischaemic Heart Disease

patients with ischaemic heart disease[11]. Also, clinical trial evidence consistently supports the efficacy of pharmacotherapies in reducing cardiovascular morbidity and mortality[12,13] and rehabilitation programs have been shown to play a pivotal role in treatment and management of ischaemic heart disease patients[43–45]. As a result, clinical guidelines commonly suggest that all patients with ischaemic heart disease should participate in at least some form of a secondary prevention program[46].

Despite the ability of current preventive strategies to reduce cardiovascular morbidity and mortality, compliance remains poor[12–14]. Some of the reasons for poor compliance include older age, lower socio-economic status, lack of motivation, transport difficulties, limited availability of preventive programs, and financial constraints[17,18]. One feature of The Chronic Care Model[20]—which focuses on proactive, planned care—includes automated reminder systems to support regular care. If put in place, such systems could make a great contribution towards increasing compliance rates. Furthermore, the vast majority of Australians over 65 years of age are eligible to receive a government concession card, entitling them to visit a GP regularly at low or no out-of-pocket expense. As a result, regular appointments with GPs are a financially feasible way for older patients to manage and monitor their disease, at least in the Australian setting.

Regular appointments with a GP as a form of secondary prevention for ischaemic heart disease reflect a more proactive approach to disease management. They create time to review the secondary prevention strategies in place, such as medication therapy, and may contribute towards medication adherence and early detection of adverse disease symptoms. In addition, regular GP appointments may help reduce stress and anxiety experienced by the patient. Evidence suggests that the reduction of emotional stress is an important consequence of secondary prevention[47]. Hence, any psychosocial support provided by the GP is likely to contribute towards reduction in future coronary risk.

Another possible mechanism for the positive effect of regular primary care is the long-term maintenance of a healthy lifestyle. Patients with a recently diagnosed ischaemic heart disease tend to begin a new healthy lifestyle with good intentions. However, the maintenance of a healthy lifestyle depends on long-term advice and personal involvement in secondary prevention[48]. As such, having regular appointments with a GP may increase the motivation of ischaemic heart disease patients to comply with secondary prevention strategies and stay on track with a healthy lifestyle. Such commitment will then in turn reduce their risk of mortality and morbidity in the long-term[49].

CONCLUSIONS

We investigated regular primary care as a possible secondary prevention strategy in older people who had been hospitalised for ischaemic heart disease in WA using linked, routine health data collected by the WA Department of Health. Our results indicated that visiting GPs at regular intervals protects against mortality and hospital admissions in older people with ischaemic heart disease. The findings point towards the importance of scheduled, regular GP visits for the secondary prevention of ischaemic heart disease.

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Conflict of Interest: *None disclosed.*

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