Health policy 126 (2022) 190–196

Contents lists available at ScienceDirect

Health policy

journal homepage: www.elsevier.com/locate/healthpol

Public health insurance and mortality in the older population: Evidence from the Irish Longitudinal Study on Ageing

Anne Nolan[a,b,*], Peter May[b,c], Soraya Matthews[b,c], Charles Normand[c], Rose Anne Kenny[b], Mark Ward[b]

[a] Economic and Social Research Institute, Dublin, Ireland
[b] The Irish Longitudinal Study on Ageing (TILDA), Trinity College, Dublin, Ireland
[c] Centre for Health Policy and Management, Trinity College, Dublin, Ireland

ARTICLE INFO

Article history:
Received 5 November 2021
Revised 7 January 2022
Accepted 28 January 2022

Keywords:
Public health insurance
All-cause mortality
Cause-specific mortality
Amenable mortality
Ageing

ABSTRACT

Most developed countries provide publicly-financed insurance for many health services for their populations although there is considerable variation across countries in the types of services covered, eligible population groups and whether co-payments are levied. The Irish healthcare system, with a complex mix of public and private financing of healthcare services, offers a useful case study for an examination of the impact of type of health insurance cover on population health. In this paper, we investigate the extent to which type of health insurance cover is associated with all-cause, cause-specific, and amenable mortality using data on a representative survey of the population aged 50+ from the Irish Longitudinal Study on Ageing (TILDA) matched to administrative data on death registrations. The results show that those without public or private health insurance have a higher risk of all-cause and cancer mortality. However, there is no evidence that type of health insurance cover affects mortality risk from causes that are considered amenable to healthcare intervention, although this analysis was based on a much smaller sample size. This analysis provides important evidence for a country that is implementing reforms to its financing and delivery structures in order to move towards a system of universal healthcare.

1. Introduction

Most developed countries provide publicly-financed insurance for many health services for their populations although there is considerable variation across countries in the types of services covered, eligible population groups and whether co-payments are levied [1]. Worldwide, there is an increasing focus on developing health financing systems that support universal healthcare [2], and major expansions in public health insurance cover have taken place recently in countries such as the United States (US) and China, amongst others [3–5]. In Ireland the 'Sláintecare' reform proposals, agreed by an all-party parliamentary committee in 2017, propose the introduction of universal healthcare, funded largely by general taxation, over a ten-year period [6,7]. While an important objective of public health insurance is to provide financial protection against large and unexpected healthcare expenses, public health insurance is designed to ensure equitable access to appropriate healthcare at minimal cost, thereby improving population health. Nonetheless, there is still considerable uncertainty about the role of public (and private) health insurance in improving population health [4,8].

One of the most definitive ways of assessing health outcomes is to examine mortality, including trends over time and differences between and within population groups [4,9]. Much of the existing evidence in this area originates from the US, where the evidence points to a protective effect of public and private health insurance on survival [10–15]. Using similar data and methods to those employed in this paper, McWilliams et al. [12] compared mortality over an eight year follow-up period amongst respondents to the US Health and Retirement Survey (HRS) who were privately insured and those who were uninsured. They found that mortality risk was significantly greater for uninsured adults than insured adults in unadjusted and adjusted analyses (a similar finding was reported by Baker et al. [10]). A related literature has used expansions in public health insurance in the US to identify the effect of public health insurance on mortality [4]. For example, Miller et al. [13] used state-level variation in the adoption of the Affordable Care Act (ACA) to examine the impact of public health insurance on mortality. They found that amongst the population aged 55–64 years of age, mortality declined in the first year of the ACA expansion and continued to decline

* Corresponding author.
E-mail address: anne.nolan@esri.ie (A. Nolan).

https://doi.org/10.1016/j.healthpol.2022.01.014
0168-8510/

(at an increasing rate) for three years thereafter, suggesting that prolonged exposure to Medicaid (the public health insurance for low income individuals in the US) resulted in increasing health improvements.

A related area of research considers the role of health insurance in reducing deaths from causes that may be considered 'amenable' to healthcare intervention. The concept of amenable or treatable mortality, first developed by Rutstein et al. [16], refers to deaths that can be avoided with timely and effective health care, including secondary prevention and treatment (i.e., after the onset of disease). These concepts are now used by several governments and international organisations as indicators of health system performance [17,18]. Deaths are considered to be amenable to high quality and timely health care if they occur before the age of 75 years (although a recent analysis increased the age limit to 79 to account for the fact that as life expectancy increases, life-saving healthcare interventions are increasingly applied at higher ages) [19]. It also takes into account the fact that co-morbidity increases with older age and hence assignation of a single underlying cause of death becomes more uncertain at older ages [20,21]. While insurance and access to healthcare is just one aspect of effective healthcare financing and delivery, there is evidence that the presence of health insurance is associated with lower amenable death rates [10–13,15,22]. The broader concept of avoidable mortality includes also deaths from preventable causes, i.e., causes of death that can be mainly prevented through effective public health and primary prevention interventions (i.e., before the onset of disease) [9,23]. Some of these causes are outside the control of health systems (e.g., appropriate road safety measures can reduce road traffic accidents), and in general therefore the narrower concept of amenable mortality is used to assess health system performance [24].

The Irish healthcare system offers a useful case study for assessing the impact of health insurance on all-cause, cause-specific, and amenable mortality. In 2019, per capita health expenditure in Ireland was €3576 per annum (the EU-27 average was €2572 per annum) [25]. The majority (75 per cent) of Irish healthcare services were financed by general taxation, with private health insurance (PHI) payments and out-of-pocket payments by individuals accounting for the remainder (at 14 and 12 per cent respectively) [26]. While this mix between financing sources is similar to that in other European countries [25], Ireland is the only European health system that does not offer universal cover of primary care [1,27]. While all Irish residents are entitled to free or subsidised public hospital services and prescription medicines, free GP, primary and community care (a 'full medical card') is granted to those on the lowest incomes only, and free GP care (a 'GP visit card') is granted to those on low (but not the lowest incomes) and to those aged 70+ and under 6 only. The latter groups account for just over 43 per cent of the population [28]. Currently 46 per cent of the population have PHI [29], which mainly fulfils a supplementary role in Ireland [30]. PHI provides cover for private or semi-private acute hospital services (many of which are delivered in public hospitals). In many cases, PHI plans also offer partial reimbursement of some primary care expenses (e.g., GP visits, routine dental care, physiotherapy, etc.). Full medical card and GP visit cardholders are able to purchase PHI (we term this 'dual' cover) (discussed in greater detail in Section 2). See Appendix Table A1 for further details on the current structure of entitlements to public healthcare services in the Irish healthcare system.

This complex financing system results in inequities in access to healthcare services. For example, those with full medical or GP visit cards have been shown to have a significantly higher utilisation of GP care, even taking into account differences in socioeconomic status and health need between those with and without medical cards [31–34]. Evidence in relation to preventive healthcare services such as influenza vaccination and cholesterol testing is more mixed [33,35]. However, those with PHI are significantly more likely to engage with cancer screening for breast and prostate cancer [36]. While PHI does not confer any advantages in accessing cancer screening services, the authors of the study note that it is possible that the higher uptake amongst those with PHI is explained by differential access to secondary care services. One of the primary reasons for purchasing PHI is to ensure faster access to elective hospital treatment [30,37,38], and this is supported by evidence showing that those without PHI face much longer waiting times for elective inpatient and outpatient care [39]. Many healthcare systems have PHI markets; 'what is unusual in the Irish context is the size of the market and the two-tier nature of the hospital system where access to services can be determined by ability to pay rather than clinical need' [36, p.1175].

In contrast to the extensive literature documenting the impact of these features on the utilisation of healthcare services (some of which is summarised in the previous paragraph), there has been little assessment of how this structure of health insurance cover ultimately impacts population health. In this paper, we investigate the extent to which type of health insurance cover is associated with all-cause and cause-specific mortality using data from a prospective representative survey of the population aged 50+ from the Irish Longitudinal Study on Ageing (TILDA) matched to administrative data on death registrations. While the sample size is smaller, we also analyse the association between health insurance cover and amenable mortality in those aged 50–74 years of age at death or follow-up. We hypothesise that those without a medical card or PHI, who must pay out-of-pocket for primary and community care, and experience the longest waits for public inpatient and outpatient hospital care, will be more likely to die prematurely and from causes that are amenable to healthcare intervention than those who are covered by a medical card, PHI (or both).

The paper is structured as follows. Section 2 describes the data and methods. Section 3 presents the main empirical results. Section 4 summarises and discusses the findings.

2. Materials and methods

2.1. Data and variables

Data from the Irish Longitudinal Study on Ageing (TILDA), matched to administrative data collected as part of the national death registration process, are used in this study. TILDA is a longitudinal study of 8504 community-dwelling adults in Ireland aged 50 and older and their partners of any age. It is nationally representative and contains comprehensive information on the health, social and economic circumstances of older people. TILDA is harmonised with other international longitudinal studies of ageing, including the Survey of Health, Ageing and Retirement in Europe (SHARE), the English Longitudinal Study on Ageing (ELSA) and the US Health and Retirement Study (HRS). Three modes of data collection are used: computer-aided personal interviewing (CAPI), a self-completion questionnaire (SCQ) and a nurse-led health assessment (the health assessment was carried out in waves 1 and 3 only). To date, five full waves of data collection, covering the period 2009–2018 have been carried out.

Cause of death was identified from official death registration records linked to TILDA. Linking was performed for all individuals who died between January 2010 and March 2017, resulting in 779 deaths. All diagnostic expressions contained in each death certificate were assigned an ICD-10 code, and an underlying cause of death selected for each case in accordance with ICD rules which defines underlying cause of death as 'the disease or injury which initiated the train of morbid events leading directly to death, or the circumstances of the accident or violence which produced the fatal injury' [40]. Underlying causes of death were aggregated to

four broad ICD-10 chapters to ensure that the chapters were large enough to enable statistically robust analyses. It was also required in order to adhere to TILDA data protection policies. Of the 779 deaths, 37.0 per cent had cancer as the underlying cause of death; diseases of the circulatory system accounted for a further 32.9 per cent of deaths; 14.4 per cent were attributed to diseases of the respiratory system; and the remaining 15.8 per cent of deaths were assigned to 'other' causes. Respondents lost to follow up were right-censored at the end of the follow-up-period (March 2017). Further details on the linking protocol is contained in [41].

In addition to all-cause mortality and cause-specific mortality, amenable mortality was analysed for the subset of respondents aged under 75 years at death or follow-up. A number of classifications of amenable causes of death have been developed over the previous three decades (see [24,24,42] for reviews). According to the latest 2019 OECD/Eurostat definition, amenable (or treatable) mortality is defined as 'causes of death that can be mainly avoided through timely and effective health care interventions, including secondary prevention and treatment (i.e., after the onset of diseases, to reduce case-fatality)' [23]. Preventable mortality is defined as 'causes of death that can be mainly avoided through effective public health and primary prevention interventions (i.e., before the onset of diseases/injuries, to reduce incidence)' [23]. As the identification of conditions that can be treated by effective healthcare is constantly changing, we also employ an earlier list of amenable ICD-10 codes compiled by Nolte and McKee [43]. Reflecting the ambiguity over the characterisation of certain causes of death as amenable or preventable, two lists for the each of the OECD/Eurostat and Nolte and McKee classifications are employed; one that assigns all deaths where 50 per cent of cases are considered amenable to the amenable cause of death ('inclusive' definition), and one that assigns all deaths where 50 per cent of cases are considered amenable to non-amenable causes of death ('conservative' definition). Appendix Table A2 and the accompanying text details the underlying causes of death and ICD-10 codes for the two main classification lists for amenable mortality examined in this paper. Table A3 shows that the proportion of TILDA deaths under the age of 75 that can be considered amenable under the various definitions ranges from 9.5 to 31.8 per cent.

Our main independent variable of interest is a variable that describes the health insurance cover of the individual. Reflecting the mixed system of public and private financing in Irish healthcare, we construct a four-category variable that distinguishes:

- Those with a full medical or GP visit card and private health insurance (i.e. 'dual cover');
- Those with a full medical or GP visit card only (i.e. 'public health insurance cover');
- Those with private health insurance only (i.e. 'private health insurance cover');
- Those with neither a full medical card, GP visit card nor PHI (i.e. 'no additional cover').

The first category ('dual cover') is the most comprehensive, comprising those with both public and private health insurance. This group can avail of free access to GP and primary care services, heavily subsidised prescription medications, and gain faster access to elective hospital care. The second category refers to those with public health insurance only, while the third category refers to those with private health insurance only. The final group has neither public nor private health insurance and is labelled the 'no additional cover' group. All Irish residents are entitled to subsidised prescription medicines and public hospital care, so in practice the latter two groups have a limited form of public health insurance. These four categories represent a continuum of cover, ranging from most comprehensive to least comprehensive. Based on descriptive survey data for the overall adult population, these entitlement groups can be broadly ranked in terms of socioeconomic status with those with PHI of higher socioeconomic status than those without [30]. However, the ranking is not as clear-cut in the older population where the income thresholds for medical card eligibility are much more generous (and where all over 70 s were granted automatic entitlement to a GP visit card in 2015). Due to sample size constraints, for the analyses of amenable mortality, we construct a binary variable to distinguish between the first ('dual cover') and all other (less comprehensive coverage) groups. Table 1 shows how health insurance cover at TILDA baseline (i.e., 2010) is distributed across the two samples employed in this paper (all those aged 50+; those aged <75 years of age).

Table 1
Healthcare Entitlement Categories.

	Aged 50+	Aged 50–74	
Dual cover	16.2%	7.8%	
Public health insurance cover	36.1%	27.5%	
Private health insurance cover	37.0%	49.8%	92.2%
No additional cover	10.8%	15.0%	
N	7714	5272	

2.2. Methods

Cox proportional hazards regression models were used to estimate the hazard ratios for the association between health insurance cover and all-cause mortality. Respondents lost to follow-up were right-censored at the end of the follow-up period (March 2017). We chose the 'dual cover' group as the reference category as we hypothesise that this is the group with the most comprehensive access to public and private healthcare services. For the analyses of cause-specific and amenable mortality, a competing risk survival analysis technique was employed [44]. This technique allows for the fact that there are competing risks to survival when examining cause-specific mortality. Individuals can survive, die from the specific cause being examined, or die from another, competing cause. The technique results in the estimation of a sub-distribution hazard ratio (SHR), which is interpreted in a similar way as the Cox hazard ratio (HR) [45]. To adjust the estimates for clustering and stratification due to the complex multistage sampling design of TILDA, survey weights were applied [46,47]. These weights also accounted for systematic differences in participation amongst different subgroups to ensure that any estimates derived from the sample are representative of the wider population of community-dwelling adults aged 50+.

Both unadjusted and adjusted analyses were carried out. Table A4 in the Appendix describes the set of variables that are used to further adjust the unadjusted estimates for confounding. Demographic and socioeconomic characteristics were accounted for by the inclusion of controls for sex, household location (urban, rural), highest level of education completed (primary, second, third) and household tenure (homeowner, renter) (as a proxy for wealth). Behavioural risk factors included smoking status (never, past, current) and physical activity (number of days in previous week where the respondent went for a walk). Finally, a comprehensive set of health status variables were included, capturing the number of doctor-diagnosed chronic health conditions (categorised from a list of 14 possible conditions), the number of doctor-diagnosed cardiovascular health conditions (categorised from a list of 10 possible conditions), depression status and polypharmacy. Depression status is measured using the 20-item center for Epidemiological Studies Depression Scale (CES-D). A cutoff score of 16 or higher is used to determine clinically significant (case level) depressive symptoms, with those scoring 8–15 displaying sub-threshold levels (i.e., moderate) depression). Polypharmacy refers to those who

Table 2
Cox Proportional Hazards Models of All-Cause Mortality (aged 50+ sample).

	Unadjusted		Adjusted	
	HR	95% CI	HR	95% CI
Dual cover	ref		ref	
Public health insurance cover	1.280**	1.101 – 1.488	1.235*	1.037 – 1.471
Private health insurance cover	1.272*	1.012 – 1.600	1.331*	1.052 – 1.683
No additional cover	2.052***	1.440 – 2.924	1.972***	1.367 – 2.845
N	7714		7714	

* P<0.05 ** P<0.01 *** P<0.001
The unadjusted model controls for sex and health insurance category only. The adjusted model controls for sex, health insurance category, location, education, home ownership, smoking status, activity level, chronic disease status, CVD disease status, depression and polypharmacy (see Table A4 for variable definitions).
See Table A5 for full set of adjusted results.

Table 3
Competing Risks Hazard Models of Cause-Specific Mortality (aged 50+ sample).

	Cancer		Heart Disease		Respiratory Disease		All Other Causes	
	SHR	95% CI	SHR	95% CI	SHR	95% CI	SHR	95% CI
Dual cover	ref		ref		ref		ref	
Public health insurance cover	1.349	0.973 – 1.871	0.963	0.699 – 1.326	1.041	0.635 – 1.709	1.568	0.924 – 2.660
Private health insurance cover	1.182	0.801 – 1.745	1.076	0.677 – 1.710	0.763	0.350 – 1.666	1.499	0.816 – 2.753
No additional cover	2.195**	1.249 – 3.859	1.040	0.424 – 2.551	0.408	0.053 – 3.147	2.047	0.720 – 5.823
N	7714		7714		7714		7714	
N deaths	718		718		718		718	
N deaths from specified cause	266		235		103		114	

* P<0.05 ** P<0.01 *** P<0.001
Results are presented for the fully adjusted models only. The adjusted model controls for sex, health insurance category, location, education, home ownership, smoking status, activity level, chronic disease status, CVD disease status, depression and polypharmacy (see Table A4 for variable definitions)
See Table A6 for full set of adjusted results.

take 5 or more regular medications. All analyses were conducted using Stata/MP 15.1.

3. Results

3.1. Main Results

The results of the unadjusted Cox proportional hazards regression model for all-cause mortality are presented in Table 2. Participants with a medical/GP visit card and PHI ('dual cover') are regarded as the reference category. The 'unadjusted' results indicate that in comparison with those with 'dual cover', all other groups have a significantly higher risk of premature all-cause mortality. In particular, those without a medical/GP visit card and PHI have an increased mortality risk (HR=2.052, 95% CI: 1.440 – 2.924). Adjustment for a set of covariates that have been associated with mortality risk in previous research (such as socioeconomic status, health and health behaviours) attenuates these associations slightly, but the broad patterns remain the same. Table A5 presents the full set of results for the adjusted model. Male sex, renting rather than being a home owner, current and past smoking, and severe depressive symptoms are also associated with an increased risk of all-cause mortality in this cohort.

In Table 3, we present the results of the competing risks analysis of cause-specific mortality, for the fully adjusted models (see Table A6 for the SHRs for additional covariates; unadjusted results available on request from the authors). Cancer is the only cause of death for which health insurance category is associated with risk of death. Similar to all-cause mortality, those without a medical/GP visit card or PHI had an increased risk of dying from cancer over the eight year follow-up period (HR=2.195; 95% CI=1.249 – 3.859).

Next, we focus on those aged 50–74 at death or follow-up and analyse the effect of health insurance on the risk of death from an amenable cause. As the number of deaths is much smaller below the age of 75 (n=242), we aggregate the three less comprehensive health insurance categories together (i.e., medical/GP visit card only; PHI only; no medical/GP visit card or PHI) and assess the risk of mortality from an amenable cause relative to those with the most comprehensive cover (i.e., those with a medical/GP visit card and PHI). As noted in Section 2, two classifications of amenable mortality are used, and for each classification, the analysis distinguishes between a 'conservative' definition (when conditions for which only 50 per cent of deaths can be considered amenable are all regarded as non-amenable) and an 'inclusive' definition (when conditions for which only 50 per cent of deaths can be considered amenable are all regarded as amenable). Table 4 presents the results. Regardless of the definition of amenable mortality employed, there is no statistically significant association between health insurance cover and risk of death from an amenable cause for those aged less than 75, although the SHRs have wide confidence intervals, reflecting the sample size. An examination of the unadjusted models (not shown here) reveals that, consistent with expectations, those with a medical/GP visit card only, or PHI only, or neither a medical/GP visit card nor PHI, have a significantly higher risk of mortality from an amenable cause relative to those with the most comprehensive cover (i.e., those with a medical/GP visit card and PHI). However, these estimates become statistically insignificant after full adjustment for other covariates.

3.2. Robustness Checks

To examine the robustness of these results, we run a number of additional analyses. First, for the analyses of all-cause and cause-specific mortality, we stratify the sample by age (age 50–69 vs. age 70+). This reflects the fact that most (but not all) over 70s will have either a medical or GP visit card, and thus it is expected that the main results will be driven largely by those aged 50–69. The results (in panel 1 of Table A8) suggest however that health insurance cover is not associated with all-cause mortality when the sample is restricted to those aged 50–69 years of age. This pat-

Table 4
Competing Risks Hazard Models of Amenable Mortality (aged 50–74 sample).

	Eurostat/OECD (2019) 'inclusive'		Eurostat/OECD (2019) 'conservative'		Nolte and McKee (201) 'inclusive'		Nolte and McKee (2011) 'conservative'	
	SHR	95% CI	SHR	95% CI	SHR	95% CI	SHR	95% CI
Dual cover		ref		ref		ref		ref
Public health insurance cover OR	1.428	0.824 – 2.476	1.547	0.621 – 3.851	1.337	0.708 – 2.525	1.368	0.623 – 3.004
Private health insurance cover OR								
No additional cover								
N		5272		5272		5272		5272
N deaths		242		242		242		242
N deaths <75 considered amenable		77		23		63		33

* P<0.05 ** P<0.01 *** P<0.001
Results are presented for the fully adjusted models only. The adjusted model controls for sex, health insurance category, location, education, home ownership, smoking status, activity level, chronic disease status, CVD disease status, depression and polypharmacy (see Table A4 for variable definitions).
See Table A7 for full set adjusted results.

tern is repeated for the cause-specific mortality analyses (panel 1 in Table A9). These results likely reflect the fact that most (nearly 80 per cent of) deaths in the TILDA cohort occur after the age of 70, so the number of events is too small to identify robust findings when the sample is restricted to those below the age of 70.

Second, panel 2 in Tables A8 and A9, and panel 1 in Table A10, show the results of additional analyses where we redefine the health insurance cover variable. We aggregate the dual cover, public health insurance cover and private health insurance cover groups into a 'more comprehensive' health insurance group to examine whether the 'no additional cover' group differs from all those with 'more comprehensive' cover in terms of all-cause, cause-specific and amenable mortality risk. We find results that are consistent with the main analyses reported in Tables 2, 3 and 4.

Finally, as noted in Section 1, the broader concept of avoidable mortality has also been used to examine the performance of healthcare systems. While it encompasses elements of healthcare that are not directly related to healthcare access (and health insurance cover), such as public health interventions, and other non-health interventions (e.g., road safety measures), we ran an additional analysis of the effect of health insurance cover on avoidable mortality risk (using the classification of ICD-10 codes employed by [23]). Approximately two-thirds of deaths in the TILDA cohort can be classified as avoidable, and the results indicate that, in comparison with the 'dual cover' group, those with PHI have a significant lower risk of avoidable mortality before the age of 75 (see Table A11). Previous research in the Irish context has found that those with PHI are more likely to avail of cancer screening services [36], i.e., primary interventions which may prevent avoidable deaths.

4. Discussion

While an important objective of public health insurance is to provide protection against large and unexpected health expenses, ultimately equitable access to appropriate health care at minimal cost is designed to improve population health. The Irish system, with a complex mix of public and private financing of healthcare services, offers a useful case study for an examination of the impact of health insurance cover on an important aspect of population health, i.e., mortality. This analysis, using matched data from the Irish Longitudinal Study on Ageing and administrative death certificates over an eight year follow-up, has shown that health insurance cover is associated with all-cause mortality risk in the older Irish population. Specifically, those who must pay the full cost of GP and primary care and who do not have private health insurance ('no additional cover') have a significantly higher risk of mortality than those who receive free GP and primary care and have private health insurance (which enables them to receive faster access to elective hospital treatment) (the 'dual cover' or most comprehensive coverage group). Those with access to free GP and primary care, but who do not have PHI (the 'medical/GP visit card only' group), also face an elevated risk of premature mortality, as do those who have PHI only. In sensitivity analysis where the sample was stratified by age (under and over 70 years of age) however, the hazard ratio for 'no additional cover' was non-significant in the younger sample, although this likely reflects the small number of events (deaths) that occurred before the age of 70. The main results suggest that it is the combination of lack of PHI (which leads to much longer waiting times for elective hospital care [39]) and a lack of a medical/GP visit card (which leads to user fees for GP care, primary care and prescription medicines), that is associated with a higher risk of all-cause mortality in this cohort.

The results for cause-specific mortality were more ambiguous, in part due to the small numbers of deaths for the four ICD-10 chapters examined (cancer, heart, respiratory and other cause). The results show that those without a medical/GP card or PHI ('no additional cover') have a higher risk of mortality from cancer than those with a medical/GP visit card and PHI ('dual cover'). This is consistent with previous research in Ireland using TILDA that has shown that this group, those without a medical/GP visit card and PHI, were least likely to participate in screening for breast and prostate cancer [36]. Deaths from cancer accounted for the majority of deaths in the TILDA matched cohort [41], so it is perhaps unsurprising that less precise estimates are observed for the other three broad causes of death.

Finally, the research examined the determinants of deaths from causes considered amenable to healthcare for those aged less than 75 years of age. On a positive note, the number of deaths in this TILDA cohort that were considered amenable to healthcare intervention was small – ranging from 23 deaths (9.5 per cent) using the most conservative definition adopted by Eurostat/OECD to 77 (31.8 per cent), using the most inclusive definition adopted by Eurostat/OECD. This is consistent with broader trends across the EU where death rates from amenable causes have been falling steadily in recent decades, with Ireland experiencing amongst the fastest rates of decline, although this partly reflects its high starting point [17,21,42]. While the proportion of deaths that may be considered amenable is relatively low across the various definitions, the range highlights the difficulties in assigning causes of death to the amenable category, particularly in older age. Similar to the results for cause-specific mortality for the overall sample, there was no association identified between health insurance cover and amenable mortality risk, although again the sample sizes were small and the SHRs imprecisely estimated. However, health insurance is just one component of a suite of healthcare financing and delivery structures that can reduce the risk of death from causes considered amenable to healthcare intervention, with factors such diagnostic and therapeutic innovation and quality of care poten-

tially as or more important than access *per se* in explaining variation in amenable death rates across a population [22]. Indeed, a recent analysis of amenable mortality in Mexico found that state-level healthcare infrastructure, in the form of a higher density of GPs and specialist physicians, was associated with lower rates of amenable mortality [48].

These results need to be interpreted in the context of the various strengths and weaknesses of this type of analysis. Any analysis of cause-specific and amenable mortality is dependant on the accuracy of the coding of cause of death on death certificates. Systematic differences in how physicians record cause of death on death certificates and in how these causes are coded have been well documented in previous research [41]. However, the use of four broad ICD-10 chapters and varying definitions of amenable mortality should mitigate these concerns to some extent for this analysis. Ideally, a larger sample size and longer follow-up period would be available to confirm whether health insurance has no effect on amenable or non-cancer mortality; the results for amenable mortality in particular were imprecisely estimated with large confidence intervals. This analysis cannot make any inferences about the causality of the associations uncovered. While a comprehensive set of demographic, socioeconomic and health status variables have been included in the fully adjusted models, it is still possible that there are further unobserved factors associated with lack of insurance that explain the associations identified. Furthermore, insurance cover is measured at baseline and therefore subsequent movements between the different insurance categories are not taken into account. Future work should investigate whether there is a dose-response relationship between insurance cover and mortality risk in this cohort.

In terms of strengths, the availability of linked survey-administrative data for a nationally representative cohort of the community-dwelling population aged 50+ allowed for an examination of cause-specific and amenable, as well as all-cause mortality. In addition, the rich characterisation of this cohort in terms of demographic, socioeconomic and health characteristics allowed us to adjust our estimates for a variety of important confounders. The interaction between public and private financing in the Irish healthcare system also allowed us to examine the complex ways in which differential access to GP, primary and secondary care services in the Irish system impact on mortality risk. This provided evidence for a country other than the US, which has been the focus of much of the existing research literature, and for a country that is contemplating reforms to its financing and delivery structures in order to move towards a system of universal healthcare.

5. Conclusions and policy implications

In this paper, we investigated the extent to which type of health insurance cover is associated with all-cause, cause-specific, and amenable mortality using data on a representative survey of the population aged 50+ from the Irish Longitudinal Study on Ageing (TILDA) matched to administrative data on death registrations. The results show that those without public or private health insurance have a higher risk of all-cause and cancer mortality, but there is no evidence that type of health insurance cover affects mortality risk from causes that are considered amenable to healthcare intervention, although caution must be exercised in drawing conclusions from the analyses of amenable mortality due to small sample sizes. For all-cause and cancer mortality, those who must pay the full cost of GP and primary care and who do not have private health insurance ('no additional cover') have a significantly higher risk of mortality than those who receive free GP and primary care and have private health insurance (which enables them to receive faster access to elective hospital treatment) (the 'dual cover' or most comprehensive coverage group). This suggests that it is the combination of lack of PHI (which leads to much longer waiting times for elective hospital care [36]) and a lack of a medical/GP visit card (which leads to user fees for GP care, primary care and prescription medicines), that is associated with a higher risk of all-cause and cancer mortality in this cohort.

The results in this paper highlight the key role that timely access to hospital outpatient and inpatient care, in addition to free GP and primary care, plays in supporting population health. While the 2017 'Slaintecare' reform plan proposed the extension of free GP care to the entire population (on a phased basis, by 500,000 people per year over the first five years) [49], at present just over 40 per cent of the population have such access [28]. Sláintecare also proposed a target waiting time of 10 weeks for outpatient appointments and 12 weeks for day and in-patient treatment [49]. However, waiting lists and times for public hospital care have continued to increase in excess of these targets (and have been exacerbated by restrictions on activity during the COVID-19 pandemic) [50]. Without further progress in extending universal primary care, and reductions in waiting lists and times, inequities in premature mortality across health insurance coverage groups are likely to persist.

Funding

This research was funded by the Health Research Board under grant number ILP-PHR-2017–022. The authors thank the General Register Office for facilitating linkage of death certificate information to TILDA, and the Central Statistics Office for assistance with ICD-10 mortality coding.

Declarations of Competing Interest

None.

References

[1] Evetovits T, Figueras J, Jowett M, Mladovsky P, Nolan A, Normand C, et al. Health system responses to financial pressures in Ireland: policy options in an international context 2012.
[2] Bank WHO/World. Tracking universal health coverage. 2017 Global Monitoring Report Geneva: WHO; 2017.
[3] Chen L, Yip W, Chang M, Lin H, Lee S, Chiu Y, et al. The effects of Taiwan's National Health Insurance on access and health status of the elderly. Health Econ 2007;16:223–42. doi:10.1002/hec.1160.
[4] Gruber J, Sommers B. The Affordable Care Act's Effects on Patients, Providers and the Economy: What We've Learned So Far. J Policy Anal Manage 2019;38:1028–52. doi:10.1002/pam.22158.
[5] Yu H. Universal health insurance coverage for 1.3 billion people: What accounts for China's success? Health Policy 2015;119:1145–52. doi:10.1016/j.healthpol.2015.07.008.
[6] Burke S, Barry S, Siersbaek R, Johnston B, Ní Fhallúin M, Thomas S. Sláintecare – A ten-year plan to achieve universal healthcare in Ireland. Health Policy 2018;122:1278–82. doi:10.1016/j.healthpol.2018.05.006.
[7] Connolly S, Wren M. Universal Health Care in Ireland—What Are the Prospects for Reform? Health Systems & Reform 2019;5:94–9. doi:10.1080/23288604.2018.1551700.
[8] McGovern L, Miller G, Hughes-Cromwrick P. Contribution of Multiple Determinants to Health Outcomes. Health Aff 2014:1–9.
[9] Holland W, Fitzgerald A, Hildrey S, Phillips S. Heaven can wait. Journal of Public Health 1994;16:321–30. doi:10.1093/oxfordjournals.pubmed.a042992.
[10] Baker D, Sudano J, Durazo-Arvizu R, Feinglass J, Witt W, Thompson J. Health Insurance Coverage and the Risk of Decline in Overall Health and Death among the near Elderly, 1992-2002. Med Care 2006;44:277–82.
[11] Kronick R. Health insurance coverage and mortality revisited. Health Serv Res 2009;44:1211–31. doi:10.1111/j.1475-6773.2009.00973.x.
[12] McWilliams J, Zaslavsky A, Meara E, Ayanian J. Health Insurance Coverage And Mortality Among The Near-Elderly. Health Aff 2004;23:223–33. doi:10.1377/hlthaff.23.4.223.
[13] Miller S, Altekruse S, Johnson N, Wherry L. Medicaid and mortality: new evidence from linked survey and administrative data. NBER Working Paper; 2019. p. 26081.
[14] Sommers B, Long S, Baicker K. Changes in Mortality After Massachusetts Health Care Reform. Ann Intern Med 2014;160:585–93. doi:10.7326/M13-2275.
[15] Swaminathan S, Sommers B, Thorsness R, Mehrotra R, Lee Y, Trivedi A. Association of Medicaid Expansion With 1-Year Mortality Among Patients With End-Stage Renal Disease. JAMA 2018;320:2242–50. doi:10.1001/jama.2018.16504.

[16] Rutstein D, Berenberg W, Chalmers T, Child C, Fishman A, Perrin E, et al. Measuring the Quality of Medical Care. N Engl J Med 1976;294:582–8. doi:10.1056/NEJM197603112941104.
[17] Karanikolos M, Mackenbach JP, Nolte E, Stuckler D, McKee M. Amenable mortality in the EU—has the crisis changed its course? Eur J Public Health 2018;28:864–9. doi:10.1093/eurpub/cky116.
[18] OECD Health at a glance 2019. Paris: OECD; 2019.
[19] Mackenbach J, Hu Y, Artnik B, Bopp M, Costa G, Kalediene R, et al. Trends In Inequalities In Mortality Amenable To Health Care In 17 European Countries. Health Aff 2017;36:1110–18. doi:10.1377/hlthaff.2016.1674.
[20] Ward M, May P, Normand C, Kenny R, Nolan A. Comparing Underlying and Contributory Cause of Death in Registry Data With End-of-Life Proxy Interviews: Findings From The Irish Longitudinal Study on Ageing (TILDA). J Appl Gerontol 2020:0733464820935295. doi:10.1177/0733464820935295.
[21] Weber A, Clerc M. Deaths amenable to health care: Converging trends in the EU? Health Policy 2017;121:644–52. doi:10.1016/j.healthpol.2017.03.017.
[22] Nolte E, McKee M. In Amenable Mortality—Deaths Avoidable Through Health Care—Progress In The US Lags That Of Three European Countries. Health Aff 2012;31:2114–22. doi:10.1377/hlthaff.2011.0851.
[23] OECD, Eurostat Avoidable mortality: OECD/Eurostat lists of preventable and treatable causes of death (November 2019 version); 2019.
[24] Kossarova L, Holland W, Mossialos E. Avoidable' mortality: a measure of health system performance in the Czech Republic and Slovakia between 1971 and 2008. Health Policy Plan 2013;28:508–25. doi:10.1093/heapol/czs093.
[25] OECD Health at a glance: europe. Paris: OECD; 2021.
[26] CSO System of health accounts 2019. Dublin: CSO; 2021.
[27] Kringos D, Boerma W, Bourgueil Y, Cartier T, Dedeu T, Hasvold T, et al. The strength of primary care in Europe: an international comparative study. Br J Gen Pract 2013;63 e742–50. doi:10.3399/bjgp13X674422.
[28] PCRS Statistical analysis of claims and payments 2019. Dublin: Primary Care Reimbursement Service; 2020.
[29] Health Insurance Authority Market figures december 2020. Dublin: Health Insurance Authority; 2020.
[30] Turner B, Smith SE. Uncovering the complex role of private health insurance in ireland. private health insurance: history, politics and performance. Copenhagen: WHO Regional Office for Europe; 2020.
[31] Hudson E, Nolan A. Public healthcare eligibility and the utilisation of GP services by older people in Ireland. The Journal of the Economics of Ageing 2015;6:24–43. doi:10.1016/j.jeoa.2014.08.005.
[32] Layte R, Nolan A. Eligibility for free GP care and the utilisation of GP services by children in Ireland. International Journal of Health Economics and Management 2014:1–25. doi:10.1007/s10754-014-9156-7.
[33] Ma Y, Nolan A. Public Healthcare Entitlements and Healthcare Utilisation among the Older Population in Ireland. Health Econ 2017;26:1412–28. doi:10.1002/hec.3429.
[34] Madden D, Nolan A, Nolan B. GP Reimbursement and Visiting Behaviour in Ireland. Health Econ 2005;14:1047–60.
[35] Mc Hugh S, Browne J, O'Neill C, Kearney P. The influence of partial public reimbursement on vaccination uptake in the older population: a cross-sectional study. BMC Public Health 2015;15:1–7. doi:10.1186/s12889-015-1356-7.
[36] Connolly S, Whyte R. Uptake of cancer screening services among middle and older ages in Ireland: the role of healthcare eligibility. Public Health 2019;173:42–7. doi:10.1016/j.puhe.2019.05.025.
[37] Moran P. A review of private health insurance in ireland. Dublin: Health Insurance Authority; 2020.
[38] Watson D, Williams J. Perceptions of the quality of health care in the public and private sectors in ireland; 2001.
[39] Whyte R, Connolly S, Wren M. Insurance status and waiting times for hospital-based services in Ireland. Health Policy 2020. doi:10.1016/j.healthpol.2020.07.001.
[40] United Nations Handbook of vital statistics systems and methods volume 1. LegalGeneva: UN: organizational and technical aspects; 1991.
[41] Ward M, May P, Briggs R, McNicholas T, Normand C, Kenny R, et al. Linking death registration and survey data: Procedures and cohort profile for The Irish Longitudinal Study on Ageing [version 1; peer review: 2 approved, 1 approved with reservations]. HRB Open Research 2020;3. doi:10.12688/hrbopenres.13083.1.
[42] Nolte E, McKee M. Measuring The Health Of Nations: Updating An Earlier Analysis. Health Aff 2008;27:58–71. doi:10.1377/hlthaff.27.1.58.
[43] Nolte E, McKee M. Variations in amenable mortality - trends in 16 high-income nations. Health Policy 2011;103:47–52. doi:10.1016/j.healthpol.2011.08.002.
[44] Fine J, Gray RA. Proportional Hazards Model for the Subdistribution of a Competing Risk. J Am Statist Assoc 1999;94:496–509. doi:10.2307/2670170.
[45] Dignam J, Zhang Q, Kocherginsky M. The use and interpretation of competing risks regression models. Clin Cancer Res 2012;18:2301–8. doi:10.1158/1078-0432.CCR-11-2097.
[46] Donoghue OA, McGarrigle CA, Foley M, Fagan A, Meaney J, Kenny RA. Cohort Profile Update: The Irish Longitudinal Study on Ageing (TILDA). Int J Epidemiol 2018;47 1398–1398l. doi:10.1093/ije/dyy163.
[47] Kearney P, Cronin H, O'Regan C, Kamiya Y, Savva G, Whelan B, et al. Cohort Profile: The Irish Longitudinal Study on Ageing. Int J Epidemiol 2011;40:877–84. doi:10.1093/ije/dyr116.
[48] Nikoloski Z, Albala S, Montero A, Mossialos E. The impact of primary health care and specialist physician supply on amenable mortality in Mexico (2000–2015): Panel data analysis using system-Generalized Method of Moments. Soc Sci Med 2021;278:113937. doi:10.1016/j.socscimed.2021.113937.
[49] Houses of the Oireachtas Committee on the future of healthcare sláintecare. Dublin: Stationery Office; 2017.
[50] Brick A, Keegan C. Paying morre to wait less: estimating the cost of reducing ireland's public hospital waiting lists. Dublin: Economic and Social Research Institute; 2020.