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The influence of geographical access to health care and material deprivation on colorectal cancer survival: Evidence from France and England

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ABSTRACT

This article investigates the influence of distance to health care and material deprivation on cancer survival for patients diagnosed with a colorectal cancer between 1997 and 2004 in France and England. This population-based study included all cases of colorectal cancer diagnosed between 1997 and 2004 in 3 cancer registries in France and 1 cancer registry in England (N=40,613).

After adjustment for material deprivation, travel times in England were no longer significantly associated with survival. In France patients living between 20 and 90 min from the nearest cancer unit tended to have a poorer survival, although this was not statistically significant.

In England, the better prognosis observed for remote patients can be explained by associations with material deprivation; distance to health services alone did not affect survival whilst material deprivation level had a major influence, with lower survival for patients living in deprived areas. Increases in travel times to health services in France were associated with poorer survival rates. The pattern of this influence seems to follow an inverse U distribution, i.e. maximal for average travel times.

1. Introduction

Colorectal cancer survival differs notably between France and England. The EUROCARE 4 study estimated the age-adjusted 5-year survival at 51.8% in England and 59.9% in France for patients diagnosed with a colorectal cancer in 2000–2002 (Verdecchia et al., 2007). The reasons behind lower survival in England are not well known, but potential explanations include the higher number of deaths in older patients, higher co-morbidity prevalences and differences in management (Dejardin et al., 2013).

Large inequalities in cancer survival have been consistently identified in relation to socioeconomic deprivation in both France (Dejardin et al., 2006) and England (Coleman et al., 2004; Woods et al., 2006). Indeed it has been estimated that a reduction in social inequalities in cancer survival in England could prevent more than 7000 cancer deaths in England annually (Ellis et al., 2012). Although later stage at diagnosis amongst more deprived patients in both countries may represent one potentially attractive explanation for the disparities observed, the observed deprivation gap in survival may also be associated with drivers such as sub-optimal treatment provision, patient lifestyles, and other factors associated with the provision of health care services (Woods et al., 2006).

In response to research evidence indicating a relationship between material deprivation and cancer survival, considerable efforts have been made to tackle deprivation related inequalities in survival (Mackenbach et al., 2003).

For example National cancer plans, the first of which was published in 2000 in England and 2002 in France, include some specific components relating to material deprivation and cancer control and prevention efforts. These include multidisciplinary team meetings for all patients; efforts to ensure early detection in all population groups; funds for research interventions dedicated to tackle social disparities in France around use of patient

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navigator programmes; and efforts for early detection, screening and optimal treatment in England such as actions to encourage smoking cessation in deprived areas, to encourage walking and cycling, particularly in deprived areas, and funding opportunities to develop palliative care for socially deprived groups.

Geographical inequalities are known to vary according to the type of health care organization. For example, in Scotland, a longer distance to hospital was associated with a higher probability of being diagnosed with colorectal cancer at time of death (Campbell et al., 2000) but was not significantly associated with survival in either Scotland or the North of England (Jones et al., 2008b). Yet research in other settings has shown strong associations with survival, including studies from France (Dejardin et al., 2008), the United States (US) (Henry et al., 2009; Huang et al., 2007) and Australia (Baade et al., 2011).

The putative mechanisms of how geographical factors impact cancer survival are complex and multidimensional (Meilleur et al., 2013). One potential explanation is the effect of travel times on patients' likelihood to seek care, and the consequent impact of this on stage at diagnosis. However, this relationship is unclear since some publications report an association (Campbell et al., 2001; Huang et al., 2009) whilst others do not (Haynes et al., 2008; Henry et al., 2013; Koka et al., 2002). Some publications have also reported that patients living far from treatments centres receive sub-optimal treatments (Crawford et al., 2009; Dejardin et al., 2008), although such findings are not universal (Campbell et al., 2002; Jones et al., 2008a). Another potential factor is specific to the French health care system, which is based on patients being able to choose freely the hospital they wish to go to. Whilst this means that all patients theoretically have access to specialized care, free hospital choice combined with high preference for proximity (Bouche et al., 2008) could mean that some patients miss out on the best possible treatment.

Population-based cancer registries offer an attractive way to investigate the effect of geographical differences in access to health care on cancer outcomes. Since the influence of such geographical inequalities may be partially mediated by the stage at diagnosis, it is crucial to control for stage at diagnosis. Population-based cancer registries also ensure the completeness of cases in the study areas.

The aim of this article was to investigate the influence of distance to health care and material deprivation on cancer survival for patients diagnosed with a colorectal cancer between 1997 and 2004 in France and England.

2. Materials and methods

2.1. Population

This study included all cases of colorectal cancer (C18.0–C20.9) (ICDO-3) (Fritz et al., 2000) diagnosed between 1997 and 2004 (follow-up to 31/12/2007) in 3 cancer registries in France (Calvados, Côte d'Or and Saone et Loire, 3% the whole national population) and 1 cancer registry in England (Northern and Yorkshire Region), which covers 13.3% of England ($N=40{,}613$) (Table 1). Patients with secondary cancer and patients under 15 years old were excluded. The methods of this study have been previously published elsewhere (Dejardin et al., 2013)

2.2. Variables

Age, sex and cancer site (ICDO-3) (Fritz et al., 2000) were collected by the cancer registries. Survival time was defined as difference between date of diagnosis and date of last contact for vital status. Only 2.38% of patients were lost to follow-up in France (end of follow-up 31/1/2008), with none lost in England. The number of 0-day survival patients was 18 in France and 946 in England (included in survival analysis with 1 day survival). Stage was coded using Duke's classification: Duke's A: Limited to mucosa; Duke's B: Penetrating through muscularis propria; Duke's C: lymph nodes involved; "Duke's D": at least one metastasis.

Cancer registry records were integrated with geographical measures of population material deprivation based on the location of patients at the time of diagnosis. The geographical units used were Lower Super Output Areas (LSOAs) in England (minimum population 296/maximum population 14,689; mean population 1620; http://www.ons.gov.uk/) and "Ilôt Regroupé pour l'Information Statistique" (IRIS) units in France (minimum population 0[1]/maximum population 9618; mean population 2000; http://www.insee.fr/fr/methodes).

To examine the association between survival and area deprivation, the Townsend index of material deprivation was computed for each IRIS in France and each LSOA in England. The Townsend index scores are generated from census based measures of unemployment (as a percentage of those aged 16 and over who are economically active); non-car ownership (as a percentage of all households); non-home ownership (as a percentage of all households); and household overcrowding. To assist with comparison across the two countries, this index was analysed by using categories based on national quintiles.

Three different measures of travel-times were used. These were travel time between the residential location of patients at the time of diagnosis and the nearest cancer centre, the nearest hospital, and the nearest radiotherapy unit. These travel times were estimated using a Geographical Information System (ArcGIS in England and MAPINFO for France) combined with a road-map database (Multinet TéléAtlas for France and Ordnance Survey Meridian data in England). Travel speeds, computed in minutes, were estimated according to legal speeds for the different road classes.

Travel times to the nearest hospital include only those hospitals that had a colorectal cancer team. These were selected as they have previously been investigated in international publications and should be considered as measure of potential access to health care (Campbell et al., 2000; Dejardin et al., 2008; Jones et al., 2008b). For the purposes of analysis, travel time was categorized based on 5 categories (0–5; 6–20; 21–40; 41–90; +91 for travel time to the nearest cancer centre and travel time to the nearest radiotherapy unit and 0–5; 6–10; 11–15; 16–40; +41 for travel time to the nearest hospital). Categories were defined by using knots (four knots) of restricted cubic splines (mkspline and xblc stata command).

2.3. Statistical analysis

To examine associations between material deprivation, access and cancer survival in the two countries, multivariate excess hazard models based on a generalized linear model with Poisson error (Dickman et al., 2004) were used. Such models estimate the excess hazard of death experienced by the cancer patients, i.e. the mortality hazard in excess to the mortality hazard observed in the general population with similar characteristics ("background or expected hazard"). Background hazard of death is provided by life tables. Causes of death are not available in French or English registries. In the absence of this information, cancer survival is commonly estimated by a relative survival approach that removes from the observed all-cause mortality the expected "background" mortality. Background mortality was provided by life tables

[1] Six communes (=IRIS) were designated as "dead for France" during WW1.