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Social and geographical factors affecting access to treatment of colorectal cancer: a cancer registry study

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ABSTRACT

Objective: Cancer outcomes vary between and within countries with patients from deprived backgrounds known to have inferior survival. The authors set out to explore the effect of deprivation in relation to the accessibility of hospitals offering diagnostic and therapeutic services on stage at presentation and receipt of treatment.

Design: Analysis of a Cancer Registry Database. Data included stage and treatment details from the first 6 months. The socioeconomic status of the immediate area of residence and the travel time from home to hospital was derived from the postcode.

Setting: Population-based study of patients resident in a large area in the north of England.

Participants: 39 619 patients with colorectal cancer diagnosed between 1994 and 2002.

Outcomes measured: Stage of diagnosis and receipt of treatment in relation to deprivation and distance from hospital.

Results: Patients in the most deprived quartile were significantly more likely to be diagnosed at stage 4 for rectal cancer (OR 1.516, $p<0.05$) but less so for colonic cancer. There was a trend for both sites for patients in the most deprived quartile to be less likely to receive chemotherapy for stage 4 disease. Patients with colonic cancer were very significantly less likely to receive any treatment if they came from any but the most affluent area (ORs 0.639, 0.603 and 0.544 in increasingly deprived quartiles), this may have been exacerbated if the hospital was distant from their residence (OR for forth quartile for both travel and deprivation 0.731, not significant). The effect was less for rectal cancer and no effect of distance was seen.

Conclusions: Residing in a deprived area is associated with tendencies to higher stage at diagnosis and especially in the case of colonic cancer to reduced receipt of treatment. These observations are consistent with other findings and indicate that access to diagnosis requires further investigation.

ARTICLE SUMMARY

Article focus

There is evidence that the poorer survival of British patients' with bowel cancer is related to more advanced stage than in similar countries.

- Is this related to the environment in which people live?
- Are there differences in this regard between colonic and rectal cancer?

Key messages

Residing in a deprived area is associated with:

- tendencies to higher stage at diagnosis.
- especially in the case of colonic cancer with reduced receipt of treatment.

Strengths and limitations of this study

- A cancer registry study looks at the whole population of a defined area and so does not depend on access to specific institutions.
- A large number of patients have been studied.
- The patients analysed were diagnosed some years ago.
- Deprivation indices relate to area of residence rather than to individuals.
- This is a cross-sectional study so inferences of causality must be cautious.

Access to treatment for cancer has been the subject of detailed policy within the National Health Service over the past 15 years. This has been stimulated by comparative studies which show that survival from cancer within the UK is inferior to that in comparable economies within Europe[1] and beyond.[2] This is particularly true of colonic cancer but much less so for rectal cancer. A 'high-resolution' study in which more detailed information about each patient was analysed than is the case for the main analysis was undertaken as part of the EUROCARE Project. This suggested that the discrepancy for colonic cancer could be ascribed to later stage at presentation.[3]

In Scotland, an association between reduced survival and rural residence attributable to more advanced stage at diagnosis has previously been reported[4] and patients with colorectal cancer are less likely to receive radiotherapy if they live in a rural area.[5] In New Zealand, both living in

a deprived area of residence and at increased distance from a cancer centre have been associated with reduced survival.[6]

We have conducted a large study using data from the Northern and Yorkshire Cancer Registry and Information Service (NYCRIS) for patients diagnosed with common epithelial cancers in the period 1994–2002. In this, we explored the relationship between measures of access to transport and medical services and disease-related outcomes. For all primary sites studied, it was shown that, after controlling for age, sex and socioeconomic deprivation, the likelihood of receiving radiotherapy was reduced with increasing travel time to the nearest radiotherapy hospital, and rectal cancer patients were less likely to receive chemotherapy if they lived distant from a hospital providing this treatment.[7] Late stage of colorectal cancer at diagnosis was associated with greater travel time to the general practitioner, living in a rural location and in one without access to community transport.[8]

In this paper, we have investigated the possible joint effect of deprivation and rural inaccessibility on the stage of presentation and receipt of active treatment for colorectal cancer patients in our study. Building on our previous findings, we test whether distance to diagnostic treatment hospitals may interact with area socioeconomic deprivation to amply the disadvantage of those living furthest from hospital and in the most deprived areas.

PATIENTS AND METHODS

The process of developing a database appropriate for geographical analyses from the Registry records has been described in detail elsewhere.[4] Briefly, for the purpose of this analysis, we assembled a database of all patients registered with cancer of the colon or rectum held by the NYCRIS during the period 1994–2002. This database included the treatment or treatments delivered in the period up to 6 months, but usually shorter, following diagnosis.

Car travel times from the patient's residence to healthcare providers were estimated in a geographical information system (ArcGIS 9.2) using the shortest road route and average driving speeds along specific classes of road. An independent survey of 475 patients attending cancer clinics in the same study area had already established that 87% of patients made the journey by car and that travel estimates based on the road network and average speeds were closely related to actual car journey times reported by patients.[9]

Deprivation was determined from the Index of Multiple Deprivation, an area-level measure associated with the postcode.[10] We removed the access to services domain from the Index of Multiple Deprivation scores so as to eliminate the potential of double counting. Patients were divided into equal quartiles for deprivation and for travel time to the closest hospital providing diagnostic access. Patients were allocated to deprivation quartiles on the basis of socioeconomic deprivation in their area of residence and travel quartiles on the basis of distance of residence from the closest hospital providing diagnostic and surgical treatment services for bowel cancer.

Statistical analyses were carried out using the SPSS V.16 software package. ORs were calculated for the stage distribution at presentation and for the receipt of treatment. Logistic regression models were fitted to determine how the covariates of hospital travel time and deprivation quartile were associated with the likelihood of receiving treatment or being diagnosed at late stage. For all models, ORs were estimated across the quartiles of both deprivation and travel time, with the least deprived and shortest travel time groups forming the respective reference categories. To test for synergies between quartiles of deprivation and travel time, interactions between the two categorical variables were fitted. In the results tables, ORs from the interactions are presented for each matching quartile category (ie, quartile 2 of deprivation by quartile 2 of travel time). The reference category for these interactions was quartile 1 by quartile 1 of each variable. As age and male sex had an adverse effect for all the variables that were studied, all ORs were adjusted for these covariates. In addition, all ORs for the receipt of treatment were adjusted for tumour stage.

RESULTS

During the time period studied, there were 39 619 colorectal tumours recorded by NYCRIS. From this, information on residential location was available for 11 406 rectal tumours and 16 850 colon, making a data set of potential 28 256 records for analysis (71.3% of the total records). From these, data on stage at diagnosis were available for 7058 of the rectal cancers (62% completeness) and 11 163 of the colon cancers (66% completeness). The mean age of patients was 70.3 years (SE 0.11) and 61.5% were men. Mean drive time to the nearest hospital was estimated to be 14 min (SE 0.09) with the longest estimate being 1.5 hr.

Stage at presentation

Table 1 shows that patients with carcinoma of the rectum who were in the most deprived quartile (n=2939 patients) were significantly more likely to present at stage 4 than at earlier stages. This relationship was weaker and less consistent for colonic cancer. There was no effect of distance on this observation for either tumour site and no evidence of an interaction between the two factors.

Treatment

We calculated the odds of receiving any surgical, radiotherapy or chemotherapy treatment, adjusted to account for the effects of age, sex and stage at presentation. Among those with rectal cancer (table 2), there was

Table 1 ORs (adjusted for age and sex) of being diagnosed at stage 4 rather than stages 1–3 for rectal cancer and colonic cancer

	Main effect: travel	Main effect: deprivation	Interaction term: travel × deprivation
Rectal			
Quartile 1	1	1	1
Quartile 2	0.940 (0.616 to 1.433)	1.072 (0.716 to 1.605)	1.258 (0.739 to 2.140)
Quartile 3	1.314 (0.895 to 1.928)	1.319 (0.900 to 1.932)	0.754 (0.465 to 1.223)
Quartile 4	1.172 (0.819 to 1.677)	1.516* (1.053 to 2.182)	0.868 (0.527 to 1.430)
Colonic			
Quartile 1	1	1	1
Quartile 2	0.938 (0.697 to 1.263)	1.156 (0.871 to 1.1535)	1.062 (0.725 to 1.555)
Quartile 3	0.993 (0.750 to 1.315)	1.334* (1.019 to 1.747)	0.997 (0.700 to 1.418)
Quartile 4	0.969 (0.750 to 1.252)	1.157 (0.892 to 1.501)	1.121 (0.770 to 1.633)

*p<0.05, 95% CIs shown.

a tendency for patients to be less likely to receive any active treatment with increasing deprivation of their area of residence, but there was no evidence that increasing distance reduced the likelihood of treatment. There was a strong tendency among patients with colonic cancer residing among the two most deprived quartiles (n=8425) to be significantly less likely to receive treatment (table 2). Although those outside the most proximal quartile were less likely to receive any treatment, these differences did not reach statistical significance and there was again no evidence of an interaction between deprivation and travel time.

When the analysis was made for receiving chemotherapy for stage 4 cancer (table 3), colonic patients living in the most deprived quartile were less than half as likely to receive the treatment. The trend with deprivation did not reach statistical significance for rectal cancer, and there were no associations with travel and nor any evidence of interactions. Overall, the impression is that there is a disadvantage for the quartile of society residing in the most deprived areas with no real effect of distance of residence from the treating hospital.

DISCUSSION

We have demonstrated a difference between colonic cancer and rectal cancer in the proportion of patients from socioeconomically deprived localities of residence receiving any treatment. Colorectal cancer is usually considered as one entity when considering how diagnostic services work, but there is a developing body of evidence that points to a difference between them.

Recent studies addressing the presentation of colorectal cancer have emphasised that features such as rectal bleeding and microcytic anaemia <10 g/dl identify a minority of patients.[11] However, Stapley *et al*[12] found that while presentation with an alarm symptom such as rectal bleeding is associated with earlier stage, presentation with mild anaemia (10–12.9 g/dl), which is likely not to cause symptoms prompting the patient to seek advice, is associated with more advanced stage and worse survival. Symptoms are otherwise non-specific: weight loss, abdominal pain and altered bowel habit. In this study, which avoided recall bias by using primary care records, increasing duration of these was not associated with advancing stage.

Table 2 ORs of receiving any treatment (adjusted for age, sex and stage) for rectal and colonic cancer

	Main effect: travel	Main effect: deprivation	Interaction term: travel × deprivation
Rectal			
Quartile 1	1	1	1
Quartile 2	0.900 (0.547 to 1.482)	0.867 (0.539 to 1.393)	0.898 (0.486 to 1.661)
Quartile 3	0.863 (0.534 to 1.396)	0.712 (0.453 to 1.118)	1.158 (0.646 to 2.075)
Quartile 4	0.987 (0.634 to 1.538)	0.544** (0.343 to 0.838)	1.394 (0.762 to 2.548)
Colonic			
Quartile 1	1	1	1
Quartile 2	0.825 (0.559 to 1.216)	0.639* (0.445 to 0.917)	1.476 (0.913 to 2.386)
Quartile 3	0.757 (0.525 to 1.091)	0.603** (0.425 to 0.854)	1.324 (0.847 to 2.068)
Quartile 4	0.810 (0.577 to 1.137)	0.544** (0.390 to 0.760)	0.731 (0.451 to 1.159)

*p<0.05, **p<0.01, 95% CIs shown.

Table 3 ORs of receiving chemotherapy (adjusted for age and sex) for stage 4 rectal cancer and colonic cancer

	Main effect: travel	Main effect: deprivation	Interaction term: travel × deprivation
Rectal			
Quartile 1	1	1	1
Quartile 2	0.702 (0.299 to 1.647)	1.037 (0.463 to 2.319)	1.304 (0.452 to 3.764)
Quartile 3	0.858 (0.402 to 1.833)	0.821 (0.386 to 1.745)	1.143 (0.443 to 3.375)
Quartile 4	1.058 (0.521 to 2.149)	0.732 (0.357 to 1.499)	1.080 (0.416 to 2.806)
Colonic			
Quartile 1	1	1	1
Quartile 2	1.310 (0.730 to 2.352)	0.815 (0.465 to 1.429)	0.973 (0.461 to 2.056)
Quartile 3	0.941 (0.540 to 1.639)	0.776 (0.455 to 1.321)	0.991 (0.496 to 1.981)
Quartile 4	1.024 (0.617 to 1.697)	0.454** (0.268 to 0.768)	1.097 (0.521 to 2.314)

**p<0.01, 95% CIs shown.

In a meta-analysis, a weak association of longer delay and increased survival in colonic cancer was found.[13] This was identifiable only after many studies were excluded for various reasons. In a further analysis, the same authors showed that there is a tendency for longer duration of symptoms to be associated with higher stage in rectal cancer but lower stage in colonic lesions.[14] This fits with the concept that colonic cancers cause few major symptoms until the flow of faecal matter is impeded by an advanced lesion, whereas prompt diagnosis following bleeding from rectal cancers permits successful intervention. This interpretation is supported by evidence from Denmark, a country with reliance on primary care, which is similar to that in the UK. In the presence of alarm symptoms, survival was shown to decrease with their duration before diagnosis with a trend to the converse for vague symptoms.[15]

A difference between colonic and rectal cancer, which is consistent with the concept of colonic cancer presenting later has been described by Møller *et al*.[16] The difference in death rates of patients both with colonic and with rectal cancer was greatest in the first month after diagnosis, more so for colonic cancer. It was markedly greater in the deprived groups as well as being strongly related to age. This is entirely consistent with our finding that patients from deprived areas are more likely to have no active treatment, a phenomenon that is stronger for colonic cancer. However, when death rates in excess of what is expected in the population occurring after the first month are considered, the disadvantage for those from a deprived background as well as older people persists up to 2 years and is stronger for rectal cancer.[16] Our finding that for rectal cancer, there is a greater likelihood of being diagnosed at stage 4 associated with deprivation is entirely consistent with this, reduced likelihood survival to 2 years being associated with the visceral metastases that define this stage. Both tumour sites exhibit a minor trend against the most deprived patients with stage 4 disease receiving chemotherapy. It is most likely that this relates to patients being too ill to be treated and as such adds detail to the observations in table 2.

This analysis of observations in colorectal cancer follows the one previously reported in lung cancer.[17] They differ in that the NYCRIS Database holds adequate staging information for bowel tumours but not for lung cancer, whereas in the latter tumour site, attainment of a histological diagnosis is a variable that reflects diagnostic activity. The colorectal cancer results show consistent effects of deprivation, but the effect of distance of residence from the diagnosing facility that we saw in lung cancer was not significant in this study.

There are consistent effects that apply to the patients living in the more deprived areas which indicate that in planning the development of services, it is the needs of these patients that should be paramount; it seems that the better off are more able to find their own way through the system. This is supported by the finding that patients from deprived backgrounds are more likely to be admitted to hospital as an emergency[18] and indeed to have their first inpatient episode for this diagnosis as an emergency admission.[19] On the other hand, increased demand for diagnostic services will mean that the costs of investigation of patients who turn out not to have cancer will increase. They already, it is estimated, account for 35% of the cost of managing colorectal cancer.[20]

However, the existence of such differences suggests that there is an avoidable cause for them. It is possible that people may experience symptoms without recognising that they signify anything of importance; therefore, the duration is not recalled and the primary care physician's advice is not sought. Encouraging early results have been obtained from one study of measures to promote understanding of early symptoms in deprived communities.[21] To do this requires proactive approaches to people in such circumstances because deprived people are not necessarily aware that they have disadvantages in receiving healthcare.[22] These cancer sites share the fact that presenting symptoms are ambiguous.

There are a number of caveats to our findings. In order to be comparable to previous work among this cohort, the analysis was based on data for patients

diagnosed between 1994 and 2002, a period up to almost a decade ago. In our data set, staging was available for 64.5% of records. In 2009, this figure stood at 65.1% so there has been no significant improvement in staging since then.[23] Furthermore, registration personnel collected data from NHS hospital records, a process that is not affected by any of the variables affecting access to care that we have studied. We therefore believe that there are unlikely to be biases associated with incomplete staging. Although pathways from primary care to diagnosis have not been addressed by any changes in practice since our patients were diagnosed, future studies will be need to determine if modifications to policy may alter the associations we observed.

Additional limitations include the fact that our study is cross sectional in nature and therefore we cannot determine if the associations we have observed are causal. Furthermore, the large number of statistical comparisons we have made raises the possibility that some associations may be due to chance. Our measure of deprivation was area rather than individual based and we relied on estimated rather than actual travel times to hospital, although these estimates have been found to be accurate in a previous validation study.[9] Nevertheless, a limitation of our analysis of associations with distance is that the most distant travel quartile includes a wide variety of circumstances: the outer suburbs of cities that host major cancer centres, towns that have no hospital and the furthest rural locations. In the future, it will be of interest to evaluate the deficiencies in access in each of these separately.

A new version of the UK Guidance on the diagnosis and management of colorectal cancer has recently been developed.[24] It has not addressed those points in the patient's pathway that precede referral to a gastrointestinal specialist; our work and other registry studies indicate that work needs to be done in this area. Timely diagnosis of cancer when symptoms are non-specific will require an increase in the number of patients with such symptoms undergoing investigation and therefore consuming more resources. These will especially need to be deployed in areas of deprivation.

CONCLUSIONS

Patients with large bowel cancer are less likely to receive a timely diagnosis and to receive active treatment if they live in a socioeconomically deprived locality. This finding is particularly strong for colonic cancer. These findings add to the evidence that colonic and rectal cancer differ in their presentation and that these differences affect the outcome. They support the view that patients in different circumstances differ in the way they are able to access diagnosis and treatment.

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Contributors MC proposed the study and drafted the manuscript. VS, RH and APJ acquired the data set and performed the statistical analyses. DF supervised the registry work. All authors contributed fully to the development of the manuscript and approved its final form.

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Competing interests None.

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