Title: - Do rural patients present later to their GPs with symptomatic colorectal cancer? A cross-sectional study

Running title: Travel time to GPs, rurality and cancer outcomes

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Abstract

Background: Several studies have reported a survival disadvantage for rural dwellers who develop colorectal cancer, but the underlying mechanisms remain obscure. Delayed presentation to general practitioners (GPs) maybe a contributory factor but evidence is lacking.

Aim: To examine the association between rurality and travel time on diagnosis and survival from colorectal cancer in a cohort from Northeast Scotland.

Design and setting: We used a database linking GP records to routine data for patients diagnosed between 1997/98, and followed up to 2011.

Method: Primary outcomes were alarm symptoms, emergency admissions, stage and survival. Travel time in minutes from patients to GP was estimated. Logistic and Cox regression were used to model outcomes. Interaction terms were used to determine if travelling time impacted differently on urban versus rural patients.

Results: Rural patients and patients travelling farther to the GP had better three-year survival. When the travel - outcomes association were explored using interaction terms, the associations differed between rural and urban areas. Longer travel in urban areas significantly reduced the odds of emergency admissions (OR 0.62, $p<0.05$), and increased survival (HR 0.75, $p<0.05$). Longer travel also increased the odds of presenting with alarm symptoms in urban areas, this was nearly significant (OR 1.34, $p=0.06$). Presence of alarm symptoms reduced the likelihood of emergency admissions (OR 0.36, $p<0.01$).

Conclusions: Living in a rural area, and travelling farther to GP in urban areas may reduce the likelihood of emergency admissions and poor survival. This may be related to how patients present with alarm symptoms.

Keywords: Geography, rurality, cancer symptoms, access, primary care, early diagnosis

How this fits in: Rural-urban differences in cancer survival have been observed in several countries, but the mechanisms to explain these differences are obscure. One possibility is that due to socio-cultural differences and poorer access to services, rural patients delay longer in presenting to their GP when they develop non-specific symptoms. In this study we found that rural patients with colorectal cancer were more likely than their urban counterparts to have alarm symptoms at presentation, but this did not increase the likelihood of diagnosis following emergency presentation, nor did it increase mortality at three years. Furthermore, travelling times to a GP appeared to have opposite association with outcomes between urban and rural areas. Unexpectedly, travel to GPs has a stronger association with colorectal cancer outcomes in urban than in rural areas, whereby longer travel in urban areas significantly reduced the likelihood for emergency admissions and increased survival.

1. Introduction

Studies in the UK have reported that people who live rurally and further away from health services have poorer cancer outcomes (1,2), and causative mechanisms have been suggested at the general practice level (3). First, rural populations may be impacted disproportionately by financial constraints and poor accessibility, compounded by the long distances travelled to obtain primary and secondary healthcare (4). For example, longer distance to health services has been associated with fewer in-patient admissions (5), with poorer uptake of cancer diagnosis and treatment (1,6,7), and with lower survival (2). Second, socio-cultural factors could manifest as different attitudes or stoicism in rural dwellers, with correspondingly lower rates of primary care consultation and as a consequence, lower likelihood of general practitioners (GPs) being enabled to detect early cancer symptoms (3,8). Geographical location and considerations of access could also influence GP decision making if they take into account patients' journey to hospital when making referral decisions (5,9).

Acting together, these mechanisms could conspire against rural patients and their GPs and lead to disproportionately longer diagnostic delays, later stage presentation and poorer survival. A study from the early 2000s in Northern Scotland supports this notion by showing that longer straight-line distances from patients' homes to a cancer centre was associated with later stage at diagnosis and poorer survival from colorectal cancer (2,10). However, research from the USA has provided contradictory findings, by reporting increased likelihood of late stage cancer amongst urban patients (11,12).

Achieving a true understanding of the relationship between rural residence and cancer outcomes is hindered by a focus on outcomes, survival and stage, rather than process. There have been few meaningful attempts to compare urban and rural cancer diagnosis at the level of patient - GP interactions. Cancer is easier to detect and refer when alarm symptoms are present (13,14), and harder when symptoms are atypical (15). Subsequent diagnosis after presentation with non-alarm symptoms may therefore require more frequent engagement with health services, which may be hindered by poor accessibility; difficulties in accessing secondary care services could mean rural GPs might delay referral until symptoms are more obvious (16). It seems plausible therefore that for rural populations, geographical inaccessibility and socio-cultural differences, would manifest as a greater likelihood to be diagnosed with colorectal cancer following presentation with alarm symptoms to a GP, or following an emergency admission.

We have been able to examine rural urban differences in the diagnosis of colorectal cancer using a historical, but highly detailed database from Northern Scotland (17). The CRUX (Comparing Rural and Urban Cancer Care) database linked detailed information from the primary care records of people diagnosed with colorectal cancer, to cancer registry and service use data from NHS Scotland. Using these data we have explored the association between rurality and symptoms at presentation, emergency admission, stage and survival for 926 people diagnosed with colorectal cancer between 1997/98. Further, for the first time we have explored the interaction between rurality, urbanity and travelling time on these important colorectal cancer outcomes.

2. Methods

The study used the CRUX linked dataset that contains primary care data from Northern Scotland. CRUX holds records of cancer cases diagnosed between 1997/98 and followed up until 2011. The dataset has information on GP consultations, linked to the Scottish Cancer Registry and the Scottish Death Registry records (17,18). The index consultation was determined as the first visit to the GP with a recording of potential symptoms of colorectal cancer that preceded diagnosis (18). The presence of alarm symptoms, emergency admissions, later (C or D versus A or B) Dukes stage and survival were identified as the primary outcomes.

Alarm symptoms were categorized according to previous research (19) along with expert advice (20). The following symptoms were defined as alarming enough to likely result in a patient seeking a consultation or a GP making an urgent referral: rectal bleeding, palpable mass and weight loss. Admission types recorded as emergency and/or A&E (Accident and Emergency) were grouped into 'emergency admissions', whilst all inpatient and outpatient admissions, day cases and domiciliary visits were grouped as 'other admissions'. Stage at diagnosis was recorded as Dukes stage (A, B, C or D). Survival time was measured from date of first presentation to primary care (18).

Travel times were estimated in minutes from the patients' home postcode to the postcode of their GP of registration at diagnosis. These were computed using a Geographical Information System (GIS) (ArcGIS 10.3, Esri Inc.). Road travel time was selected as the most appropriate measure of accessibility; a previous study demonstrated that over 87% of cancer patients travel to hospital by car (21). Scottish rural-urban classifications (2003-04) were used to group patients according to rural or urban residence (22).

All data were analysed using Stata Version 13 (StataCorp College Station, TX, USA). Estimated travel time was analysed as a continuous variable. Symptoms, admissions and stage data were binary coded as 'alarm symptoms vs not', 'emergency vs not', 'early stage (CD) vs late stage (AB)'. Logistic regression was used to examine how rurality and travel time were associated with the likelihood of these outcomes. So that parameter estimates were conservative, models were adjusted for variables deemed to have a relationship with the outcomes; age, sex, Carstairs deprivation score (23) and Charlson comorbidity index (24). Odds ratios (OR) and 95% CI were calculated in all models. Cox survival analysis was used to examine the relationship between rurality, travel time, and survival. For each patient, follow-up began at the date of their index presentation (see definition above) and ended at the date of death or was censored after three years. Hazard ratios (HR) and 95% confidence intervals (CI) were calculated.

To test whether travel times may have a different relationship with the outcomes for those living in rural compared to urban settings, we fitted interaction terms to examine if rurality moderated associations between travel times and the outcomes. We then plotted separate urban and rural slopes for these associations, testing for statistical significance in the differences. A p-value of 0.05 or less was used to indicate statistical significance.

3. Results

Data on 926 patients with symptomatic colorectal cancer were used in this analysis. The majority of patients (83.1%) were above 60 years of age, and over half (52.4%) had one or more comorbidities. Nearly a third (32.2%) lived in a rural area. The median travel time was 5.5 minutes, whereas 75% of all patients could access their GP within 10 minutes. There were 373 patients with one or more alarm symptom, 243 patients were admitted to hospital via an emergency route and 424 patients had Dukes stage C and D (Table 1).

Travel times to GPs were longest for those living in rural vs urban areas (12.0 vs 6.2 minutes) and those with four or more symptoms vs one to three symptoms at the index presentation (10.7 vs. 7.7 minutes). There was little variation in mean travel times between the other variables (Table 1).

In the model without travel time – rurality interaction terms, there were no independent associations between travel time to GP, rural-urban residence and the first three primary outcomes (alarm symptoms, emergency admissions and Dukes stage). However, both longer travel and rural residence were significantly associated with better survival (0.81 and 0.71, $p<0.01$ respectively) (Table 2, model 4a&b).

The addition of an interaction term to each model (Table 2, models 1d - 4d) showed that associations with travel time and each outcome differed between urban and rural patients. This difference was statistically significant for alarm symptoms (OR 0.62, $p<0.05$) and emergency admissions (OR 1.69, $p<0.05$). As an example, Table 2, model 1d, shows longer travel in urban areas increased the likelihood of presenting with alarm symptoms (OR 1.34, $p=0.06$), but this likelihood was reduced in rural areas (OR 0.83, $p=0.08$, obtained by multiplying OR of the estimate of travel time to GP with the interaction term). Conversely, longer travel time in urban areas reduced the likelihood of having an emergency admission (OR 0.62, $p<0.05$) (Table 2, 2d) and of death within three years of diagnosis (OR 0.75, $p<0.05$) (Table 2, 4d).

Figure 1 graphically illustrates the output from Table 2, models 1d – 4d. Figure 1 (1a - 4a) shows the differences in association between rural and urban areas; the lines indicate modelled association between travel time and the primary outcomes. Figure 1 (1b – 4b) shows the scale of the rural – urban difference in outcomes (solid line). This difference is statistically significance at the $p<0.05$ level where the 95% CI does not the cross zero marker (dashed line).

The odds of emergency admission was significantly lower in the presence of alarm symptoms (0.36, $p<0.01$) (Table 2, model 2c). Alarm symptoms were not significantly associated with survival, and there was no significant interaction between alarm symptoms and rural residence in the models with emergency admission and survival as outcomes.

4. Discussion

Summary of main findings
This study has examined the potential influence that rurality has on how patients present to their GP with symptomatic colorectal cancer and their subsequent outcomes. Additionally, we have considered how rurality, urbanity and estimated travel time interact to influence the same outcomes. We believe our work is novel because it considers for the first time whether symptomatic presentation of colorectal cancer to GPs is different in rural compared to urban areas.

We found that rural patients had superior three year survival than their urban counterparts (OR 0.71, $p<0.01$). The association between longer travel and the primary outcomes was opposite in rural areas to that observed in urban localities. The difference was statistically significant for alarm symptoms (OR 0.62, $p<0.05$) and emergency admissions (OR 1.69, $p<0.05$). The moderation by travel times was statistically significant in urban areas but not in rural areas and may suggest that rural and urban patients may perceive geographical inaccessibility differently (25). The presence of alarm symptoms significantly reduced the odds of emergency admissions (OR 0.36, $p<0.01$), whilst alarm symptoms were not associated with survival at three years.

Strengths and limitations
The study has several strengths; the sample has high levels of linkage to high quality routine datasets which includes all patients diagnosed within the study period. Record linkage has enabled a detailed analysis using clinical, demographic and geographical information, and adjustment for a greater array of potential explanatory variables. Finally, the long follow-up period has made it possible to examine associations with long-term survival.

The study has a number of limitations. Except for survival analyses, it is a cross-sectional study hence the directions of cause and effect cannot be inferred. In order to allow for adequate follow up of deaths, the data is based on diagnoses made over a decade ago. Further, defining symptoms as either alarm or non-alarm is problematic in the absence of information on symptom severity. For instance, we have grouped abdominal pain and anaemia as non-alarm symptoms, but severe cases of these symptoms may be alarming enough to instigate a GP consultation or referral to hospital. Another limitation is not considering the availability of public transport, although previous work suggests this is infrequently used by cancer patients (21).

Comparison with existing literature
Rural patients had better three year cancer survival, confirming some reports of better cancer outcomes in rural areas from the USA (11). Travelling farther to GPs in urban areas increased the odds of presenting with alarm symptoms; this supports our hypothesis that poor access results in greater odds of cancer diagnosis resulting from an alarm symptom presentation. Patients presenting with alarm symptoms were less likely to be diagnosed with cancer following emergency admission, perhaps because patients with alarming symptoms are more likely to be referred using standard referral pathways (13). Unlike a previous study that associated alarm symptoms with better survival (26), our analysis could not confirm this finding.

We expected that travelling farther in rural areas would also have higher odds of a diagnosis after presenting with alarm symptoms, rather, we found the opposite; longer travel time to GPs in rural areas reduced the odds of presenting with alarm symptoms. It is plausible that at the onset of such symptoms, those with the poorest geographical access in rural areas will delay seeking healthcare in comparison to their urban counterparts. Such rural - urban differences may be driven by social cultural differences in health seeking behaviour, where the most remote rural patients may be displaying stoicism when seeking help (3,4,8,27). This may be supported by studies from the Northern Scotland that found rural patients were more likely to present later, had lower expectations of healthcare, and may pursue their care less tenaciously (28,29).

Urban patients with shorter travel to their GP had the worst outcomes. This may be related to disadvantages amongst patients living in inner city deprived areas. Although we controlled for area deprivation, our findings may suffer from residual confounding by deprivation; the Carstairs index may not fully capture individual level deprivation. Further, a measure of car ownership used in the index may not appropriately capture deprivation in rural areas where a car can be an essential possession (30).

Implications for research and/or practice

Our starting hypothesis was that living in rural areas and having longer travel to a GP would be associated with greater likelihood of obtaining a diagnosis from alarm symptoms, and via emergency admissions. This in turn would lead to later stage colorectal cancer diagnosis and poorer three year survival. Unexpectedly, we found that rural patients and urban patients with longer travel generally had better outcomes, were less likely to have emergency presentations, and had better survival. We also found the association between longer travel, alarm symptoms and emergency presentation was reversed between rural and urban areas.

Our findings suggest that the interplay between attitudes and location is more complex than has previously been considered in researcher into cancer and rurality. Socio-cultural attitudes and geographical location may influence how patients present to GPs with symptomatic colorectal cancer, and this may influence differences in outcomes in ways that may be counterintuitive. Most existing research has tended to make straight comparisons between urban and rural populations or considered distance separately from constructs of rurality or urbanity. Future research should explore the mechanisms driving the interaction between location, access and outcomes. Such mechanisms may include time delays occurring at various stages of the diagnostic pathway such as patient, primary care or system delays (31).

These findings should reassure most rural cancer patients and their GPs that where they live may not be conferring the widely perceived rural diagnostic and survival disadvantages. In contrast, longer travel in urban areas may be associated with better outcomes. This has potential implications for urban GPs whose patients travel the least distance; such patients are more likely to live in the inner cities and may experience other access barriers such as longer delays due to larger GP list sizes. This has implications for defining catchment areas for urban practices that encapsulate travelling distances as well as transport options. Considering these in the context of practice list size and appointment availability could facilitate more efficient and effective healthcare access and outcomes.

Conflict of interest
None

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References

1. Jones AP, Haynes R, Sauerzapf V, Crawford SM, Zhao H, Forman D. Travel time to hospital and treatment for breast, colon, rectum, lung, ovary and prostate cancer. Eur J Cancer [Internet]. 2008;44(7):992–9. Available from: http://www.sciencedirect.com/science/article/pii/S0959804908000890
2. Campbell NC, Elliott AM, Sharp L, Ritchie LD, Cassidy J, Little J. Rural factors and survival from cancer: analysis of Scottish cancer registrations. Br J Cancer [Internet]. 2000;82(11):1863–6. Available from: http://dx.doi.org/10.1054/bjoc.1999.1079
3. Emery JD, Walter FM, Gray V, Howting D, Bulsara C, Webster A, et al. Diagnosing cancer in the bush: A mixed-methods study of symptom appraisal and help-seeking behaviour in people with cancer from rural Western Australia. Fam Pract [Internet]. 2013;30(3):294–301. Available from: http://search.ebscohost.com/login.aspx?direct=true&db=edselc&AN=edselc.2-52.0-84878624310&authtype=sso&custid=s8993828&site=eds-live&scope=site
4. Douthit N, Kiv S, Dwolatzky T, Biswas S. Exposing some important barriers to health care access in the rural USA. Public Health [Internet]. 2015;129(6):611–20. Available from: http://www.sciencedirect.com/science/article/pii/S0033350615001584
5. Haynes RM, Bentham CG. The effects of accessibility on general practitioner consultations, out-patient attendances and in-patient admissions in Norfolk, England. Soc Sci Med [Internet]. 1982;16(5):561–9. Available from: http://www.sciencedirect.com/science/article/pii/0277953682903094
6. Lau KKW, Rathinam S, Waller DA, Peake MD. The Effects of Increased Provision of Thoracic Surgical Specialists on the Variation in Lung Cancer Resection Rate in England. J Thorac Oncol [Internet]. 2013;8(1):68–72 10.1097/JTO.0b013e3182762315. Available from: http://journals.lww.com/jto/Fulltext/2013/01000/The_Effects_of_Increased_Provision_of_Thoracic.12.aspx
7. Crawford SM, Sauerzapf V, Haynes R, Zhao H, Forman D, Jones AP. Social and geographical factors affecting access to treatment of lung cancer. Br J Cancer [Internet]. 2009;101(6):897–901. Available from: http://search.ebscohost.com/login.aspx?direct=true&db=afh&AN=44095391&site=ehost-live
8. Farmer J, Iversen L, Campbell NC, Guest C, Chesson R, Deans G, et al. Rural/urban differences in accounts of patients' initial decisions to consult primary care. Health Place [Internet]. 2006;12(2):210–21. Available from: http://www.sciencedirect.com/science/article/pii/S1353829204001200
9. Sladden MJ, Thomson AN. How do general practitioners manage rectal bleeding?

Aust Fam Physician. 1998/03/21. 1998;27(1–2):78–82.
10. Campbell NC, Elliott AM, Sharp L, Ritchie LD, Cassidy J, Little J. Rural and urban differences in stage at diagnosis of colorectal and lung cancers. Br J Cancer [Internet]. 2001;84. Available from: http://dx.doi.org/10.1054/bjoc.2000.1708
11. McLafferty S, Wang F. Rural Reversal? Rural-Urban Disparities in Late-stage Cancer Risk in Illinois. Cancer [Internet]. 2009;115(12):2755–64. Available from: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2774239/
12. McLafferty S, Fahui W, Lan L, Butler J. Rural -- urban inequalities in late-stage breast cancer: spatial and social dimensions of risk and access. Environ Plan B Plan Des [Internet]. 2011;38(4):726–40. Available from: http://search.ebscohost.com/login.aspx?direct=true&db=8gh&AN=65392750&authtype=sso&custid=s8993828&site=eds-live&scope=site
13. Jensen H, Tørring ML, Olesen F, Overgaard J, Vedsted P. Cancer suspicion in general practice, urgent referral and time to diagnosis: a population-based GP survey and registry study. BMC Cancer [Internet]. 2014;14(1):636. Available from: http://dx.doi.org/10.1186/1471-2407-14-636
14. Hamilton W. Five misconceptions in cancer diagnosis. Br J Gen Pract. 2009;59(563).
15. Lyratzopoulos G, Wardle J, Rubin G. Rethinking diagnostic delay in cancer: how difficult is the diagnosis? BMJ [Internet]. 2014;349:g7400–g7400. Available from: http://search.ebscohost.com/login.aspx?direct=true&db=mdc&AN=25491791&authtype=sso&custid=s8993828&site=eds-live&scope=site
16. Vedsted P, Olesen F. Are the serious problems in cancer survival partly rooted in gatekeeper principles? An ecologic study. Br J Gen Pract [Internet]. 2011;61(589):e508–12. Available from: http://search.ebscohost.com/login.aspx?direct=true&db=edselc&AN=edselc.2-52.0-80054087523&authtype=sso&custid=s8993828&site=eds-live&scope=site
17. Robertson R, Campbell NC, Smith S, Donnan PT, Sullivan F, Duffy R, et al. Factors influencing time from presentation to treatment of colorectal and breast cancer in urban and rural areas. Br J Cancer [Internet]. 2004;90(8):1479–85. Available from: http://dx.doi.org/10.1038/sj.bjc.6601753
18. Murchie P, Raja EA, Brewster DH, Campbell NC, Ritchie LD, Robertson R, et al. Time from first presentation in primary care to treatment of symptomatic colorectal cancer: effect on disease stage and survival. Br J Cancer [Internet]. 2014;111(3):461–9. Available from: http://dx.doi.org/10.1038/bjc.2014.352
19. Van Hout AMGH, de Wit NJ, Rutten FH, Peeters PHM. Determinants of patient's and doctor's delay in diagnosis and treatment of colorectal cancer. Eur J Gastroenterol Hepatol [Internet]. 2011;23(11):1056–63. Available from: http://journals.lww.com/eurojgh/Fulltext/2011/11000/Determinants_of_patient_s_and_doctor_s_delay_in.14.aspx
20. Hamilton W. Grouping colorectal cancer symptoms. Email conf. Murage P, editor. 2015.
21. Haynes R, Jones A, Sauerzapf V, Zhao H. Validation of travel times to hospital estimated by GIS. Int J Health Geogr [Internet]. 2006;5(1):40. Available from: http://www.ij-healthgeographics.com/content/5/1/40
22. Scottish Executive. Scottish Executive Urban Rural Classification [Internet]. Environment and Rural Affairs Department, editor. Scotland; 2004. Available from: http://www.gov.scot/Topics/Statistics/About/Methodology/UrbanRuralClassification
23. Morris R, Carstairs V. Which deprivation? A comparison of selected deprivation

indexes. J Public Health (Bangkok) [Internet]. 1991;13(4):318–26. Available from: http://jpubhealth.oxfordjournals.org/content/13/4/318.abstract
24. Charlson ME, Pompei P, Ales KL, MacKenzie CR. A new method of classifying prognostic comorbidity in longitudinal studies: Development and validation. J Chronic Dis [Internet]. 1987;40(5):373–83. Available from: http://www.sciencedirect.com/science/article/pii/0021968187901718
25. Field KS, Briggs DJ. Socio-economic and locational determinants of accessibility and utilization of primary health-care. Health Soc Care Community [Internet]. 2001;9(5):294–308. Available from: http://dx.doi.org/10.1046/j.0966-0410.2001.00303.x
26. Dregan A, Charlton J, Gulliford MC, Møller H. Are alarm symptoms predictive of cancer survival? Population-based cohort study. Br J Gen Pract [Internet]. 2013;63(617):e807–12. Available from: http://search.ebscohost.com/login.aspx?direct=true&db=edselc&AN=edselc.2-52.0-84888781572&authtype=sso&custid=s8993828&site=eds-live&scope=site
27. Elliott-Schmidt R, Strong J. The concept of well-being in a rural setting: understanding health and illness. Aust J Rural Heal. 1997/05/01. 1997;5(2):59–63.
28. Bain NSC, Campbell NC, Ritchie LD, Cassidy J. Striking the right balance in colorectal cancer care—a qualitative study of rural and urban patients. Fam Pract [Internet]. 2002;19(4):369–74. Available from: http://fampra.oxfordjournals.org/content/19/4/369.abstract
29. Bain NSC, Campbell NC. Treating patients with colorectal cancer in rural and urban areas: a qualitative study of the patients' perspective. Fam Pract [Internet]. 2000;17(6):475–9. Available from: http://fampra.oxfordjournals.org/content/17/6/475.abstract
30. Information Services Division I. Problems with the use of area classifications [Internet]. The Carstairs and Morris Index. 2010 [cited 2011 Jun 20]. Available from: http://www.isdscotland.org/products-and-Services/GPD-Support/deprivation/carstairs/
31. Neal RD. Do diagnostic delays in cancer matter[quest]. Br J Cancer [Internet]. 2009;101(S2):S9–12. Available from: http://dx.doi.org/10.1038/sj.bjc.6605384