Deprivation level and the risk of colorectal cancer by anatomic subsite in Northern England

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Abstract

Background: evidence suggests that the incidence of many cancers including bowel cancer vary according to socioeconomic status and education. In case of colorectal cancer, the direction of this association might be even different for anatomical subsites. The aim of this study was to describe the variation in the incidence of colorectal cancer by subsites across North of England and correlate it with community deprivation.

Methods: Incidence data were obtained from a population- based cancer registry for the period 1976-2000. Small areas were characterized by their affluence or lack of it, by deriving a Townsend score for each Enumeration District from the 1991 census. The age-standardized incidence rates were calculated for different sites of colorectal cancer for each fifth. The association of each fifth with incidence was also studied using Poisson regression.

Results: in men, the age standardized incidence for rectal cancer ranged from 18.3 (for fifth 1, most affluent) to 22.3 (for fifth 5, most deprived) but the trend for proximal cancer was reverse (9.4 for fifth 1 and 8.8 for fifth 5). Poisson models showed a significant inverse association between deprivation level and proximal cancer in both genders. Rectal cancer had a positive significant association with deprivation level in men (RR+1.25, 95% CI, 1.19-1.32).

Conclusion: the association of socioeconomic status with proximal cancer was different from that with rectal cancer. Socioeconomic status is not a direct risk factor and might consider as a proxy for life style factors. This indicates that lifestyle correlates of different subsites of bowel cancer differ. Therefore, the different sites of CRC should not be combined in aetiological studies.

Keywords: anatomical subsites, colorectal cancer, ecological study, Townsend score

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Introduction

Colorectal cancer (CRC) is among the five most common cancers in the world in terms of incidence for both men and women[1]. This cancer continues to be the third most common cancer in the Northern and Yorkshire catchment area of UK. The theory of two categories of colorectal cancer has been suggested in recent years[2], but it is still not common for cancer registries to report the incidence of colon cancer divided into distal and proximal locations. Incidence of cancer in subsites of large bowel might differ in a number of ways. For example, proximal colon carcinoma rates in blacks of North America were higher than distal and rectal cancer rates whereas the greatest risk among whites has been shown for distal colon cancer with declining trends[3-5]. It has also been shown that proximal colon cancer is more likely to occur in females and at older ages than distal or rectal cancer[3;6-9]. In terms of socioeconomic status (SES), evidence suggests that the incidence of many cancers in a society vary according to this status[10]. Each population has its own culture, and social and economic situation, which affect how and why people are exposed to particular factors. In case of colorectal cancer, the direction of this association might be even different for anatomical subsites. The aim of this ecological study was to describe variations in the incidence of colorectal cancer by subsites across north region of England and to correlate it with community deprivation.

Methods

The data on each new tumor site within the colon and rectum diagnosed in 89,541 patients for this study was obtained from Northern and Yorkshire Cancer Registry and Information Services (NYCRIS) for the years between 1976 and 2000. These data consist of age at diagnosis, the year of diagnosis,

gender, site of colon or rectum based on the 10th edition of International Classification of Diseases (ICD-10), the Townsend score at Enumeration District (ED) level for each anonymous case. A new variable of subsite was created to group cases into the four sites: proximal colon, distal colon, unknown sites of colon and rectal cancer based on ICD-10 codes (appendix 1).

To protect the privacy of individuals (confidentiality), access to the postcodes of patients for this study was not possible. Thus in first step, using variables at small area statistics (SAS) in the 1991 census, the Townsend deprivation score was calculated for 14,548 EDs of the NYCRIS region (census data was not available for 615 EDs). The Townsend score is based on four pieces of information. The percentage of (I) unemployed economically active persons (age 16 and over); (II) households with more than one person per room (III) households not owner occupied and (IV) households without a car were calculated. Each of the four percentages was standardized to a mean of zero with a standard deviation of one in order to make all four factors contribute equal weight to the Townsend score. These standardized scores were added to obtain the Townsend score for each ED. A high positive value represents an area with high deprivation and a high negative value represents an affluent area. The Townsend score (ranging from -9.44 to 8.59) was then grouped into five equal categories (fifth) with the first fifth containing the lowest 20 percent of Townsend scores (the most affluent enumeration districts) and the last fifth containing the highest 20 percent of Townsend scores (the most deprived enumeration districts).

In the next step, the Townsend score of diagnosed cases at ED level, obtained from NYCRIS, was used to allocate them into relevant deprivation fifth based on the distribution of the Townsend score for NYCRIS area. Age standardized incidence rates of colorectal cancer subsites (ASR) were calculated for each fifth, standardized to the world standard population. Poisson regression was used to compare the incidence of cancer in each fifth of the population by gender and adjusting for age group.

Results

NYCRIS provided data on 89,541 cases of colorectal cancer. All diagnoses were made between 1 January 1976 and 31 December 2000 on patients aged 10 years and over. 407 (0.45 per cent) cases were excluded from analysis because of a missing Townsend score. ASR for colorectal cancer and its subsites are shown in table 1. It can be seen that there is an apparent trend in incidence of combined colorectal cancer and rectal cancer and cancer with unknown sites of colon, the lowest in the most affluent areas and highest in the most deprived areas. Opposite trend was seen for cancer in proximal and distal sites of colon. These trends were tested formally by Poisson regression adjusted for age group which gave the rate ratios and 95 % confidence intervals for each fifth. The deprivation effect was more apparent for rectal cases among men, producing a 6 % significant increase in incidence for moving between fifths from the most affluent to the most deprived. The similar significant trend was also shown for colon cancer with unknown sites. In contrast, the deprivation effect produced a borderline significant decrease (2 %) in incidence of proximal colon cancer for moving between fifths from the most affluent to the most deprived. There was a similar but weaker trend for the incidence of cancer in subsites mentioned above for women.

Discussion

Our findings suggest that SES is associated with factors determining the occurrence of colorectal cancer in different anatomical subsites in the Northern population of England. Deprived colorectal cancer patients have an excess risk of suffering from rectal cancer and by contrast affluent patients have an excess risk of suffering from proximal colon cancer. In other words, the tumours located on the proximal side are more likely to occur in people living in affluent areas, while tumours located in the rectal segment tend to occur in people in deprived areas. These findings are confirmed by some studies that have been done on subsites of tumour. Mellemegaard et al (1999) using Poisson models in a record linkage study, found a similar association between right and left colon cancer and longer education and salaried employed in men[11]. Faivre et al (1989) also found the highest risk of left colon cancer in high social class in men and also the highest risk of rectal cancer in farmers[12].

The findings of this study are more consistent with a study showing excess risk of rectal cancer in deprived patients in Northern Ireland[13]. Similarly, in England and Wales, a clear deprivation gradient for males, with the incidence rate of rectal cancer being around 25% higher in the more deprived groups than in the affluent groups, has been shown while there was no variation in incidence by deprivation group in females[14]. The association between proximal colon cancer and people living in affluent areas in this study also is confirmed by Lyrazotopoulos [15] who found a marginally

significant lower likelihood of proximal subsite with increasing levels of deprivation for the Merseyside and Cheshire Cancer Registry during 1989-1996.

This study also found an overall mild positive association between whole colorectal cancer and living in deprived areas for 1976-2000 after adjusting for age group particularly in men. One study carried out in Northern Ireland confirms this finding [13] while another study in South Thames was not able to show any associations between deprivation and colorectal cancer[16]. In terms of incidence of tumours with unknown location across deprivation fifth, there was also a positive pattern of association with deprivation level in both men and women. Thus the interpretation of findings about the association between colorectal cancer and deprivation level by subsite is not straightforward and might create a diagnosis bias related to deprivation. This point can be considered as one weakness for this study.

Population figures used for the period 1976-2000 were taken from the 1991 census. However, the change in population over the period in which the cancers were diagnosed may introduce some errors and inaccuracy into the calculation of the expected rates. To investigate this effect, the overall population figures of 1981 and 1991 for the region covered by NYCRIS were compared. Overall, the population had increased by 4.3%. To approach this problem, the analysis was repeated using cases registered in the 1976-1986 and 1987-1996 separately. The direction of association between subsites of colorectal cancer and deprivation in the two time periods of 1976-1986 and 1987-1996 was similar to that of the entire period of 1976-2000.

The sort of analysis used in this study was susceptible to the "ecological fallacy" which results from inferring that associations at the aggregate level are true at the individual level. The aggregate level correlations with disease do not always show the same pattern at the individual level. Moreover, the significant differences are short and might not be very interesting from a clinical or public health point of view.

In conclusion, despite short significant differences discovered in this study, the obtained results can suggest that colorectal cancer subsites should ideally be treated differently in analytic epidemiological research. However, since SES might be a proxy of different life style factors such as food consumption, the different associations of colorectal cancer with SES in different populations might indicate the presence of different risk factors in different populations.

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Table 1: The ASR and Rate Ratio of colorectal cancer among men by subsites in relation to deprivation fifths in the Northern England area, 1976-2000

Deprivation fifth	Proximal		Distal		Rectal		Colorectal	
	ASR	95% CI	ASR	95% CI	ASR	95% CI	ASR	95% CI
1 (most affluent)	9.40	9.00-9.90	9.30	8.90-9.70	18.3	17.7-19.0	43.2	42.3-44.2
RR	1.00	-	1.00	-	1.00	-	1.00	-
2	9.10	8.60-9.50	8.60	8.20-9.00	19.0	18.4-19.6	42.8	41.9-43.7
RR	0.96	0.90-1.02	0.93	0.86-0.99	1.03	0.98-1.09	0.99	0.96-1.02
3	9.30	8.80-9.70	9.10	8.70-9.50	20.7	20.0-21.4	46.1	45.1-47.1
RR	0.98	0.92-1.04	0.98	0.91-1.05	1.12	1.07-1.18	1.06	1.03-1.10
4	8.80	8.40-9.30	9.00	8.60-9.50	21.6	20.9-22.2	46.8	45.8-47.8
RR	0.94	0.88-1.00	0.97	0.90-1.03	1.16	1.10-1.22	1.07	1.04-1.11
5(most deprived)	8.80	8.4-9.3	8.60	8.20-9.10	23.2	22.5-23.9	49.1	48.0-50.1
RR	0.92	0.96-0.99	0.99	0.98-1.01	1.06	1.05-1.07	1.03	1.02-1.04

Table 2: The ASR and Rate Ratio of colorectal cancer subsites among women in relation to deprivation fifths in the Northern England area, 1976-2000

Deprivation fifth	Proximal		Distal		Rectal		Colorectal	
	ASR	95% CI	ASR	95% CI	ASR	95% CI	ASR	95% CI
1 (most affluent)	9.40	9.0-9.90	9.30	8.90-9.70	18.3	17.7-19.0	43.2	42.3-44.2
RR	1.00	-	1.00	-	1.00	-	1.00	-
2	9.10	8.60-9.50	8.60	8.20-9.00	19.0	18.4-19.6	42.8	41.9-43.7
RR	0.99	0.93-1.05	0.90	0.84-0.96	0.99	0.94-1.05	0.96	0.93-0.99
3	9.30	8.8-9.7	9.10	8.7-9.5	20.7	20.0-21.4	46.1	45.1-47.1
RR	0.97	0.91-1.02	0.93	0.87-1.00	1.05	0.99-1.11	1.00	0.97-1.03
4	8.80	8.40-9.30	9.00	8.60-9.50	21.6	20.9-22.2	46.8	45.8-47.8
RR	0.93	0.87-0.98	0.92	0.86-0.98	1.06	1.10-1.22	0.99	0.96-1.02
5 (most deprived)	8.80	8.4-9.3	8.60	8.20-9.10	23.2	22.5-23.9	49.1	48.0-50.1
RR	0.90	0.84-0.95	1.00	0.93-1.06	1.06	1.01-1.13	1.03	0.99-1.06

Appendix 1: Classification of tumour sites of the colon and rectum based on ICD-10.

Sites of malignant tumour	ICD-10 code	New variable (Subsite)
Colon cancer	C18	
Appendix	C18.1	Proximal colon
Caecum	C18.0	
Ascending colon	C18.2	
Hepatic flexure	C18.3	
Transverse colon	C18.4	
Splenic flexure	C18.5	
Descending colon	C18.6	Distal colon
Sigmoid colon (flexure)	C18.7	
Other (overlapping lesion)	C18.8	Unknown sites
Colon, NOS (Not otherwise specified)	C18.9	
Rectosigmoid junction	C19	Rectum
Rectum	C20	

References

1. Parkin DM, Pisani P, Ferlay J. Estimates of the worldwide incidence of 25 major cancers in 1990. Int J Cancer1999; 80(6):827

2. Iacopetta B. Are there two sides to colorectal cancer? Int J Cancer.2002; 101(5):403

3. Cheng X, Chen VW, Steele B, Ruiz B, Fulton J, Liu L, Carozza SE, Greenlee R. Subsite-specific incidence rate and stage of disease in colorectal cancer by race, gender, and age group in the United States 1992-1997. Cancer .2001; 92(10):2547

4. Demers RY, Severson RK, Schottenfeld D ,Lazar L. Incidence of colorectal adenocarcinoma by anatomic subsite. An epidemiologic study of time trends and racial differences in the Detroit. Michigan area. Cancer. 1997; 79(3):441

5. Nelson RL, Persky V, Turyk M. Carcinoma in situ of the colorectum. SEER trends by race, gender, and total colorectal cancer. J Surg Oncol. 1999; 71(2):123

6. Gonzalez EC, Roetzheim RG, Ferrante JM, Campbell R. Predictors of proximal vs. distal colorectal cancers. Dis Colon Rectum. 2001;44(2):251

7. Nelson RL, Dollear T, Freels S, Persky V. The relation of age, race, and gender to the subsite location of colorectal carcinoma. Cancer. 1997; 80(2):193

8. Devesa SS, Chow WH. Variation in colorectal cancer incidence in the United States by subsite of origin. Cancer. 1993 ;71(12):3819-3826

9. Baquet CR, Commiskey P. Colorectal cancer epidemiology in minorities: a review. J Assoc Acad Minor Phys. 1999;10(3):51

10. Faggiano F, Partanen T, Kogevinas M, Boffetta P. Socioeconomic differences in cancer incidence and mortality. IARC Sci Publ.1997; (138):65

11. Mellemgaard A, Engholm G, Lynge E. High and low risk groups for cancer of colon and rectum in Denmark: multiplicative Poisson models applied to register linkage data. J Epidemiol Community Health.1988; 42(3):249

12. Faivre J, Bedenne L, Boutron MC, Milan C, Collonges R, Arveux P. Epidemiological evidence for distinguishing subsites of colorectal cancer. J Epidemiol Community Health. 1989;43(4):356

13. Kee F, Wilson R, Currie S, Sloan J, Houston R, Rowlands B, Moorehead J. Socioeconomic circumstances and the risk of bowel cancer in Northern Ireland. J Epidemiol Community Health. 1996 ;50(6):640

14. Quinn M, Babb P, Brock A, Kirby L, Jones J. Cancer trends in England and Wales, 1950-1999. 2001. Office for National Statistics.

15. Lyratzopoulos G, West CR, Williams EM. Socioeconomic variation in colon cancer tumour factors associated with poorer prognosis. Br J Cancer 2003; 89(5):828,

16. Pollock AM, Vickers N. Breast, lung and colorectal cancer incidence and survival in South Thames Region, 1987-1992: the effect of social deprivation. J Public Health Med. 1997; 19(3):288