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Social determinants of access to reference care centres for patients with colorectal cancer – A multilevel analysis

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ABSTRACT

Background: Although social disparities in survival for patients with cancer are documented in an increasing number of papers, knowledge on the underlying mechanisms concerning screening, diagnosis, treatment or follow-up, is relatively poor. Our study was aimed at investigating the social determinants of access to reference cancer care centres for surgery for colorectal cancer in France.

Methods: Retrospective analysis was conducted on population-based data from a specialised cancer registry (County of Calvados, France). The population consisted of 5156 patients with surgical treatment for colorectal cancer recorded between January 1st 1981 and December 31st 2000.

Results: The probability of being cared for in a reference care centre was 1.3-fold lower for people living in a deprived district (mean income < 15000€) and 3-fold lower for people living in a district where more than 7% of houses were devoid of bath and shower in comparison with districts where this rate was under 2%. After adjustment for distance from reference care centre, the probability of being cared for in a reference care centre was still over one third lower for people living in a district with more than 7% of houses devoid of bath and shower. Social disparities in management of patients with colorectal cancer have increased in the last decade. The reduction of access to reference care with distance was stronger in elderly patients.

Conclusions: There is a social and geographical determination of type of treatment centre for care management of colorectal cancer in France. Special attention needs to be paid to the high quality of care management in non-specialised care centres in order to avoid an increased social gradient in cancer mortality in France.

1. Introduction

Colorectal cancer is a major cause of death in all industrialised countries. In France, where more than 36,000 cases are reported annually, the corresponding standardised incidence rate is 39.1 and 24.6 per 100,000 respectively for males and females.[1] Colorectal cancer management is a major concern for both practitioners and public health authorities. All in all, the survival rate for patients with colorectal cancer in France is reasonably high in comparison with other European countries, the 5-year survival rate being 51% and 48% respectively for colon and rectal cancer.[2] Social differences in cancer mortality have been clearly established in Europe.[3] Several French population-based studies have emphasised that colorectal cancer prognosis was poorer in patients from underprivileged classes[4,5] as demonstrated in England and

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Wales.[6,7] Knowledge on the mechanisms underlying this social disparity, concerning screening, diagnosis, treatment, or follow-up remains relatively poor. Concerning treatment, recent Scottish and American studies suggest that the specialisation level of surgeons or the volume of hospital procedures has a direct influence on the survival of patients with breast or colorectal cancer.[8–11] In France, where the ratio of care centre per inhabitant is twice as high as the European mean, patients with colorectal cancer are managed in many different care centres, with a large range of activity volume and specialisation. Although association between volume of hospital procedures or level of surgeon specialisation and survival has not been investigated in France, a surgical expert's report[12] recently emphasised that small general hospitals could produce under-quality care. Differences in access to specialised care need therefore to be considered as a potential mechanism of social difference in survival, even if differences in cancer survival according to cancer care centre type have not yet been established in France. The influence of road-distance from the place of residence was recently demonstrated,[13] but little investigation has been carried out on the social determination of care centre types, mainly due to the lack of social data in medical files and in cancer registries. To palliate this limitation, ecological measurement of poverty is attractive in order to approximate the social position of each patient. Therefore, as suggested by Picket and Pearl[14] for different aspects of social determinants in health, the use of multilevel analysis is required for investigating social determinants for patient care management.

The aim of this study was to investigate the social determinants of access to reference cancer care centres in France for patients with colorectal cancer, using population-based data from specialised cancer registries and socio-demographic census data in a multilevel analysis.

2. Patients and methods

2.1. Population

Between January 1st 1981 and December 31st 2000, 5729 people were diagnosed with colorectal cancer in the French county of Calvados, and were recorded in the specialised digestive tract cancer Registry of Calvados. This registry is part of the French network of cancer registries (FRANCIM) and, as such, its quality (reliability, exhaustiveness, completeness) is assessed every 4 years by the French INSERM - *Institut National de la Santé et de la Recherche Médical* - National Institute for Health and Medical Research, and the InVS - *Institut de Veille Sanitaire* - Health Protection Agency. The population study was performed, among this population, on 5156 patients (90.0%) with surgical treatment, after the exclusion of 79 poorly documented patients.

2.2. Data set

Place of surgery was classified as the reference care centre (university hospital or specialised oncology hospital) or as other care centres (private hospital or general hospital). Both reference care centres were located in the same town, Caen, the regional capital. In 1991, two private hospitals were also opened in the same regional capital.

2.2.1. Individual data

Sex, age and place of residence were known for each case as well as cancer site and stage of extension. The cancer site was coded according to the international classification of disease for oncology in colon cancer (C18.0-C18.9) versus rectosigmoid or rectal cancer (C19.9-C20.9), referred to in our study as 'rectal cancer'. The stage of extension was classified according to Dukes' classification (Dukes A, Dukes B, Dukes C and colorectal cancer with metastases (Dukes 'D'). Surgery was classified according to type of intervention: curative (tumour resection) or palliative (derivation or laparotomy). The year of diagnosis was considered in two ten-year periods: 1981–1990 and 1991–2000.

2.2.2. Aggregate data

To palliate the lack of informative individual data, patients' social environment was assessed according to the social characteristics of their place of residence provided by the French National Institute for Statistics and Economic Studies (*INSEE*) in charge of national census (1999 national census) and the National Institute in charge of tax collection (*Direction Générale des Impôts*) (data from 2003): unemployment rate, postgraduate diploma rate, working man or woman rate, standard of housing with neither bath nor shower, annual average taxable income and type of district according to the INSEE classification (urban/rural study zoning). Since road distance between the place of residence and the nearest reference care centre was shown as an independent determinant of access to reference care, it was calculated in our data set using CHRONOMAP 2.1 software (*Magellan Ingéniérie*) combined with MAPINFO 6.5 (*Mapinfo Corporation*).

All socio-economic variables were analysed as categorical variables using quartiles of their distribution.

2.3. Statistical analysis

The influence of aggregate data (social environment) and individual data on place of treatment were analysed using multilevel logistic regressions,[15] individual data being considered as level one data, and aggregate social data as level two. We adopted a 'step by step' procedure using the Likelihood Ratio Test, with increasing model complexity at each step, as described for the linear multilevel model by Hox.[16] During the first step, the empty model allowed us to test the influence of context on the type of care centre (heterogeneity between districts). During the second step, individual data which were significantly associated ($p < 0.05$) with the type of care centre were then added with adjustment variables (age, sex, cancer localisation, cancer extension at diagnosis). During the third step, significantly associated ($p < 0.05$) aggregate variables were then added according to a forward procedure. As a final analysis, we added to the last model the distance between district of residence and Caen.

Interactions were tested between level 1 variables, between level 1 and level 2 variables and between level 2 variables.

For each model, we calculated the Variance Partition Coefficient (VPC)[17] to evaluate the proportion of total variance in the outcome attributable to district level.

Statistical analyses were conducted with SAS software, the NLMIXED procedure being used for multilevel models. The significance level was fixed at 5%.

3. Results

Table 1 shows the distribution of patient and cancer characteristics (level 1 variables) and district characteristics (level 2 variables) in the study population according to place of treatment. More than 60% of the cancers were diagnosed during the second ten-year period. The mean age was 67.5 years for males and 70.3 years for females. Cancer was confined to the organ for almost one quarter of cases, and more than 16% already had metastases at diagnosis. The great majority of patients (almost 95%) underwent tumour resection. Only a third of patients (38%) were cared for in a reference care centre. Using a univariate approach, the patients treated in a reference care centre were the youngest, presented with a more advanced cancer and more frequently underwent palliative surgery in comparison to other places of treatment. The proportion of patients treated in a reference care centre was lower in the last decade than in the first decade of the study ($p < 0.001$).

The probability of being treated in a reference care centre varied significantly between the different districts ($p < 0.0001$; Table 2, empty model), VPC reaching 17.8%. When individual data were analysed without aggregate data, period, stage of extension and type of surgery were significantly and independently associated with the place of treatment (Table 2, model 1).

With the exception of the unemployment rate, all district social and geographic characteristics were associated with place of treatment after adjustment on level 1 variables, postgraduate diploma rate ($p < 0.01$), working man or woman rate ($p < 0.05$), standard of housing with neither bath nor shower ($p < 0.0001$), annual average taxable income ($p < 0.0001$), type of district (urban/rural) ($p < 0.01$), and distance to reference care centre ($p < 0.001$) (results not shown in table). After adjustment in a model including all social characteristics, (Table 3, model 2), only two variables remained significantly associated in the model: standard of housing with neither bath nor shower ($p < 0.0001$) and annual average taxable income ($p < 0.05$), the other socio-economic variables (postgraduate diploma rate, working man or woman rate and type of district) no longer being significant after adjustment for these two variables. In this model, the probability of being cared for in a reference care centre was more than 3-fold lower for people living in a district where more than 7% of houses were devoid of bath and shower in comparison with districts where this rate was under 2%. Similarly, and independently, the probability of being cared for in a reference care centre was 1,3-fold lower for people living in a district where the mean income was lower than 15,000 € in comparison with other districts (Table 3, model 2). The VPC diminished slightly after inclusion of these two variables in the model, meaning that the heterogeneity between districts was only explained to a small extent by these socio-economic indexes.

The VPC was substantially diminished when the distance between the district of residence and Caen, significantly associated with the type of care centre ($p < 0.0001$), was added to the model (Table 3 – model 3). In this model including social characteristics and distance to reference care centre, the mean taxable income was no longer significant, and the standard of housing with neither bath nor shower was the only level 2 variable which remained significantly associated with the type of care centre ($p < 0.01$). In this final model, the probability of being cared for in a reference care centre was diminished by more than one third for people living in a district where more than 7% of houses were devoid of bath and shower in comparison with districts where this rate was under 2% (Table 3, model 3).

Table 4 shows that social disparities in management of patients with colorectal cancer were more important in the last decade. The influence of rate of housing with no comfort on the probability of being treated in a reference care centre was higher in the more recent decade and its significance was confined to this last decade. Concerning geographical disparities, the association between distance to nearest care centre and type of care centre remained important over the entire period study (odds ratio (OR) = 0.21 (0.13–0.33) for the first decade versus OR = 0.28 (0.18–0.42) for the last decade, for patients living at 45 km or more from a reference care centre).

There was a significant interaction between age and place of residence. The reduction of access to reference care with distance was stronger in elderly patients. Among patients aged over 80 years, with a distance of < 20 km as reference class, the adjusted OR was respectively 0.29 [0.17–0.51], 0.12 [0.06–0.24] and 0.11 [0.06–0.21] for people living in a district with a difference of 20–30, 35–44 and more than 44 km respectively from a reference care centre. There was a significant interaction between distance and socio-economic characteristics. The standard of housing with neither bath nor shower and annual average taxable income, whose influence on the type of care centre was respectively significant ($p < 0.001$) and borderline ($p = 0.053$) for people living in a district less than 35 km from a reference care centre, no longer had an influence for people living in a district at a distance superior to 35 km.

4. Discussion

This study, based on population-based data, suggests that access to a reference care centre in France is influenced by neighbourhood social determinants. Even after adjustment for tumour characteristics (localisation and stage of extension at diagnosis) and for geographical variables (road-distance from district of residence to reference care centre), patients with colorectal cancer living in an underprivileged district (highest rate of houses devoid of bath and shower) were less frequently cared for in a reference care centre. The influence of socio-economical characteristics was more important in districts close to reference care centres than districts over 35 km from reference care centres. Moreover, the influence of social characteristics on access to health care management for patients with colorectal cancer was more important in the last decade of the study period. Geographical disparities in access to reference care remained important over the entire period study.

Table 1 – Distribution of sex, age and cancer characteristics (level 1) and district of residence characteristics (level 2) according to care centre type among patients with colorectal cancer in the county of Calvados (1981–2000)

Care centre	Reference care centres (N = 1949)		Other centres (N = 3207)		P-values	Total (N = 5156)	
	N	%	N	%		N	%
Level 1: Patient							
Sex							
Male	1053	54.00	1671	52.10	0.18	2724	52.80
Female	896	46.00	1536	47.90		2432	47.20
Age							
<60 years	433	22.20	610	19.00	<0.001	1043	20.20
60–69 years	553	28.40	886	27.60		1439	27.90
70–79 years	608	31.20	1047	32.70		1655	32.10
80 years or more	355	18.20	664	20.70		1019	19.80
Period							
1981–1990	988	50.70	1026	32.00	<0.001	2014	39.10
1991–2000	961	49.30	2181	68.00		3142	60.90
Localisation							
Colon	1199	61.50	1993	62.10	0.653	3192	61.90
Rectum	750	38.50	1214	37.90		1964	38.10
Extension at diagnosis							
Dukes A	418	21.50	877	27.30	<0.001	1295	25.10
Dukes B	573	29.40	962	30.00		1535	29.80
Dukes C	505	25.90	802	25.00		1307	25.40
Dukes 'D'	373	19.10	464	14.50		837	16.20
Unknown	80	4.10	102	3.20		182	3.50
Type of surgery							
Curative	1794	92.00	3083	96.10	<0.001	4877	94.60
Palliative	111	5.70	101	3.10		212	4.10
Unknown	44	2.30	23	0.80		67	1.30
Level 2: District of residence							
Proportion of house with neither bath nor shower							
<2%	1211	62.20	1554	48.40	<0.001	2765	53.60
2–4%	474	24.30	902	28.10		1376	26.70
4–7%	184	9.40	422	13.20		606	11.80
8% and more	80	4.10	329	10.30		409	7.90
Mean taxable income							
<15,000 €	1291	66.20	2260	70.50	0.001	3451	66.90
15,000 € or more	658	33.80	947	29.50		1605	33.10
Distance to reference care centre							
Less than 20 km	1225	62.90	1168	36.40	<0.001	2393	46.40
20–34 km	327	16.80	656	20.50		983	19.10
35–44 km	145	7.40	498	15.50		643	12.50
45 km or more	252	12.90	885	27.60		1137	22.10
Proportion of manual workers					<0.0001		
<21.5%	896	45.97	1000	31.20		1896	36.77
21.5–28.5%	252	12.93	516	16.09		768	14.90
28.5–34.0%	457	23.45	979	30.53		1436	27.85
34% or more	344	17.65	712	22.20		1056	20.48
Type of place of residence					<0.0001		
Urban	1653	84.81	2511	78.30		4164	80.76
Rural	296	15.19	696	21.70		992	19.24
Proportion of people with postgraduate diploma					<0.0001		
<6.5%	246	12.62	528	16.46		774	15.01
6.5–8%	369	18.93	655	20.42		1024	19.86
8%–11%	377	19.34	1024	31.93		1401	27.17
11% or more	957	49.10	1000	31.18		1957	37.96

The investigation of social determinants in cancer management in France suffers from the lack of informative individual social data in medical files and in cancer registries, and from the technical legal difficulties involved in crossing cancer registry files with census files. Even basic information on occupation is unavailable from most cancer registries. We therefore resorted to aggregate data at district level for assessing patients' social environment. Our study is therefore subject to the same limitations as ecological studies, and in particular the lack of accuracy in the assessment of individual social characteristics. Other study limitations were due to the choice of geographical units and socio-economic variables. Although the district is the smallest administrative subdivision, its relevance as a geographical unit depends on the

Table 2 – Association of sex, age and cancer characteristics (level 1 variables) with care centre type for surgery among patients with colorectal cancer (n = 5156) (multilevel analysis)

	Empty model			Model 1		
				OR_a	CI 95%	*p*
Level 1: patient						
Sex						NS
Male				1		
Female				0.95	0.83–1.07	
Period						<0.001
1981–1990				1		
1991–2000				0.41	0.36–0.46	
Age						NS
<60 years				1		
60–69 years				0.95	0.79–1.14	
70–79 years				0.88	0.72–1.08	
80 years or more				0.86	0.70–1.06	
Stage of extension						<0.001
Dukes A				1		
Dukes B				1.17	0.98–1.40	
Dukes C				1.27	1.06–1.52	
Dukes 'D'				1.66	1.35–2.04	
Unknown				1.36	0.94–1.96	
Localisation						NS
Colon				1		
Rectum				1.05	0.92–1.20	
Type of surgery						<0.001
Curative				1		
Palliative				1.52	1.09–2.11	
Unknown				0.67	0.38–1.19	
Level 2: district of residence						
Residual effects						
Level 2 Variance (SE)	0.71	(0.12)	<0.0001	0.84	(0.14)	<0.001
VPC (%)	17.8			20.3		

OR_a: Adjusted odds ratio; CI 95%: Confidence interval (95%); VPC: Variance partition coefficient.

number of its inhabitants. For larger districts, social indicators were less relevant than in smaller districts since they cover very heterogeneous populations. For instance, the population of the regional capital (Caen) district appears as one of the poorest in the county, whilst it actually consists of very privileged and underprivileged people. For these larger districts, the availability of precise addresses for individuals recorded in cancer registries will offer the use of more accurate geographical units for further studies. The choice of socio-economic variables was limited to those available at district level. Therefore, we could not use relevant social indicators such as occupation or insurance coverage. Moreover, level 2 variance was still high in our final models, indicating that the level 2 variables we used were not sufficient in explaining the heterogeneity between districts. A last methodological limitation was the fact that the multilevel analysis does not take into account potential auto-correlations between close geographical units.[18]

Our study suffers from the lack of information on previous district socio-economic status. Due to the lack of detailed information on district social characteristics from census tract covering the period of data collection (1981–2000), we used the data concerning district socio-economic status derived from the census conducted in 1999. We therefore could not take into account the potential changes in district social characteristics over the study period. At district level, there is a high correlation between geographical and socio-economic characteristics. Our study suggests that both have an independent influence on the type of care centre in which the patient is cared for, socio-economic characteristics having a more apparent influence in districts closer to reference care centres.

As previously reported in a French study,[13] the scale of geographical disparities emphasised in the present study reveals an important preference for proximity compared to specialised care. This result confirms the rules of social network in the decision process concerning place of care management. It is worthwhile noting that this last point does not constitute inequality in itself since no other studies have yet established the influence of care centre type on survival in France.

Several studies carried out in different countries suggest socio-economic differences in cancer survival, underprivileged classes having the worse survival[6,19–21] but very few studies have been aimed at investigating the underlying mechanisms of such differences. Moreover, most studies used a deprivation index for investigating social inequalities and were therefore unable to explain which socio-economic variable was responsible for such disparities. In public health, distance is the most consistent factor determining the utilisation of health care services in studies conducted in the United States of America (USA)[22–25] and in United Kingdom (UK).[26,27] Some socio-economic factors have been shown to limit the access to specialised management such as chemotherapy:

Table 3 – Association of socio-economic characteristics of place of residence (level 2 variables) with care centre type for surgery among patients with colorectal cancer (n = 5156)

	Reference centres	Other centres	Model 2			Model 3		
	N	*N*	OR_a	CI 95%	*p*	OR_a	CI 95%	*p*
Level 1: patient								
Sex					NS			NS
Male	1053	1671	1			1		
Female	896	1536	0.95	0.83–1.07		0.95	0.83–1.08	
Period					<0.001			<0.001
1981–1990	988	1026	1			1		
1991–2000	961	2181	0.4	0.35–0.46		0.41	0.36–0.47	
Age					NS			NS
< 60 years	433	610	1			1		
60–69 years	553	886	0.95	0.79–1.14		0.98	0.82–1.18	
70–79 years	608	1047	0.87	0.73–1.05		0.89	0.75–1.07	
80 years or more	355	664	0.87	0.71–1.07		0.89	0.73–1.10	
Stage of extension					<0.001			<0.001
Dukes A	418	877	1			1		
Dukes B	573	962	1.18	0.99–1.41		1.69	1.38–2.08	
Dukes C	505	802	1.27	1.06–1.51		1.45	1.01–2.10	
Dukes 'D'	373	464	1.69	1.37–2.07		1.26	1.06–1.51	
Unknown	80	102	1.39	0.96–2.00		1.18	0.99–1.41	
Localisation					NS			NS
Colon	1199	1993	1			1		
Rectum	750	1214	1.05	0.92–1.20		1.05	0.92–1.19	
Type of surgery					0.02			0.02
Curative	1794	3083	1			1		
Palliative	111	101	1.49	1.07–2.08		1.48	1.07–2.06	
Unknown	44	23	0.68	0.39–1.20		0.69	0.39–1.21	
Level 2: District of residence								
Distance to reference centre								<0.001
<20 km	1225	1168				1		
20–34 km	327	656				0.50	0.36–0.68	
35–44 km	145	498				0.27	0.19–0.39	
45 km and more	252	885				0.25	0.17–0.35	
Mean taxable income					0.04			NS
< 15000 Euros	1291	2260	1			1		
15000 euros and more	658	947	1.31	1.01–1.71		0.95	0.74–1.22	
Housing standard with neither bath nor shower					<0.001			0.01
<2%	1211	1554	1			1		
2–4%	474	902	0.82	0.6–1.11		1.18	0.89–1.56	
4–7%	184	422	0.56	0.4–0.79		0.92	0.66–1.28	
7% and more	80	329	0.34	0.22–0.51		0.62	0.42–0.92	
Residual effects								
Level 2 variance (SE)			0.65	–0.12	<0.001	0.38	(0.09)	
VPC (%)			16.5			10.4		

OR_a: Adjusted odds ratio; CI 95%: Confidence interval 95%; VPC: Variance partition coefficient; MOR: Median odds ratio.

deprivation in the UK,[27] lack of private insurance in the USA.[22] Two studies, conducted within different health care systems in America and Europe, have consistently demonstrated that social differences in cancer survival are less important in countries where people benefit from the same access to care, independently of their financial means.[3,28]

This study, using a multilevel approach on French cancer registry data, suggests a social determination of place of treatment. Its results add to a range of French studies derived from digestive tract cancer registries informing on social determination of colorectal cancer survival[4,5,29] and management.[30] Interestingly, the standard of housing with neither bath nor shower, which was the most influent variable in our study, was already mentioned as an independent prognosis factor in the study conducted on data from the other French digestive tract cancer registry of the Côte d'Or region (single level approach).[4] In our study, aggregate variables should only be considered as a substitute to individual data. Among them, the standard of housing is certainly one of the more reliable indicators of deprivation in French public health issues.

Previous French population-based studies focused on social determinants of cancer care management were limited by either the lack of individual data on social status or the lack of consideration of hierarchical structure (patients within districts) when aggregate data were used, this last limitation engendering potential biases.[4,13,30]

In addition, to improve understanding of social determinants in health, the purpose of investigating the mechanisms underlying social difference in cancer survival should be to suggest public health measures aimed at

Table 4 – Association of socio-economic characteristics of place of residence (level 2 variables) with care centre type for surgery among patients with colorectal cancer (n = 5156) according to period study (multilevel study)

	1981–1990 *n* = 2014							1991–2000 *n* = 3142						
	Reference centres		Other centres		OR_a	CI 95%	*p*	Reference centres		Other centres		OR_a	CI 95%	*p*
	N	%	N	%				N	%	N	%			
Level 1: patient														
Sex							NS							NS
Male	526	50.0	525	50.0	1			527	31.5	1146	68.5	1		
Female	462	48.0	501	52.0	0.97	0.80–1.19		434	29.5	1035	70.5	0.93	0.79–1.10	
Age														
< 60 years	240	51.9	222	48.1	1		NS	193		388	66.8	1		NS
60–69 years	301	51.5	284	48.5	1.08	0.82–1.41		252	29.5	602	70.5	0.92	0.72–1.18	
70–79 years	305	49.4	313	50.6	0.96	0.73–1.26		303	29.2	734	70.8	0.82	0.65–1.05	
80 years or more	142	40.7	207	59.3	0.74	0.54–1.02		213	31.8	457	68.2	0.93	0.71–1.21	
Stage of extension														<0.0001
Dukes A	278	50.4	274	49.6	1		NS	227	30.1	528	69.9	1		
Dukes B	166	53.0	147	47.0	1.23	0.88–1.74		207	39.5	317	60.5	1.98	1.53–2.58	
Dukes C	48	50.5	47	49.5	1.26	0.74–2.15		32	36.8	55	63.2	1.70	1.01–2.84	
Dukes 'D'	197	50.3	195	49.7	1.01	0.76–1.35		221	24.5	682	75.5	1.45	1.15–1.84	
Unknown	299	45.2	363	54.8	0.82	0.62–1.09		274	31.4	599	68.6	1.53	1.22–1.93	
Localisation							NS							NS
Colon	596	48.3	639	51.7	1			603	30.7	1358	69.3	1		
Rectum	392	50.3	387	49.7	1.06	0.87–1.30		358	30.2	827	69.8	1.02	0.86–1.21	
Type of surgery							NS							<0.01
Curative	919	49.1	951	50.9	1			896	29.8	2111	70.2	1		
Palliative	55	52.4	50	47.6	0.98	0.61–1.57		56	52.3	51	47.7	2.15	1.36–3.39	
Unknown	14	35.9	25	64.1	0.52	0.25–1.07		9	32.1	19	67.9	1.36	0.56–3.30	
Level 2: District of residence														
Distance to reference centre							<0.0001							<0.0001
<20 km	607	64.2	339	35.8	1			618	42.7	829	57.3	1		
20–34 km	169	46.6	194	53.4	0.50	0.32–0.76		158	25.4	462	74.2	0.49	0.34–0.71	
35–44 km	83	33.1	168	66.9	0.26	0.16–0.42		62	15.8	330	84.2	0.28	0.18–0.44	
45 km and more	129	31.6	325	71.9	0.21	0.13–0.33		123	18.0	560	82.0	0.28	0.18–0.42	
Housing standard with neither bath nor shower							NS							<0.01
<2%	609	56.7	466	43.3	1			602	35.6	1088	64.4	1		
2–4%	233	43.8	299	56.2	1.12	0.76–1.64		241	28.6	603	71.4	1.19	0.86–1.64	
4–7%	96	38.6	153	61.4	0.90	0.58–1.40		88	24.6	269	75.4	0.93	0.62–1.40	
7% and more	50	31.6	108	68.4	0.74	0.44–1.24		30	12.0	221	88.0	0.50	0.30–0.83	
Mean taxable income							NS							
< 15,000 €	686	47.8	750	52.2	1			605	28.6	1510	71.4	1		NS
15 000 € and more	302	52.2	276	47.8	0.82	0.59–1.15		356	34.7	671	65.3	1.00	0.75–1.34	
Residual Effects														
Level 2 variance (SE)					0.37	(0.14)	0.009					0.37	(0.11)	<0.001
VPC (%)					10.1							10.1		

improving management for the worst survival groups. In accordance with previous studies,[13,30] our study suggests that access to reference care centres is limited for certain populations: patients living in underprivileged districts (low income, high rate of uncomfortable housing) and patients living far from reference care centres. Contrary to certain European countries, differences in cancer survival according to care centre type have not yet been established in France; therefore the social determination of care centre types cannot yet be considered responsible for social difference in survival. Nevertheless, preservation of high quality of care management and rapid dissemination of improvements in non-reference care centres are crucial to avoid a social gradient in cancer mortality in France.

Conflict of interest statement

None declared.

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