



Research paper

The effect of age on specialized palliative care use in the last year of life for patients who die of cancer: A nationwide study from Norway

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ARTICLE INFO

Keywords:

Palliative care
Geriatric oncology
cancer
End of life
Socioeconomic status
Comorbidity
Epidemiological data
Registry data

ABSTRACT

Introduction: Specialized palliative care (SPC) is beneficial towards end of life because of its holistic approach to improve quality of life and comfort of patients and their families. Few studies have described how patient age, sex, comorbidities, and socioeconomic status (SES) are associated with SPC use in nonselective populations who die of cancer. This study aimed to evaluate the use of SPC in the year preceding death by all Norwegian individuals with a recent cancer diagnosis who died of cancer.

Materials and Methods: From nationwide registries, we identified patients with a recent (<5 years) cancer diagnosis who died during 2010–2014. Using binary logistic regression models, we estimated the probability of receiving hospital-based SPC during the last year of life according to individual (age, sex, comorbidity), cancer (stage, type, and months since diagnosis), and SES (e.g., living alone, household income, and education) characteristics.

Results: The analytical sample contained 45,521 patients with a median age at death of 75 years; 46% were women. The probability of receiving hospital-based SPC in the total cohort was 0.43 (95% confidence interval [CI] 0.42–0.43). Use of SPC was higher if patients were younger, female, had limited comorbidity, metastatic disease, had one the following cancer types: colorectal, pancreatic, bladder, kidney, or gastric, were diagnosed more than six months before death, and had higher SES. Adjusted model results suggested that the probability of using SPC in the last year of life for patients aged 80–89 years was 0.31 (95% CI 0.30–0.32), compared to a probability of 0.63 (95% CI 0.61–0.65) for patients aged 50–59 years. For patients ≥ 90 years, the probability was 0.16 (95% CI 0.15–0.18).

Discussion: Less hospital-based SPC use among older patients, males, and those with lower SES indicates possible under-treatment in these groups. Future studies should be designed to determine the underlying reasons for these observed differences.

1. Introduction

In the last period of life, patients with cancer prefer to have optimal symptom management, avoid hospitalizations, and be prepared for death [1]. Palliative care aims to improve the quality of life (QoL) and comfort of patients with serious conditions by providing relief from symptoms and the stress of illness [2]. Core components of palliative care are treatment of physical and psychological symptoms, communication to establish goals of care and assist with decision making about

complex medical issues, coordination of care, and support for spiritual distress [3]. The purpose of palliative care is also to reduce the burden of support often faced by caregivers. Several trials have demonstrated the benefits of palliative care interventions for improving QoL and symptom burden [4], and ideally, patients with serious illness should be offered palliative care regardless of their age and socioeconomic status (SES). Cancer is a leading cause of death worldwide, and with age being the most important risk factor for cancer, geriatric oncology has become a specific focus area for research in recent years [5]. There are studies

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<https://doi.org/10.1016/j.jgo.2022.08.002>

Received 12 January 2022; Received in revised form 24 May 2022; Accepted 8 August 2022

Available online 13 August 2022

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suggesting that older adults with cancer receive inadequate symptom management and insufficient delivery of supportive care [6,7], while underutilization of palliative care services is also thought most prevalent among this group [8]. The majority of studies are from the United States, but similar results have been found in studies from countries with universal health care, such as Norway and France [9,10]. Studies also indicate that SES and sex are decisive factors for receiving palliative care [10–12].

As the number of patients who die of cancer is increasing, research into the use of specialized health care services in the last year of life bears relevance at both the societal level, for planning health services (i. e., need for hospital beds/specialized health care services), and the individual level, for informing patients and caregivers about what lies ahead. Palliative care is unique because it is a service that has the patients' QoL at its core. A recent report by the independent Norwegian research organization Sintef concluded that the need for palliative care exceeds what is currently on offer in Norway [13]. In particular, this applies to specialized palliative care (SPC), which in the Norwegian universal public health care refers to palliative care provided by the tertiary and secondary health care services (hospitals). According to Norwegian policy, all palliative care is integrated into existing levels of public health care, and hospices are therefore rare. Furthermore, the respondents in the report considered the palliative care offered by the specialized health care services superior to what is offered in primary care (home care and nursing homes) due to a higher level of competence and resources. Therefore, we wanted to investigate if existing hospital-based SPC resources are equally distributed, or if the access for patients with cancer might be related to their age, sex, or SES.

Based on observations from clinical practice and the wider scientific literature, we hypothesized that older decedents with cancer received less SPC than their younger counterparts, and that the differences cannot be fully explained by differences in comorbidity, cancer types, cancer stage or SES. Due to extensive and comprehensive national registry data, it is possible to investigate the associations between SPC use and age, comorbidity, cancer characteristics and SES for a full nationwide sample of patients with a recent cancer diagnosis who later died of cancer.

2. Material and Methods

2.1. Study Design and Cohort Selection

In Norway, with a population of 5.4 million, specialized health care services are financed through taxation, and hospital treatment including SPC is free of charge for individual patients. This is a population-based, retrospective study of a cohort of all patients who had cancer in their recent (<5 years) medical history and died in Norway between January 1, 2009, and December 31, 2014. To avoid issues of left censoring, we excluded patients for whom we did not have twelve months observation time in the dataset. The analytical sample is thus restricted to patients who died on or after January 1, 2010. The study was approved by the Regional Committee for Medical and Health Research Ethics in North Norway (2016/2312/REK nord).

2.2. Data Sources

We used the Cancer Registry of Norway (CRN) to identify index cases of patients with a cancer diagnosis in their histories. The CRN is a population-based cancer registry with high quality, comparability, completeness, and validity (Cancer In Norway 2020) [14]. The completeness is approximately 98.6% when all cancer diagnoses are considered. All Norwegian citizens have a personal identification number. Using encrypted personal identification numbers, we linked index cases from the CRN to the National Patient Register (NPR), the Cause of Death Registry (DAAR) and sociodemographic registers held at Statistics Norway (SSN). NPR provided diagnostic and procedure information on all discharges and outpatient contacts from public hospitals for residents

of Norway, DAAR provided information on all registered deaths in Norway, while SSN data were used to obtain proxy measures of patient SES. Information on comorbidity during the year prior to diagnosis was captured from NPR [15].

2.3. Classification of Variables

2.3.1. Main Outcome Measure and Relation to Organization of Palliative Care in Norway

Palliative care in Norway is offered on all levels of the public health care system: tertiary care, with palliative medicine units in university hospitals coupled with research groups; secondary care, with hospital-based consult teams, inpatient units, and outpatient clinics; and primary care, with home care and small, designated palliative care units in nursing homes (limited number of beds). In this study, the term SPC refers to palliative care offered only by secondary and tertiary care, which is hospital-based palliative care. A billing code was invented in 2003 for hospital-based palliative care in Norway to ensure more robust funding, and due to excessive demands in the first year; specific conditions for palliative care teams and units were put in place for financial reimbursement [16]. This system has encouraged the development of new services; and most Norwegian middle-sized or large hospitals have their own palliative care program. The use of SPC was therefore identified using the ICD-10 "SPC" coding (Z51.5) as a primary or related diagnosis in NPR, either during hospital admission (inpatient) or in outpatient clinics. The variable SPC was calculated as a dichotomous indicator (yes/no) of whether the patient received any inpatient SPC, outpatient SPC, or both at least once during the last year of life.

2.3.2. Independent Variables

Age, sex, date of diagnosis, type of cancer, stage of cancer at diagnosis (metastatic versus non-metastatic), number of cancer diagnoses (multiple cancers versus one cancer), and date of death were available from CRN. When patients had multiple cancers diagnosed throughout life, we used the date and type of the last non-skin cancer diagnosis before death in the analyses. Comorbidity was calculated using a version of the Charlson Comorbidity Index (CCI) adapted to national patient registers, and categorized into four groups: no hospital admissions (CCI = no admission); low (CCI = 0); intermediate (CCI = 1–2); and high (CCI ≥ 3) [15]. Cancer was considered the index disease, and therefore excluded as a comorbidity. All sociodemographic information was obtained from SSN and refer to the year prior to death (i.e., number of household members [dichotomized into living alone vs not alone], educational level, and household income). Educational attainment was categorized as low (<12 years) versus high (13 or more years), whereas household income was categorized into quartiles relative to age group, sex, and year. Household income is the combined sum of income from work, property income, taxable transfers, and tax-free transfers received during the calendar year for all household members. Place and cause of death were obtained from DAAR.

2.4. Statistical Analyses

With our measure of SPC use being dichotomous, we employed binary logistic regression. Our main independent variable of interest was patient age in years at death (<50, 50–59, 60–69, 70–79, 80–89, 90+). Based on clinical experience and findings from the literature, our models also accounted for type and stage of cancer at diagnosis, multiple cancers, months between diagnosis and death, comorbidity, as well as sociodemographic characteristics (sex, living alone, educational level, household income). Our first model examined the main effects of the independent variables on SPC use. A second logistic regression model incorporated interaction terms to assess how the SPC and age association was modified by cancer characteristics, comorbidity, sex, household composition (living alone), educational attainment, and household income across age-at-death categories. The marginal effects were used to

calculate the predicted probability of receiving SPC. In order to aid interpretation of the interaction effects, predicted probabilities of the interaction effects are presented in Fig. 1 and Fig. 2. All statistical analyses were performed in Stata, version 16.

3. Results

3.1. Descriptive Statistics

Overall, 101,705 patients were included. The cohort was restricted to patients who had a cancer diagnosed within the five years preceding death ($n = 69,883$), and patients with only skin cancer (except melanoma) were excluded ($n = 2639$). To avoid issues of left censoring, we excluded patients for whom we did not have twelve months observation time in the dataset ($n = 8345$). We also excluded patients who died of causes other than cancer ($n = 10,608$). The remaining cohort consisted of 45,521 patients, and patient and tumor characteristics for these patients are presented in Table 1. Median age at death was 75 years (interquartile range [IQR] 66–83); 46% of the patients were women. Altogether, 19,053 (42%) had distant metastases at diagnosis, and 19,908 (44%) were diagnosed with cancer less than six months before death. The most frequent cancer types were lung (23%), colorectal (15%), pancreatic (7%), prostate (6%), breast (4%), and gastric (4%). The most common comorbidity group was CCI = 0 (46%), while 15% had CCI = 1–2, 8% had CCI ≥ 3 and 31% had no hospital admissions in the year prior to diagnosis. Most patients died in nursing homes (46%), while 42% died in hospitals and 12% died at home. With increasing age, the proportion of patients who died in nursing homes and who were diagnosed less than six months before death increased substantially. The distributions of place of death and months since diagnosis according to

age group are presented in Tables 2 A and B, respectively.

3.2. Factors Associated with SPC Utilization in the Last Year of Life

3.2.1. Patient Characteristics

Specialized palliative care was received by 19,404 patients (43%); 17,375 (38%) received SPC as inpatients, 8246 (18%) received SPC as outpatients, and 6217 (14%) received both inpatient and outpatient SPC. Table 1 displays the use of SPC according to patient characteristics. Table 3 displays the results, in terms of odds ratios (OR), from the multivariate logistic regression analysis without interaction terms. Older age was strongly associated with less use of SPC; indeed, patients aged 90 or older had an OR of 0.09 (95% confidence interval [CI] 0.08–0.11), relative to patients younger than 50 years.

3.2.2. Cancer Characteristics and SES

The odds of using SPC was higher if patients had metastatic disease at diagnosis, multiple cancers, or cancer diagnosed 6–60 months before death. Patients with colorectal cancer, pancreatic cancer, bladder cancer, kidney cancer, and gastric cancer had higher odds of receiving SPC. Patients with lung cancer, brain cancer, and myeloma had lower odds of receiving SPC. Higher education and higher household income were associated with a higher likelihood of receiving SPC, while higher odds were also observed for females as compared to males. There was a statistically significant interaction between sex and living alone, wherein we observed that living alone significantly increased the odds of receiving SPC for women, while being male significantly decreased the odds of receiving SPC (data not shown). Significant interaction effects were observed between age at death and comorbidity, cancer stage, months since diagnosis, colorectal cancer, educational attainment,

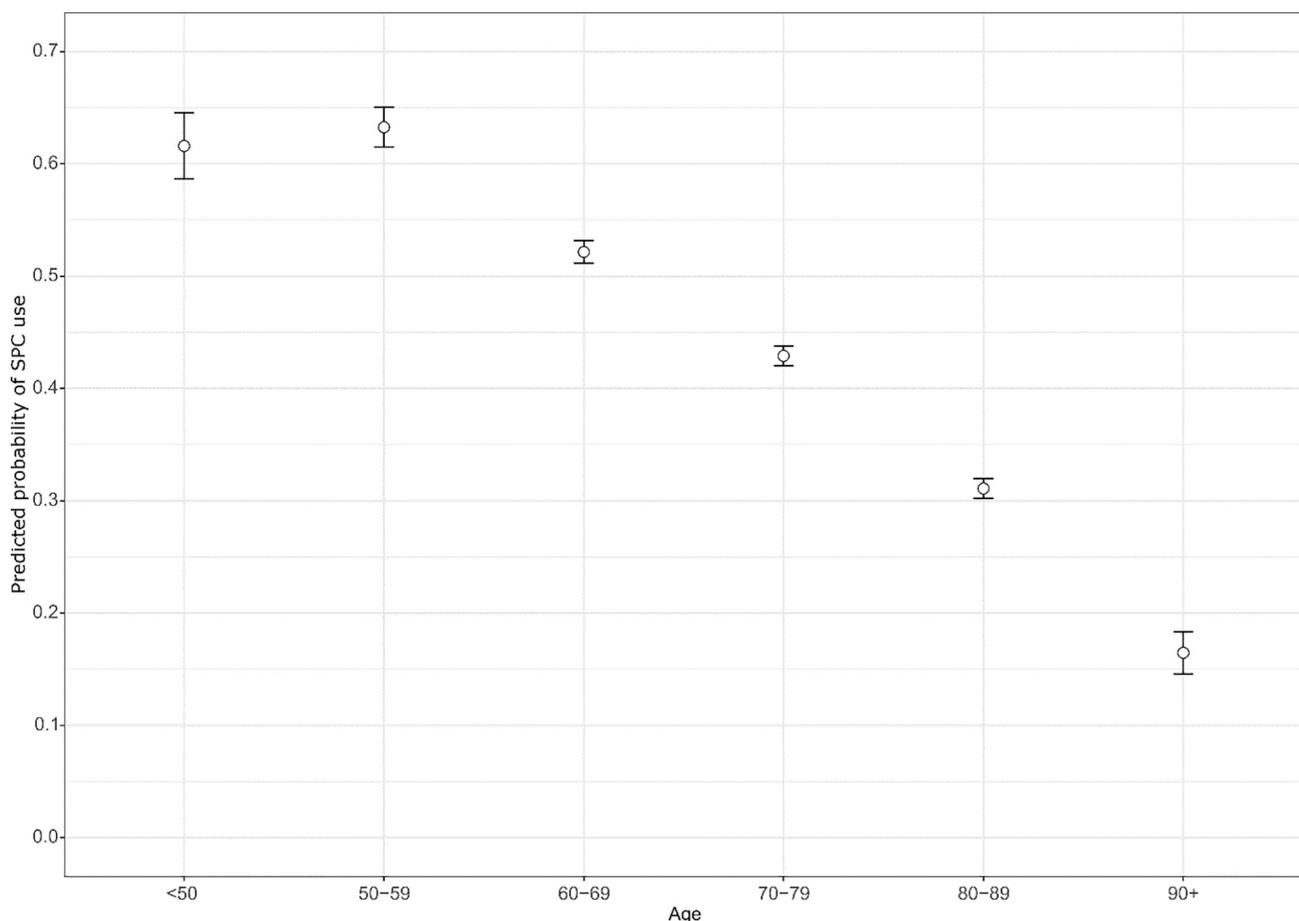


Fig. 1. Predicted probability of specialized palliative care (SPC) use in the last 12 months of life in age at death groups, age in years.

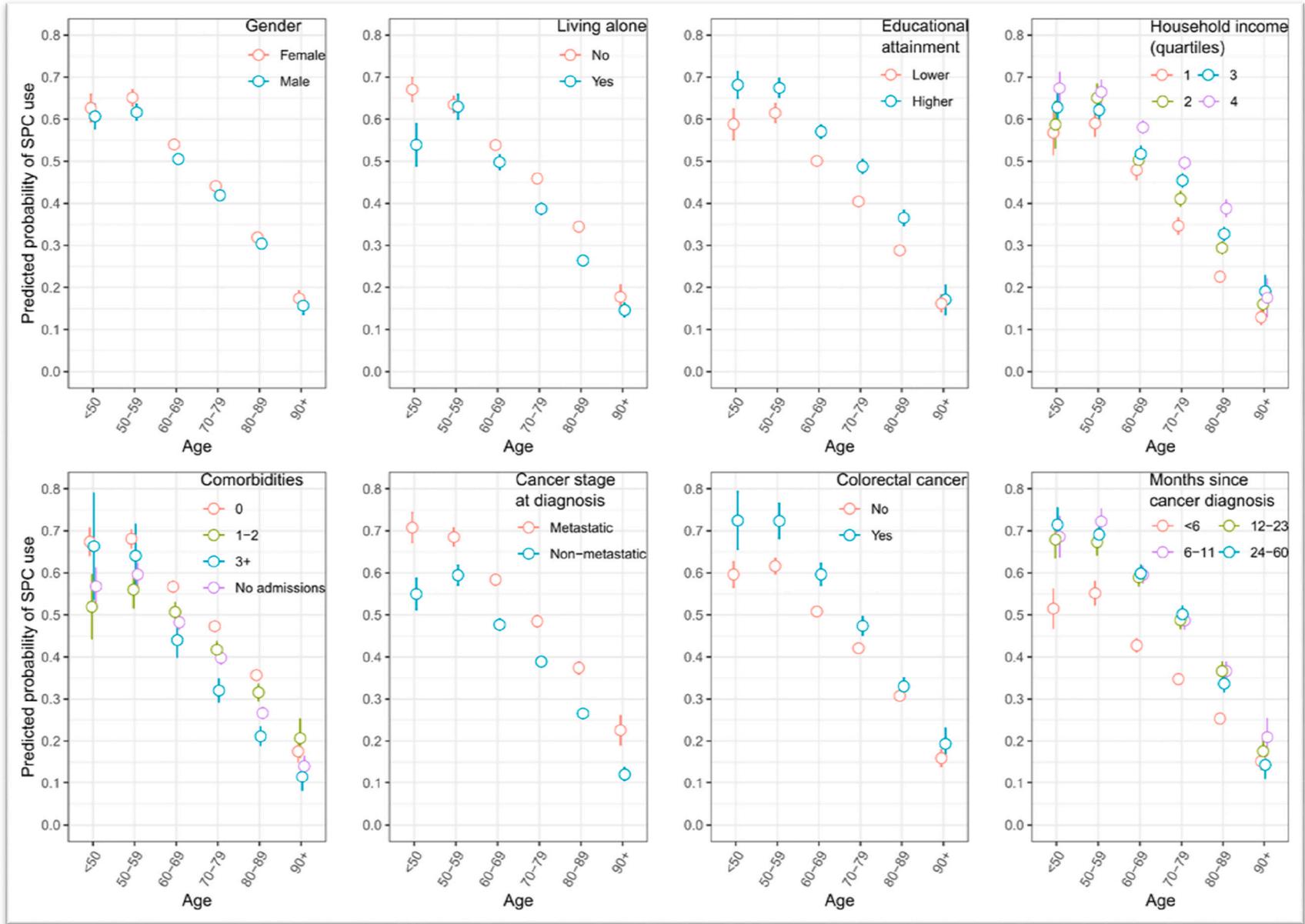


Fig. 2. Predicted probability of specialized palliative care (SPC) use by age at death modified by sex, living alone, educational attainment, household income, comorbidities, cancer stage at diagnosis, months since diagnosis, and colorectal cancer.

Table 1
Sociodemographic data and use of specialized palliative care.

	Use of specialized palliative care before death, (column proportion)		
	No	Yes	Total
Total (N, row proportion)	26,117 (0.57)	19,404 (0.43)	45,521 (1.0)
Age at death, years			
Age mean [SD]	76.9 [12.1]	69.1 [12.8]	73.6 [13]
Age median [IQR]	79 [69.4–85.7]	70 [61.6–78.6]	75 [65.7–83.3]
Age at death, years, grouped			
<50	633 (0.02)	1394 (0.07)	2027 (0.04)
50–59	1449 (0.06)	2753 (0.14)	4202 (0.09)
60–69	4761 (0.18)	5707 (0.29)	10,468 (0.23)
70–79	7022 (0.27)	5445 (0.28)	12,467 (0.27)
80–89	9341 (0.36)	3664 (0.19)	13,005 (0.29)
90+	2911 (0.11)	441 (0.02)	3352 (0.07)
Sex			
Male	14,119 (0.54)	10,256 (0.53)	24,375 (0.54)
Female	11,998 (0.46)	9148 (0.48)	21,146 (0.46)
Comorbidity index 1 year prior to death			
no admission	8801 (0.34)	5481 (0.28)	14,282 (0.31)
CCI = 0	10,738 (0.41)	9990 (0.51)	20,728 (0.46)
CCI = 1–2	4130 (0.16)	2910 (0.15)	7040 (0.15)
CCI ≥ 3	2448 (0.09)	1023 (0.05)	3471 (0.08)
Multiple cancers			
No	20,064 (0.77)	15,371 (0.79)	35,435 (0.78)
Yes	6053 (0.23)	4033 (0.21)	10,086 (0.22)
Cancer stage at diagnosis			
Non-metastatic	16,774 (0.64)	9694 (0.50)	26,468 (0.58)
Metastatic	9343 (0.36)	9710 (0.50)	19,053 (0.42)
Cancer site			
Lung	6318 (0.24)	4262 (0.22)	10,580 (0.23)
Colorectal	3822 (0.15)	3148 (0.16)	6970 (0.15)
Prostate	1735 (0.07)	993 (0.05)	2728 (0.06)
Breast	931 (0.04)	830 (0.04)	1761 (0.04)
Pancreatic	1343 (0.05)	1847 (0.10)	3190 (0.07)
Brain	976 (0.04)	509 (0.03)	1485 (0.03)
Bladder	899 (0.03)	563 (0.03)	1462 (0.03)
Ovarian	575 (0.02)	597 (0.03)	1172 (0.03)
Uterine	354 (0.01)	287 (0.01)	641 (0.01)
Kidney	544 (0.02)	533 (0.03)	1077 (0.02)
Gastric	853 (0.03)	832 (0.04)	1685 (0.04)
Myeloma	666 (0.03)	240 (0.01)	906 (0.02)
Other	7101 (0.27)	4763 (0.25)	11,864 (0.26)
Months since cancer diagnosis			
<6 months	13,315 (0.51)	6593 (0.34)	19,908 (0.44)
6–11 months	3969 (0.15)	4110 (0.21)	8079 (0.18)
12–23 months	4070 (0.16)	4121 (0.21)	8191 (0.18)
24–60 months	4763 (0.18)	4580 (0.24)	9343 (0.21)
Living alone			
No	13,818 (0.53)	12,778 (0.66)	26,596 (0.58)
Yes	12,299 (0.47)	6626 (0.34)	18,925 (0.42)
Household income			
Lowest quartile	7327 (0.28)	3523 (0.18)	10,850 (0.24)
Quartile 2	6626 (0.25)	4442 (0.23)	11,068 (0.24)
Quartile 3	6397 (0.24)	5170 (0.27)	11,567 (0.25)
Highest quartile	5767 (0.22)	6269 (0.32)	12,036 (0.26)
Education			
High	6544 (0.25)	6987 (0.36)	13,531 (0.30)
Low	19,573 (0.75)	12,417 (0.64)	31,990 (0.70)
Place of death			
Hospital	10,179 (0.39)	8946 (0.46)	19,125 (0.42)
Nursing home	12,960 (0.50)	7756 (0.40)	20,716 (0.46)
Home	2698 (0.10)	2547 (0.13)	5245 (0.12)
Other/missing	280 (0.01)	155 (0.01)	435 (0.01)

Abbreviations: SD; standard deviation, IQR; interquartile range, CCI: Charlson comorbidity index.

household income, and living alone. The estimated coefficients from the final interaction model are shown in the online appendix Table A1.

3.2.3. Predicted Probabilities of Using SPC

Fig. 1 presents the predicted probability of using SPC in the last year

of life by age at death based on the final interaction model. The predicted probability for patients aged 80–89 years was 0.31 (95% CI 0.30–0.32), while for patients aged 50–59 years, we observed a probability of 0.63 (95% CI 0.61–0.65). For patients aged 90 years or above, the probability was 0.16 (95% CI 0.15–0.18). Fig. 2 shows the effect of age on SPC use was modified by sex, living alone, educational attainment, household income, comorbidities, cancer stage at diagnosis, months since diagnosis, and colorectal cancer.

A noticeable decline in the variation of SPC use between SES groups is observed among the 90+ age group, when compared to younger age groups.

4. Discussion

In this national sample of 45,521 patients who died of cancer, 43% received hospital-based SPC in their last year of life. The probability of receiving SPC decreased markedly with increasing age. The use of SPC was also lower for patients who were male, lived alone, had low income or low education. There was relatively little variation between different sociodemographic characteristics in SPC use among patients who were 90 years or older at death.

A recent systematic review by Parajuli et al. (2020) [8] assessed research into the utilization of palliative care and hospice care among older patients with cancer, and identified nineteen studies. Of these studies, seventeen were from the US, one from Canada, and one from the Netherlands. In line with our results, these studies identified less use of palliative or hospice care among males, unmarried individuals, those with low SES, free-for-service enrollees, and those residing in rural areas. The results were mixed with regards to the association between advancing age and palliative and hospice care use. With that said, a separate study of the use of palliative radiotherapy in Norway suggested markedly lower usage both among individuals aged 80+ years and those with low household income [9]. Likewise, a nationwide study from France observed that 57% of patients who died within two years of a cancer diagnosis had access to inpatient palliative care and, while this share is far higher than we observe in our Norwegian data, older age and being male were again associated with less SPC use [10]. The consistent finding that males receive less SPC needs further exploration. Sex differences in patient preferences for palliative care have been documented [17]. A contributing explanation may also be that men with female partners use fewer services because women take on a larger care burden for a sick partner, similar to what is observed in the use of long-term care [18].

Why does age at death have such a strong association with the use of SPC? One explanation could be that the palliative care needs of older adults are handled in primary care and in hospital departments without SPC. Because the Norwegian SPC service is closely connected to oncology departments, the primary gateway to SPC runs via oncologists. One reason for not having received SPC may be that patients were not referred to an oncology department because of frailty or extensive comorbidity. In such cases, follow-up and potential referrals to SPC are left to the primary health care service. The use of palliative care in primary care and hospital departments without SPC was not captured in this study. Compared to hospital-based SPC, there is limited documentation regarding the effect of basic palliative care on QoL and patient satisfaction in both settings [13,19,20]. A recent overview of systematic reviews, which summarized evidence of the effects of palliative care interventions in nursing homes and in patients' homes, concluded that it is uncertain whether home-based or nursing home-based palliative care has an effect on patients with different diagnoses [20]. Furthermore, low adherence to national guidelines for palliative care by general practitioners in Norway has been demonstrated, and the majority of respondents reported a need to improve their knowledge of palliative care [19]. In general hospital departments delivering basic palliative care, 80% of respondents reported that competencies regarding palliative care need to be strengthened [13].

Table 2

A: Distribution of age at death and place of death, (row proportion). B: Distribution of age and months since diagnosis, (row proportion)

A	Place of death				B	Months since cancer diagnosis				
	Hospital	Nursing home	Home	Other/missing		<6 months	6–11 months	12–23 months	24–60 months	Total
Age at death, years										
<50	1290 (0.63)	389 (0.19)	331 (0.16)	17 (0.01)	510 (0.25)	403 (0.20)	519 (0.26)	595 (0.29)	2027 (1.0)	
50–59	2337 (0.56)	1178 (0.28)	646 (0.15)	41 (0.01)	1321 (0.31)	900 (0.21)	943 (0.22)	1038 (0.25)	4202 (1.0)	
60–69	5517 (0.53)	3452 (0.33)	1403 (0.13)	96 (0.01)	3880 (0.37)	2156 (0.21)	2211 (0.21)	2221 (0.21)	10,468 (1.0)	
70–79	5408 (0.43)	5475 (0.44)	1470 (0.12)	114 (0.01)	5500 (0.44)	2343 (0.19)	2220 (0.18)	2404 (0.19)	12,467 (1.0)	
80–89	3977 (0.31)	7785 (0.60)	1111 (0.09)	132 (0.01)	6790 (0.52)	1866 (0.14)	1894 (0.15)	2455 (0.19)	13,005 (1.0)	
90+	596 (0.18)	2437 (0.73)	284 (0.08)	35 (0.01)	1907 (0.57)	411 (0.12)	404 (0.12)	630 (0.19)	3352 (1.0)	
Total	19,125 (0.42)	20,716 (0.46)	5245 (0.12)	435 (0.01)	19,908 (0.44)	8079 (0.18)	8191 (0.18)	9343 (0.21)	45,521 (1.0)	

Table 3

Logistic regression model presenting odds ratios of receiving SPC in the last year of life, model not including interaction terms.

Age at death, years, grouped	OR	95% CI	
<50	1		
50–59	0.87	0.76	0.98
60–69	0.55	0.50	0.62
70–79	0.38	0.34	0.42
80–89	0.22	0.19	0.24
90+	0.09	0.08	0.11
Sex			
Female	1		
Male	0.85	0.82	0.89
Comorbidity index 1 year prior to death			
no admission	1		
CCI = 0	1.21	1.15	1.27
CCI = 1–2	1.02	0.95	1.09
CCI = 3+	0.77	0.71	0.85
Multiple cancers			
No	1		
Yes	1.09	1.03	1.14
Cancer stage at diagnosis			
Non-metastatic	1		
Metastatic	1.64	1.57	1.72
Cancer site			
Lung	0.87	0.83	0.92
Colorectal	1.20	1.13	1.28
Pancreatic	2.16	2.04	2.41
Brain	0.56	0.50	0.64
Bladder	1.30	1.16	1.47
Kidney	1.36	1.19	1.55
Gastric	1.52	1.36	1.69
Myeloma	0.59	0.51	0.70
Months since cancer diagnosis			
<6 months	1		
6–11 months	1.90	1.80	2.01
12–23 months	1.82	1.71	1.94
24–60 months	1.88	1.77	2.00
Living alone			
No	1		
Yes	1.01	0.99	1.11
Household income			
Lowest quartile	1		
Quartile 2	1.25	1.17	1.33
Quartile 3	1.35	1.25	1.45
Highest quartile	1.55	1.43	1.68
Education			
Low	1		
High	1.22	1.16	1.27

Abbreviations: SPC: specialized palliative care; OR: odds ratio; CI: confidence interval; CCI: Charlson comorbidity index.

A secondary gateway to Norwegian SPC runs via hospital admission. If the primary diagnosis for the admission is cancer-related, palliative care referrals are often executed [13]. If the patient is admitted for other reasons, which is likely as older patients have more comorbidities, this may be forgotten. Comorbidities may also confuse the picture of symptoms, and although older patients with cancer and multimorbidity

report higher levels of pain [21], palliative care referrals may not be performed if symptoms are thought to be the results of chronic diseases or age-related problems [13]. In addition, older patients may complain less and/or expect more symptoms, and without proper assessments, SPC may not be judged as needed [22]. Therefore, given the growing number of older patients with cancer, geriatric expertise is needed both in palliative and oncology teams.

Place of death in our study warrants discussion. In agreement with Norwegian policy and guidelines, all palliative care is integrated into existing levels of public health care, and therefore hospices are not common. Instead, patients of all ages are admitted to nursing homes when they are unable to live at home, and a large proportion die there. Norway also has a high percentage of patients with cancer dying in acute-care hospitals compared to other countries [23]. Furthermore, the rate of home death has been stable around 12–15% from 2004 to 2018, and this is low compared to other European countries. In our sample, 46% died in nursing homes; for patients who were 80–89 years or 90 years and older the proportions were 60% and 73%, respectively. Deaths in nursing homes warrant special considerations. The palliative care needs in nursing homes are huge, with 80% of patients having dementia and the majority needing assistance with activities of daily living [24]. However, these issues are not traditionally incorporated into palliative care, which is often regarded as pain treatment and symptom management only. About 1% of the total number of beds in nursing homes in Norway are dedicated beds for palliative care, and are almost exclusively used for patients dying of cancer [13]. As nursing homes typically provide care to patients in the late stages of life, travelling to the hospital for SPC may do more harm than good for older patients with frailty and comorbidity, which might explain a lower use of SPC. However, when we restrict our analysis to patients with multiple hospitalizations who die in the hospital, the association between age and SPC use is unchanged, indicating that this is not a major explanation for findings regarding advancing age and reduced SPC use (data not shown).

In the present study we also found lower overall use of SPC among patients with a lower SES, perhaps because patient-provider communication and use of specialist care tend to vary along both educational and income dimensions [25,26]. Thus, patients with high education and high income might be better able to demand more optimal care than persons with fewer resources. This may also apply to patients who live alone, who also receive less hospital-based SPC. Indeed, partnered patients could call on the support of their partners when seeking to navigate relatively complex healthcare systems, which may lead to better outcomes [25].

The variation in SPC use by cancer type also warrants discussion. Cancer types associated with significantly more SPC use were pancreatic, gastric, kidney, colorectal, and bladder cancer. Cancer types with significantly less use of SPC were lung, brain, and multiple myeloma. By the time of diagnoses and death of the patients in the present study, there were few treatment options available in the metastatic setting for many of the cancer types that were associated with higher SPC use. Thus, as SPC has often been referred to when no further treatment was

available, this may be one explanation for our finding. Pancreatic and gastric cancer are cancer types with a particularly high symptom burden. However, similar issues apply to both lung and brain cancer. These cancers, as well as multiple myeloma, are often attended to by pulmonologists, neurologists, and hematologists, respectively, rather than by oncologists, and palliative care is integrated into these clinics to a lesser extent. Others have also found that patients with hematological malignancies receive less palliative care than patients with solid tumors [27]. In a study from the US, it was found that despite a high symptom burden, many patients with high-grade gliomas did not receive the same level of palliative care and had fewer interactions with palliative care services than other cancer populations [28].

Our study has some limitations. Firstly, the population-based approach includes a heterogeneous sample of patients varying from patients who were diagnosed with advanced cancer only a few months before they died to patients who were diagnosed up to five years before death. Secondly, cause of death reporting is less accurate in older adults. However, the results of our study were mainly unchanged when we included all causes of death in the analyses. Thirdly, the income variable used as an SES proxy may be less relevant for the older ages included here, since most receive old-age pensions. Information on capital gains that relate, for instance, to homeownership would have improved this proxy. Fourthly, as we did not have information on the housing conditions of the patients, parts of the reason for the low SPC usage among the oldest might be because a significant share resided in nursing homes. Lastly, an important limitation is that we have only focused on SPC carried out in the secondary and tertiary health care system. Our dataset does not include palliative care in the primary health care system or in hospital departments that do not fulfill the requirements to use the billing code for SPC. In addition, this analysis is purely descriptive and is focused on examining associations. It cannot reveal the mechanisms underpinning these associations. As such, there is scope for more detailed and in-depth qualitative work in this area.

Our results highlight several potential next steps for the population of older patients who die of cancer. Increasing evidence suggests that introducing palliative care early in the disease trajectory is beneficial [29]. Screening tools may be used to identify patients based on palliative care needs and not age. And lastly, education of oncologists, internists, surgeons, and community providers about what SPC can offer could raise attention and thereby increase referrals to such services regardless of patient age.

In summary, our analyses show that older adults who die of cancer receive much less hospital-based SPC than equivalent younger adults, indicating under-treatment. Closer attention should therefore be paid to these patients and their needs. Older adults with cancer do not have strong support groups, and the need for improving QoL and comfort by addressing relief from symptoms and stress of illness, improving coordination of care, and discussing preferences with trained professionals is independent of patient age. Patients with a high comorbidity burden or dependency may also be considered too frail to be evaluated for tumor treatment, and with the growing population of older adults with cancer there is a need for increased palliative care resources both inside and outside of hospital.

Authorship contributions

Conceptualization: SR, AS, MS, BM
 Study design: SR, AS, MS, BM.
 Data acquisition: SR.
 Quality control of data: SR, AS.
 Data analysis and interpretation: SR, AS, MS, MJT, BM.
 Formal analysis: SR, AS, MJT.
 Funding acquisition: SR, AS, MS, BM
 Writing - original draft: SR.
 Writing - review & editing: All authors.

Funding acknowledgement

This study was funded by a research grant from South-Eastern Norway Regional Health Authority (to SR).

Declaration of Competing Interest

Authors report no conflicts of interest.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jgo.2022.08.002>.

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