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Factors associated with healthcare utilisation during first year after cancer diagnose—a population-based study

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Abstract

Background: Improved cancer treatments and models of care (such as early palliative care) has developed during recent years. Aspects of healthcare utilisation—unplanned care have been used for evaluation of coordination and quality. The aim was to explore factors associated with cancer healthcare utilisation, during the first year after a cancer diagnosis.

Methods: Population-based registry and patient-reported data, (The European Organisation of Research and Treatment of Cancer (EORTC), QLQ- C30 questionnaire and study-specific questions) were collected. Descriptive statistics and multivariate regression models were performed.

Results: The sample consists of 1718 patients (haematological, gynaecological, upper gastrointestinal and head and neck cancers). Living alone were associated with unplanned hospital admissions (OR 1.35; 95% CI [1.15, 1.59], $p < 0.001$). Patients with specialised palliative home care had a higher likelihood of unplanned hospital admissions, (OR 4.35; 95% CI [3.22-5.91], $p < 0.001$) and re-admissions within 30 days, (OR, 5.8; 95% CI [4.12-8.19], $p < 0.001$).

Conclusions: Sociodemographic and clinical factors, such as living alone and disease stage, is associated with healthcare utilisation. Patients with specialised palliative home care report lower levels of HRQoL and higher levels of unplanned care, and our findings stresses the importance of a holistic view when planning care.

KEYWORDS
Hospitalisation, Length of Stay, Neoplasms, Palliative care, Patient Acceptance of Health Care, Patient Re-admission

1 | INTRODUCTION

Developments in cancer treatment during recent decades have resulted in improved survival (Cancerplan & Stockholm-Gotland, 2020-2023; Padma, 2015; Tan et al., 2020), and an increasing demand for coordination of care, symptom management and psychosocial support. These developments have also increased the economic burden on healthcare systems (Chalkidou et al., 2014). The main contributor of costs in cancer care is healthcare utilisation (Sullivan et al., 2011). We defined this term as the quantification and description of the use of healthcare services during a defined time period (Carrasquillo, 2013). Previous research on cancer healthcare utilisation, mostly focus on end-of-life (EoL) care and/or advance stage disease. Unplanned care is an indicator to evaluate healthcare utilisation (Frolich et al., 2008) and may

be impacted by diagnosis (Henson et al., 2018), symptom burden (Johnson et al., 2019), co-morbidity (Kidane et al., 2018) and socioeconomic factors (Henson et al., 2018). Aspects of healthcare utilisation have been used as indicators to demonstrate how well healthcare systems are integrated and structured (BLOCKS: tools & Methodologies to assess integrated care in Europe, 2017; Cortis et al., 2017; Shaw, 2011).

Palliative care introduced concurrent with acute cancer care has been shown to improve quality of life and symptom management, reduce unplanned hospital visits and prolong survival (El-Jawahri et al., 2011; Ferrell et al., 2016; Greer et al., 2012; Scibetta et al., 2016; Temel et al., 2010; Vanbutsele et al., 2018; Zimmermann et al., 2014). Therefore, new concepts of care have been introduced, for example early palliative care (Temel et al., 2010) and integrated palliative care, (Ferrell et al., 2016). However, these concepts are not always clearly defined and have rarely been systematically implemented (Kaasa et al., 2018).

Sweden have a long tradition of publicly financed health care with a national healthcare insurance covering almost all healthcare costs and all legal residents. Traditionally, a vast majority of healthcare providers have been operated through the public healthcare system. During the last decade, the organisation of health care in the Stockholm region has changed. Now around 60% of all primary care providers and 30% of the hospitals treating patients with cancer are operated privately, but still tax-funded and not increasing patients out-of-pocket costs (Burström, 2015). Similar developments are ongoing regarding specialised palliative home care (SPHC).

Recent surveys from the region, revealed that the integration between SPHC and acute cancer care were inadequate (Ullgren et al., 2017; Westman et al., 2019). In summary, cancer care often includes several healthcare providers and if needed, non-medical social support may also be provided (organised by the municipality). To our knowledge, no formal evaluation has previously been performed, and no population-based studies could be found exploring healthcare utilisation over time, from cancer diagnosis, through treatment and follow-up.

The aim of this study was to explore healthcare utilisation, health-related quality of life, sociodemographic and clinical factors during the first year after cancer diagnosis.

2 | MATERIALS AND METHODS

2.1 | Study design

We performed a population-based, retrospective study analysing patient-reported and registry data from the Stockholm-Gotland region, Sweden. The Regional Ethical Review board approved the study (2018/2230-31/5). When reporting the data, we followed the STROBE (strengthening the reporting of observational studies in epidemiology) checklist (von Elm et al., 2007).

2.2 | Participants

In two previously conducted population-based survey's, patients diagnosed with haematological-, gynaecological-, upper gastro intestinal (upper GI)—and Head & Neck (H&N), in the years of 2014 and 2016, were included (Sharp et al., 2018; Ullgren et al., 2017; Westman et al., 2019). Those patients were identified via cancer site-specific quality registries (Emilsson et al., 2015; Lofgren et al., 2019; Tingstedt et al., 2019). The responders of those surveys are the participants in this study. For the purpose of this study, we linked survey data with registries (see section on registry data).

2.3 | Data collection

2.3.1 | Patient-reported data

To collect patient-reported data, we used a validated tool and a study-specific questionnaire. Health-related quality of life (HRQoL) was analysed using The European Organisation of Research and Treatment of Cancer (EORTC), QLQ- C30 questionnaire that includes five functional scales, three symptom scales and additional single items on symptoms as well as two items on global health status/quality of life (QoL). A four-point Likert scale, ranging from 1 (not at all) to 4 (very much), alternatively 1 (very poor) to 7 (excellent) were used for scoring the responses (Aaronson et al., 1993). The 57-item study-specific questionnaire, developed by a local research team, includes items on; demographics (8 items), investigation and cancer diagnose (11 items), information exchange and patient participation (20 items), palliative care and care transitions (18 items). In this current study, four items on socioeconomic status and one on cancer treatment were included in the analysis.

2.3.2 | Registry data

We used data from cancer site-specific quality registries (Emilsson et al., 2015; Lofgren et al., 2019; Tingstedt et al., 2019) and the VAL-registry (a local database storing data on healthcare utilisation). The VAL-registry covers 99% of Stockholm-Gotland's hospital care (planned and/or unplanned admissions, outpatient care, length of stay, LoS) (Carlsson et al., 2013). Diagnoses are coded according to the World health organization (WHO) International Classification of Diseases, 10th edition (ICD-10).

2.3.3 | Linkage of data

The survey data were linked with data from the above-described registries. The linking procedure was performed using unique personal identification numbers, assigned to all residents (by birth or on immigration) that enables accurate linkage between registries (Ludvigsson et al., 2009).

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2.4 | Statistical methods and analysis

We defined five outcome measures as dependent variables. The first two LoS and Total number of times admitted to hospital were defined as discrete count variables. Patients without any hospital admission were given zero values. The remaining three dependent variables, unplanned admissions to hospital, unplanned re-admissions within 30 days of discharge from hospital and SPHC were considered as binary variables. All five dependent variables are measuring the total healthcare utilisation, from the date of diagnosis and the following 365 days. In addition to gender, age and cancer site, the following variables were considered as explanatory variables; type of cancer treatment and stage, country of birth, education level, living situation, occupational status and HRQoL (EORTC QLQ-C30). We calculated the EORTC QLQ-C30 scores according to the scoring manual (Fayers, Bottomley, Group, & Quality of Life, 2002) and linearly transformed them into a 0 - 100 scale High scores on the functional scales indicate higher level of functioning, whereas higher scores on the symptom scales indicates higher level of symptoms. A summary score of EORTC QLQ-C30 was calculated, based on 27 items (excluding global health and financial difficulties) (Giesinger et al., 2016).

Treatment (surgery, radiotherapy, chemotherapy or other) was dichotomised into 'Single modality' / 'Multi-modality), disease stage was dichotomised into 'Low' (I-II) and 'High' (III-IV) stage. As a proxy for stage among the haematological patients, patients were divided into high / low stage depending on diagnosis (TableS1). Occupational status was divided into three groups (working, retired or other).

Descriptive statistics was used for describing the clinical and patient characteristics, and discrete count variables are presented with mean, standard deviation, median, quartiles, minimum and maximum. The categorical variables are presented with frequencies and percentages.

We summarised the EORTC QLQ-C30 scores with frequencies, mean and standard deviations (SD). To evaluate mean differences, Mann-Whitney-Wilcoxon test was performed.

To investigate any relationship between healthcare utilisation, sociodemographic and clinical variables, we computed multivariate negative binominal regression models for dependent variables total LoS and total number of times admitted to hospital, estimating incidence rate ratio (IRR) with bootstrapped (Efron & Tibshirani, 1993) confidence interval (CI). For dependent variables (unplanned admissions to hospital, unplanned re-admissions within 30 days of discharge from hospital and SPHC), we computed a multivariate logistic regression models, estimating odds ratio (OR) and CI. The patients with SPHC were included in the first two models, but this group was also analysed independently, using a multivariate logistic regression for comparison with patients without SPHC. We adjusted for the explanatory variables mentioned above. A significance level of

0.05 was used for all statistical analysis, and all statistical tests were two sided.

To assess the impact of missing data, we performed a sensitivity analysis, where a missing category was introduced in all categorical variables, that is no patients were deleted from the regression model. We found minor differences in effect size (IRR) compared with the main model for all our dependent variables, not changing any of our conclusions. We also addressed missing data by using a nonparametric random forest imputation method (Stekhoven & Buhlmann, 2012), not changing our conclusion and the original models were chosen in this analysis (data not shown).

Statistical software R (version 3.6.1) was used for the data analyses.

3 | RESULTS

3.1 | Demographics

The total sample consists of 1718 patients, and characteristics and summary of the dependent variables are presented in Table 1. The median number of days from cancer diagnosis to responding to the survey was approximately 10 months. The median time for referral to specialised palliative care was 8 weeks (56 days). When comparing responders with non-responders, we found no difference in gender, but the responders were slightly older (mean age 67 years and 64 years, respectively, diff [95% CI] −2.93 [−4.04, −1.81], $p < .0001$).

3.2 | Health-related Quality of Life (HRQoL).

When comparing with EORTC QLQ-C30 reference values (Scott, 2008), we found relatively high scores reported on functional scales as well as global health. Cognitive and emotional functioning were the highest reported functions (mean score 81, SD=23 and 77, SD=23, respectively). Among the symptom scales, fatigue was highest reported (mean score 37, SD=28), Table 2.

Among patients with SPHC (compared with patients without), we found both clinically relevant (Osoba et al., 1998) and statistically significant differences in all EORTC QLQ C-30 functional scales, apart from emotional scale, as well as in 5 out of 9 symptom scales. All differences between the groups showed lower HRQoL and higher symptom burden among patients with SPHC (Table 2).

When comparing patients without hospital admissions (n = 419, 24%) to those with (n = 1299, 76%), we found no differences in HRQoL. The group with hospital admissions (n = 1299, 76%) were compared with those with unplanned hospital admissions (n = 568, 44%), revealing clinically relevant, statistical significant differences in most functional and symptom scales (Table 3).

When analysing HRQoL in the SPHC group with hospitalisations (n = 263, 90%), comparing those with unplanned hospital

TABLE 1 Demographic, clinical and proportions of dependent variables during first year of cancer diagnose. Total number admitted to hospital, n = 1299

	Total sample
	N = 1718
Age, years, mean (SD)	67 (12.74)
Sex	n (%)
Women	1021 (59)
Men	697 (41)
Cancer site	
Haematological	442 (26)
Gynaecological	567 (33)
Head&Neck	305 (18)
Upper GI	404 (23)
Disease stage	
Stage I-II	881 (54)
Stage III-IV	754 (46)
Missing	83 (5)
Treatment modality	
Single modality (radiotherapy or surgery or medical treatment)	752 (54)
Multi-modality (more than one modality)	648 (46)
Missing	318 (19)
Country of birth	
Sweden	1272 (80)
Other	310 (20)
Missing	136 (8)
Education level	
University or equivalent	593 (38)
Less than university of equivalent	969 (62)
Missing	156 (9)
Living situation	
Alone	528 (34)
Cohabitant	1044 (66)
Missing	146 (8)
Current occupational situation	
Retired	1066 (68)
Working	327 (21)
Sick-leave, student or parental leave	177 (11)
Missing	148
Specialised palliative home care	293 (17)
Proportion of cohort receiving inpatient care	1299 (76)
Unplanned admission to hospital[a]	568 (44)
Unplanned re-admissions within 30 days[a]	240 (18)

[a]percentage of patients admitted to hospital (n = 1299).

admissions (n = 193, 73%), to those without unplanned hospitalisations (n = 70, 27%), one statistical significant and clinical relevant difference were found; scores of global health/QoL (lower reported levels in groups with unplanned hospitalisations), (data not shown).

3.3 | Overall healthcare utilisation

Overall, 1299 (76%) of the patients were admitted to hospital at least once. The median LoS during the first year were 6 days. A third of the hospitalised patients had at least one unplanned admission

TABLE 2 Difference in mean scores of European organisation of research and treatment QLQ-C30, the whole sample and between groups with specialised palliative home care versus without

Scale	All participants		With SPHC[a]		Without SPHC		Diff[b]	p value
	Mean	SD	Mean	SD	Mean	SD		
Global health status/QoL	65.07	22.98	58.30	23.86	66.50	22.55	−8.2	<0.001
Physical functioning	76.65	23.43	67.36	26.14	78.64	22.32	−11.28	<0.001
Role functioning	70.13	32.66	57.79	33.82	72.74	31.82	−14.95	<0.001
Emotional functioning	77.44	23.25	75.54	25.24	78.06	22.77	−3.52	0.062
Cognitive functioning	81.34	23.09	74.91	26.75	82.72	22.0	−7.81	<0.001
Social functioning	74.86	28.67	63.98	31.71	77.15	27.45	−13.17	<0.001
Fatigue	37.35	27.59	48.99	28.05	34.87	26.86	14.12	<0.001
Nausea & vomiting	8.04	16.70	12.10	20.03	7.18	15.78	4.92	<0.001
Pain	23.33	28.25	30.84	32.35	21.72	27.04	9.12	<0.001
Dyspnoea	29.12	29.96	37.68	32.79	27.30	29.01	10.38	<0.001
Insomnia	29.02	31.0	31.19	32.36	28.55	30.70	2.64	0.277
Appetite loss	19.23	29.63	30.29	34.32	16.87	27.98	13.42	<0.001
Constipation	16.44	26.69	20.23	29.22	15.64	26.06	4.59	0.016
Diarrhoea	13.73	24.65	18.45	27.59	12.72	23.88	5.73	<0.001
Financial difficulties	12.56	25.45	15.27	26.83	11.98	25.12	3.29	0.025
QLQ-C30 summary score[c]	77.58	18.07	70.62	19.32	79.02	17.47	−8.4	0.001

[a]Specialised palliative home care

[b]Difference in mean scores between the group with specialised palliative home care and the group without

[c]based on 27 items (excluding Global Health and Financial difficulties)

TABLE 3 Scores of European organisation of research and treatment QLQ-C30 in group with no hospital admissions, and difference in scores between those with unplanned hospital admissions and those with planned hospital admissions

No hospital admissions								
Scale		Mean score	SD	Mean score	SD	Mean score	SD	Difference in score	
Global health status	QL	65.04	23.90	61.27	22.60	68.05	22.36	−6.78	<0.001
Physical functioning	PF	76.20	23.75	71.91	24.85	80.54	21.38	−8.63	<0.001
Role functioning	RF	69.78	34.39	64.71	33.51	74.45	30.41	−9.74	<0.001
Emotional functioning	EF	77.95	23.23	75.66	24.36	78.53	22.31	−2.87	0.073
Cognitive functioning	CF	82.33	22.81	78.12	24.76	83.31	21.61	−5.19	<0.001
Social functioning	SF	75.62	29.30	70.92	29.65	77.5	27.22	−6.58	<0.001
Fatigue	FA	37.31	28.50	42.96	27.98	33.07	26.03	9.89	<0.001
Nausea & vomiting	NV	7.26	16.37	9.90	17.85	7.04	15.85	2.86	0.002
Pain	PA	23.06	29.17	27.71	30.01	20.1	25.85	7.61	<0.001
Dyspnoea	DY	31.13	31.38	33.47	30.87	24.72	27.84	8.75	<0.001
Insomnia	SL	30.18	30.94	30.52	32.77	27.24	29.56	3.28	0.201
Appetite loss	AP	18.25	28.56	22.87	31.0	16.95	28.87	5.92	<0.001
Constipation	CO	17.96	28.96	17.77	27.63	14.62	24.53	3.15	0.083
Diarrhoea	DI	12.84	25.21	16.53	26.18	12.04	22.93	4.49	0.002
Financial difficulties	FI	11.37	25.74	13.84	26.48	12.21	24.47	1.63	0.426
QLQTOTAL[a]	qlqtot	77.36	19.33	74.23	18.64	80.25	16.46	−6.02	<0.001

[a]based on 27 items (excluding Global Health and Financial difficulties)

(n = 568, 44%), and 18% (n = 240) were unplanned re-admitted within 30 days (Table 1). Further, nearly a quarter of these patients had multiple (three or more) unplanned hospitalisations (n = 134, 23%) and 27% (n = 61) had three or more unplanned re-admissions within 30 days. We also explored the total healthcare utilisation among the whole sample, by describing the number of times

admitted to hospital and/or SPHC in addition to visits to outpatient care (Figure S2).

3.4 | Healthcare utilisation among patients referred to specialised palliative care

A multivariate logistic regression analysis among patients with SPHC revealed significantly higher levels of unplanned admissions (OR 4.35; 95% CI [3.22–5.91], p < 0.001) unplanned re-admissions within 30 days (OR, 5.8; 95% CI [4.12–8.19], p < 0.001), compared with patients without SPHC.

No other explanatory variables in this group, apart from disease stage and age, were associated with unplanned admissions and re-admissions. Low-stage disease significantly decreased the likelihood of unplanned admissions (OR 0.52; 95% CI [0.40–0.68], p < 0.001) and unplanned re-admissions (OR 0.47; 95% CI [0.33–0.69], p < 0.001). However, age was only associated with unplanned re-admissions, where higher age decreased the odds of unplanned re-admissions (OR 0.98; 95% CI [0.97–0.99], p < 0.001).

In addition, nearly a quarter of the SPHC patents had multiple (three or more) unplanned hospital admissions (n = 61 of 263, 23%).

Patients with high disease stage were more likely to receive SPHC (Figure 1), (OR 2.77; 95% CI [1.96, 3.96], p < 0.001).

Cancer site were associated with the likelihood of receiving SPHC. Patients with gynaecological cancers were least likely to receive SPHC (compared with patients with haematological cancers), (OR 0.41; 95% CI [0.25, 0.68], p < 0.003) while patients with upper GI and H&N cancer did not differ significantly from the haematological group.

3.5 | Sociodemographic variables associated with healthcare utilisation

The following sociodemographic factors were associated with healthcare utilisation; living and occupational status, disease stage, treatment type and cancer site (Figures 2, 3, 4). Living alone was both associated with an increased total LoS and total times admitted to hospital, (IRR 1.35; 95% CI [1.13-1.62], p < 0.001; IRR 1.15; 95% CI [1.04–1.30], p = 0.022). In addition, living alone also increased the likelihood of unplanned admissions, OR 1.37; 95% CI [1.06–1.78], p < 0.031.

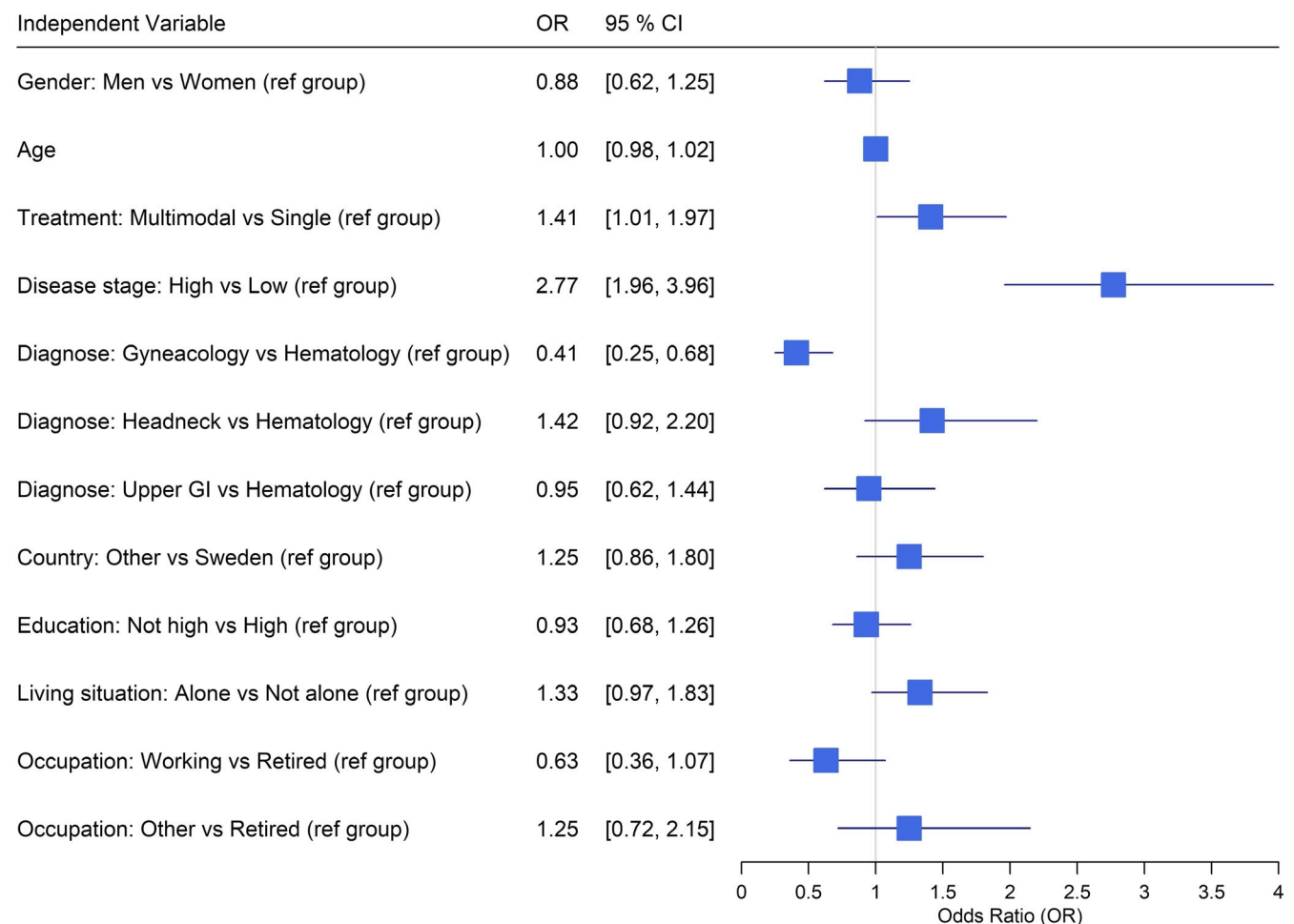| Independent Variable	OR	95 % CI
Gender: Men vs Women (ref group)	0.88	[0.62, 1.25]
Age	1.00	[0.98, 1.02]
Treatment: Multimodal vs Single (ref group)	1.41	[1.01, 1.97]
Disease stage: High vs Low (ref group)	2.77	[1.96, 3.96]
Diagnose: Gyneacology vs Hematology (ref group)	0.41	[0.25, 0.68]
Diagnose: Headneck vs Hematology (ref group)	1.42	[0.92, 2.20]
Diagnose: Upper GI vs Hematology (ref group)	0.95	[0.62, 1.44]
Country: Other vs Sweden (ref group)	1.25	[0.86, 1.80]
Education: Not high vs High (ref group)	0.93	[0.68, 1.26]
Living situation: Alone vs Not alone (ref group)	1.33	[0.97, 1.83]
Occupation: Working vs Retired (ref group)	0.63	[0.36, 1.07]
Occupation: Other vs Retired (ref group)	1.25	[0.72, 2.15]

FIGURE 1 Factors that are associated with the odds of access to specialised palliative home care during first year of cancer diagnose. Independent variable with odds ratio (OR) and 95% confidence interval (CI). Odds ratios with confidence intervals 0.25 to 3.75 on the X-axis.
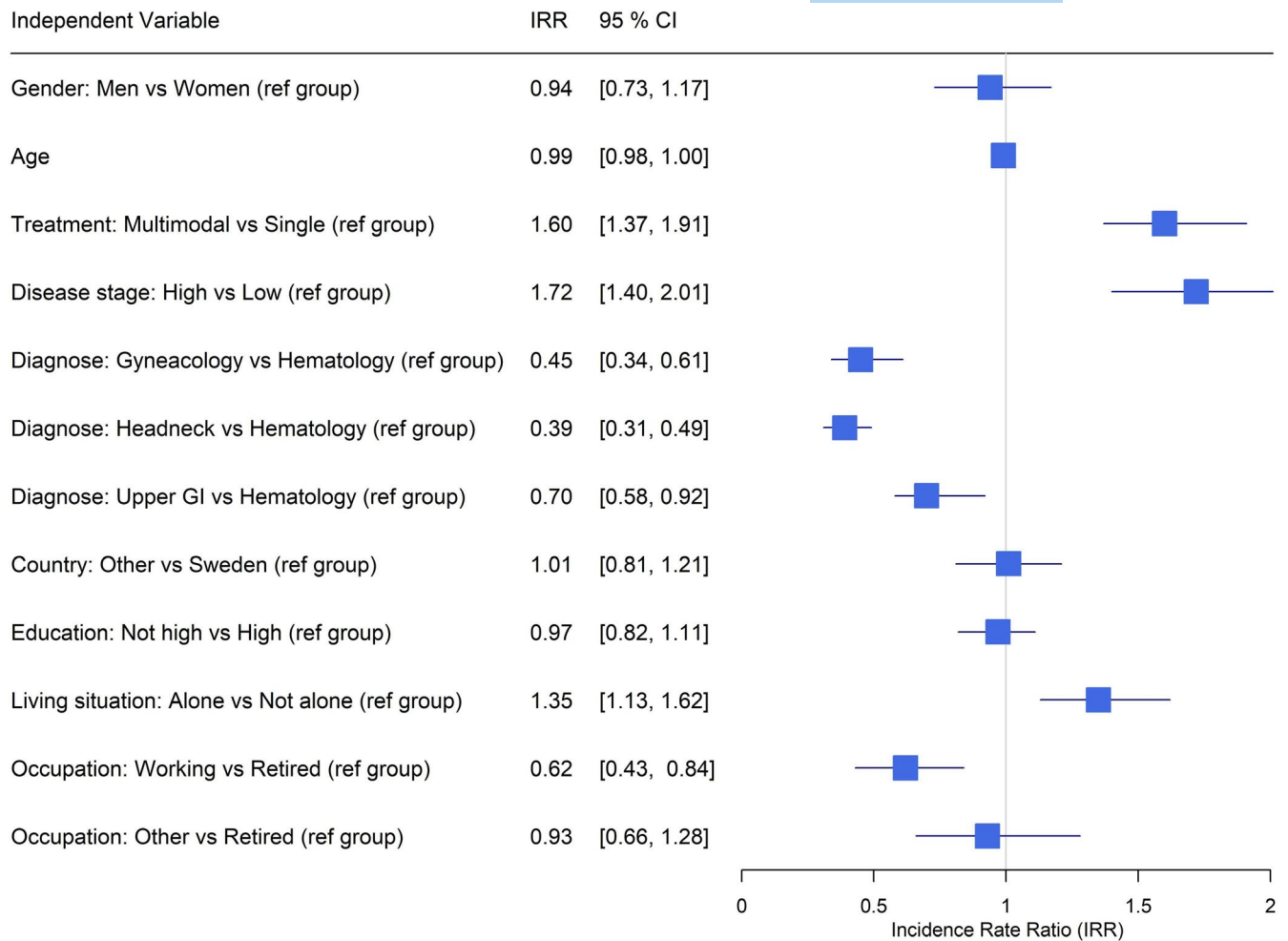
Independent Variable	IRR	95 % CI
Gender: Men vs Women (ref group)	0.94	[0.73, 1.17]
Age	0.99	[0.98, 1.00]
Treatment: Multimodal vs Single (ref group)	1.60	[1.37, 1.91]
Disease stage: High vs Low (ref group)	1.72	[1.40, 2.01]
Diagnose: Gyneacology vs Hematology (ref group)	0.45	[0.34, 0.61]
Diagnose: Headneck vs Hematology (ref group)	0.39	[0.31, 0.49]
Diagnose: Upper GI vs Hematology (ref group)	0.70	[0.58, 0.92]
Country: Other vs Sweden (ref group)	1.01	[0.81, 1.21]
Education: Not high vs High (ref group)	0.97	[0.82, 1.11]
Living situation: Alone vs Not alone (ref group)	1.35	[1.13, 1.62]
Occupation: Working vs Retired (ref group)	0.62	[0.43, 0.84]
Occupation: Other vs Retired (ref group)	0.93	[0.66, 1.28]

FIGURE 2 Factors that are associated with total Length of stay in hospital (all-cause admissions) during first year of cancer diagnose. Independent variable with incidence rate ratio (IRR) and 95% confidence interval (CI). Incidence rate ratios with confidence intervals 0.3 to 1.9 on the X-axis.

Patients that were working had lower total LoS (IRR 0.62; 95% CI [0.43–0.84], $p < 0.001$), compared with retired patients, and after controlling for other explanatory variables.

Sex, age, country of birth or educational level where not significantly associated with any of the dependent variables.

3.6 | Clinical variables associated with healthcare utilisation

Cancer site was associated with the dependent variables, varying between IRR 0.39 (H&N ca) and 0.70 (upper GI cancer) in total LoS (Figure 2). We found small but statistically significant differences between groups, in total number of admissions (Figure 3). We also found differences in likelihood of unplanned care, varying from OR 0.28 (gynaecological cancer) to 0.46 (upper GI cancer), Figures 4, Figure 5.

Disease stage affected all aspects of healthcare utilisation, with high stage disease increasing the total LoS (IRR 1.72; 95% CI [1.40–2.01], $p < 0.001$) and number of admissions (IRR 1.36; 95% CI

[1.21–1.51], $p < 0.001$, Figure 2, Figure 3). Further, high-stage disease significantly increased the likelihood of unplanned admissions and unplanned re-admissions, OR of 1.71 and 2.10, respectively (Figures 4, Figure 5).

Finally, multi-modality treatment did also relate to healthcare utilisation, with an increased total LoS (IRR 1.60; 95% CI [1.37–1.91], $p < 0.001$), total number of admissions (IRR 1.23; 95% CI [1.09–1.37], $p < 0.001$), but were not associated with unplanned hospital admissions.

4 | DISCUSSION

This large, population-based study gives an overview of healthcare utilisation during the year after cancer diagnosis among four groups of patients with complex care trajectories in Sweden. We found that several of the demographic, socioeconomic and clinical variables were associated with healthcare utilisation, which is important to explore further in order to improve quality and efficacy of care.
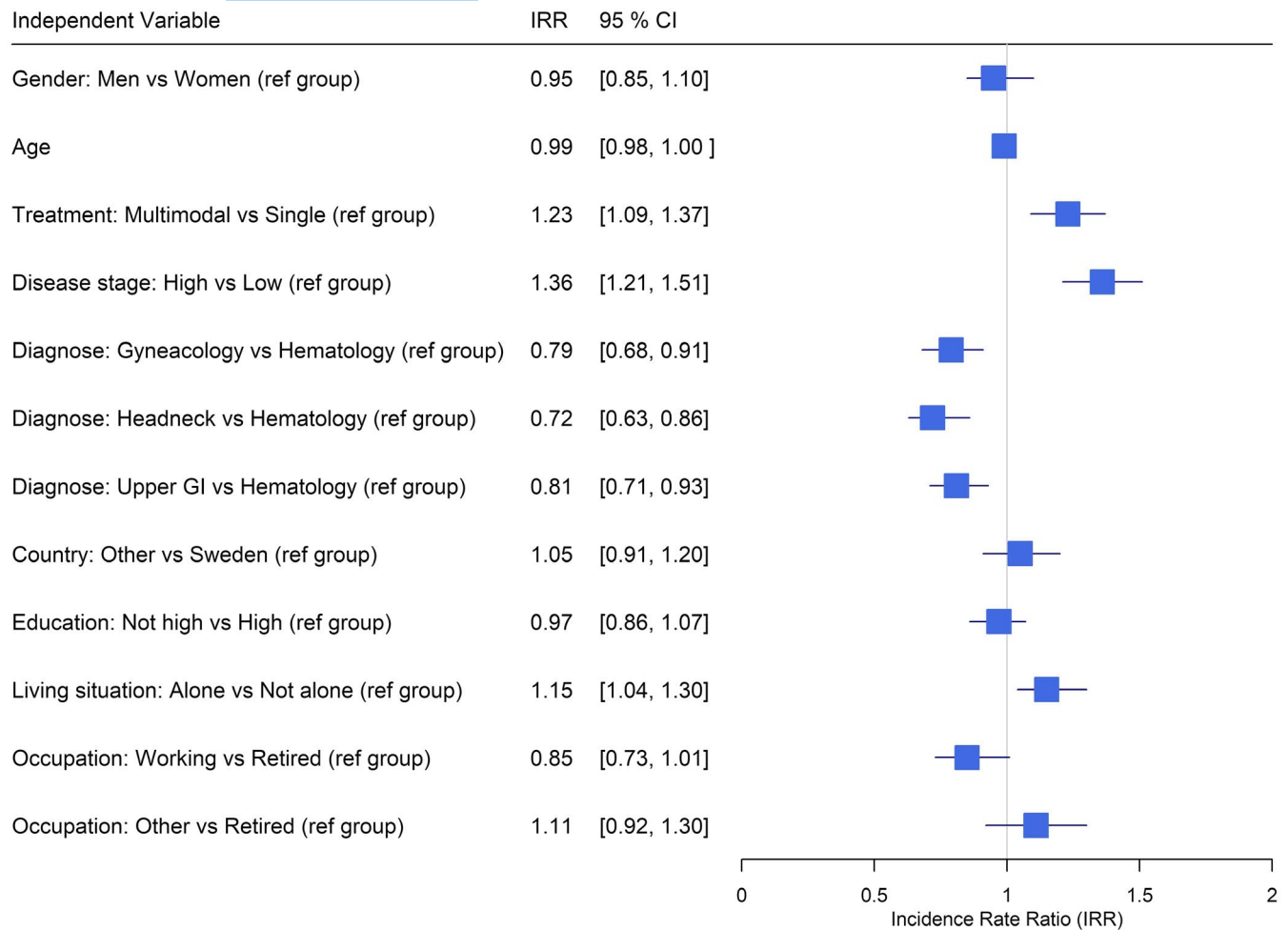
Independent Variable	IRR	95 % CI
Gender: Men vs Women (ref group)	0.95	[0.85, 1.10]
Age	0.99	[0.98, 1.00]
Treatment: Multimodal vs Single (ref group)	1.23	[1.09, 1.37]
Disease stage: High vs Low (ref group)	1.36	[1.21, 1.51]
Diagnose: Gyneacology vs Hematology (ref group)	0.79	[0.68, 0.91]
Diagnose: Headneck vs Hematology (ref group)	0.72	[0.63, 0.86]
Diagnose: Upper GI vs Hematology (ref group)	0.81	[0.71, 0.93]
Country: Other vs Sweden (ref group)	1.05	[0.91, 1.20]
Education: Not high vs High (ref group)	0.97	[0.86, 1.07]
Living situation: Alone vs Not alone (ref group)	1.15	[1.04, 1.30]
Occupation: Working vs Retired (ref group)	0.85	[0.73, 1.01]
Occupation: Other vs Retired (ref group)	1.11	[0.92, 1.30]

Incidence Rate Ratio (IRR)

FIGURE 3 Factors that are associated with total number of times admitted to hospital (all-cause admissions) during first year of cancer diagnose. Independent variable with incidence rate ratio (IRR) and 95% confidence interval (CI). Incidence rate ratios with confidence intervals 0.5 to 1.5 on the X-axis.

Among the demographic variables, living alone increased most aspects of healthcare utilisation in our study. These are important findings, indicating as in previous studies, that family caregivers perform tasks similar to trained healthcare professionals (Ullgren et al., 2018). Previous research has revealed both heavy burden on family caregivers as well as the challenge of living alone during cancer treatment (Johnson et al., 2019; Lash et al., 2017). One third of the patients in our study were living alone. This may reflect that Sweden have the highest number of single households in Europe ('Europstats statistics explained, cancer statistics', Data extracted July 2018) compared with a worldwide average of 16% (United Nations, 2017). The patients living situation need to be taken into account when planning cancer care. With social care in Sweden being managed separately to health care, integration and coordination may be challenging but nevertheless important. Living status also affected other healthcare utilisation variables, for example increasing LoS, again indicating that cancer care needs to be well integrated to limit hospital care.

One subgroup that stands out in our study are patients with SPHC as they reported the highest levels of unplanned care and re-admissions. The analysis showed significantly lower HRQoL and higher symptom burden compared with patients without SPHC. This may explain the higher levels of unplanned care within this group, but there might also be other explanatory factors, for example co-morbidities, which was not explored in this study. We did find that high disease stage and living alone increased the likelihood of receiving SPHC. However, within the SPHC group (comparing those with unplanned hospitalisations to those without any unplanned hospitalisation), we found no significant differences in HRQoL, apart from lower reported levels of global health/QoL in the group with unplanned hospitalisations, indicating that the higher likelihood of unplanned care relates to other factors. Further, we found that a proportion of the patients (23%) had multiple (three or more) unplanned hospitalisations. We can only speculate on the reasons, but it might be related to other factors that determine high levels of unplanned care, such as geographic differences. One of the purposes of palliative care is to provide support and coordination between different care providers at home (Ferrell et al., 2016), and previously, research found that palliative care reduce unplanned hospitalisations (Scibetta et al., 2016).
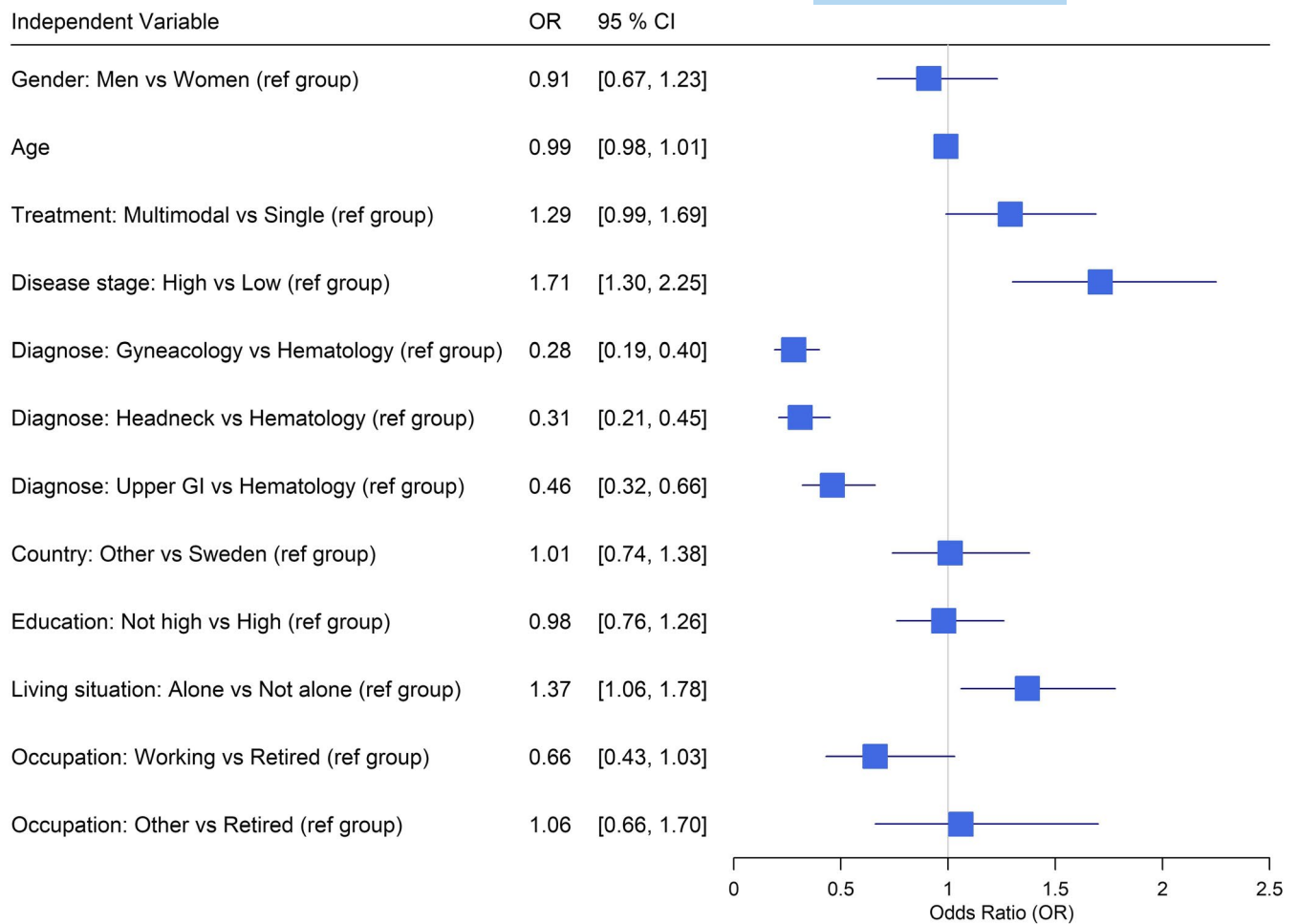
Independent Variable	OR	95 % CI
Gender: Men vs Women (ref group)	0.91	[0.67, 1.23]
Age	0.99	[0.98, 1.01]
Treatment: Multimodal vs Single (ref group)	1.29	[0.99, 1.69]
Disease stage: High vs Low (ref group)	1.71	[1.30, 2.25]
Diagnose: Gyneacology vs Hematology (ref group)	0.28	[0.19, 0.40]
Diagnose: Headneck vs Hematology (ref group)	0.31	[0.21, 0.45]
Diagnose: Upper GI vs Hematology (ref group)	0.46	[0.32, 0.66]
Country: Other vs Sweden (ref group)	1.01	[0.74, 1.38]
Education: Not high vs High (ref group)	0.98	[0.76, 1.26]
Living situation: Alone vs Not alone (ref group)	1.37	[1.06, 1.78]
Occupation: Working vs Retired (ref group)	0.66	[0.43, 1.03]
Occupation: Other vs Retired (ref group)	1.06	[0.66, 1.70]

FIGURE 4 Factors that are associated with total number of all-cause unplanned admissions to hospital first year of cancer diagnose. Independent variable with odds ratio (OR) and 95% confidence interval (CI). Odds ratios with confidence intervals 0.15 to 2.25 on the X-axis.

The median LoS in this study was 6 days (during the first year past cancer diagnose), and the median time admitted each time was 3 days. Even if exact comparison is not appropriate, statistics from European union ('Europstats statistics explained, cancer statistics', & Data extracted July, 2018), show average LoS of 3 days. The proportion of unplanned re-admission rates in previous studies varies between 11%, (Saunders et al., 2015) to 22%, which is in line with our results (18%). However, we also found that nearly a third (27%) of all hospitalised patients had multiple (3 or more), unplanned re-admissions to hospital and we failed to find other studies to compare these findings.

A clinical variable that was associated with healthcare utilisation in our study was cancer site. It is an important finding that the haematological group is utilising health care more than the other three groups. Previous research found lung cancer and H&N cancer as risk factors for emergency attendance (Henson et al., 2018). In contrast, in a systematic review of emergency admissions, patients with ovarian cancers were at risk for high admission rates (Bell et al., 2017; Lash et al., 2017).

Other variables with significant impact on healthcare utilisation were high disease stage and multimodal treatment. Stage impacted all four dependent variables, with the highest impact on unplanned re-admissions within 30 days, which from clinical perspective is not surprising, and also supported by previous research (Manzano et al., 2015). This finding highlights the need for carefully planning and assessment of patients with high stage disease to reduce unplanned care. Multimodal treatment did relate to increased LoS and total times admitted to hospital, but not with any of the variables of unplanned care. In a previous study (May et al., 2017), they found that complications from treatment was related to hospitalisations, but did not differentiate between planned or unplanned care.

A weakness in this study is that most patients responded in follow-up phase, with recovering HRQoL levels, while most of the healthcare utilisation occurred earlier in the cancer care trajectory. The analytical method were chosen after descriptively looking at data, and we tested different regression models, but it did not change our results significantly; however, to comprehensively evaluate healthcare utilisation, a more multidimensional model would be needed, looking into different aspects also important from patients perspective, such as accessibility and continuity (Da Silva et al., 2011). Another weakness is that the study lack data on reasons for admissions and co-morbidities, which may affect the interpretation of the results. On the other
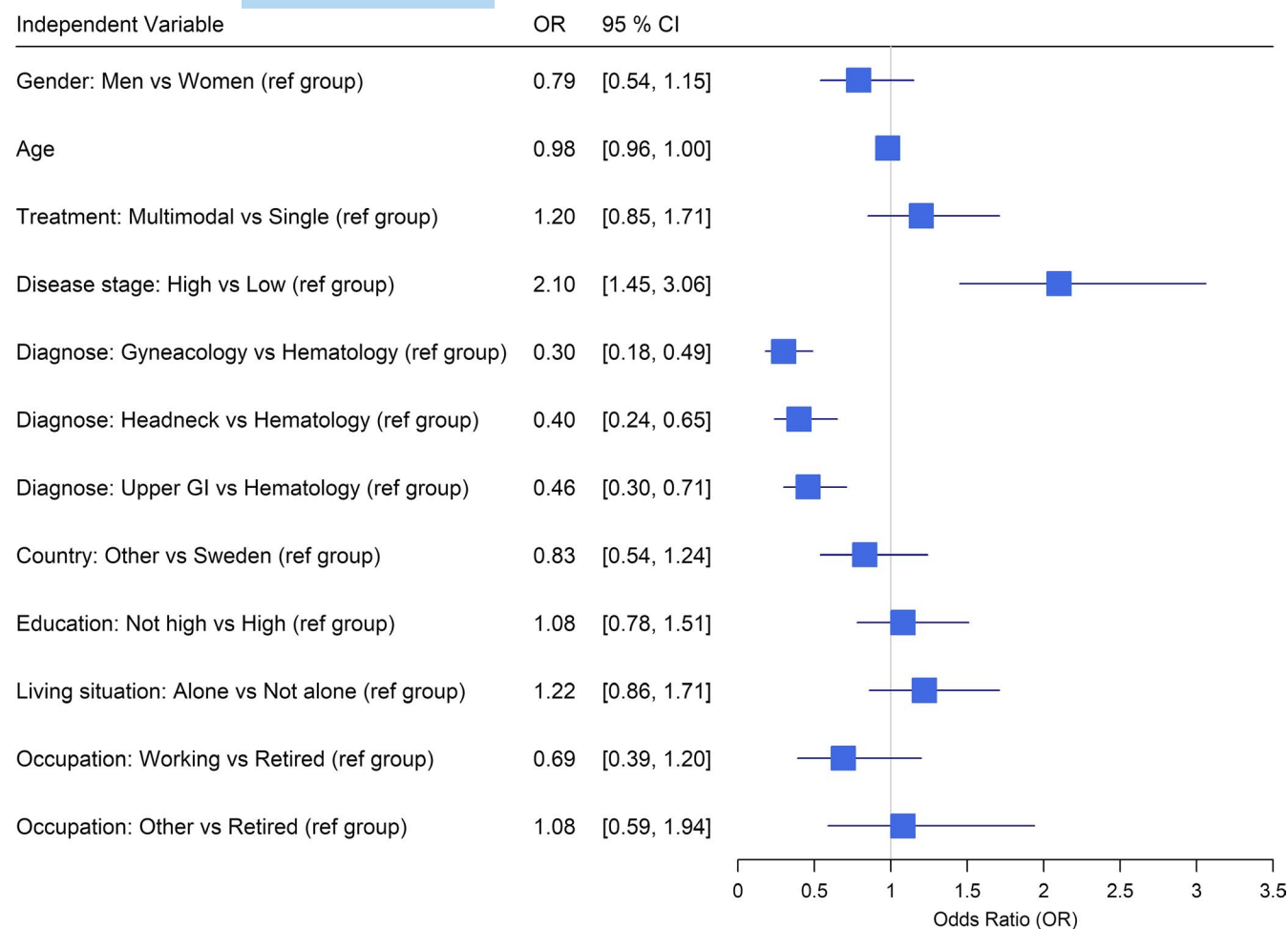
Independent Variable	OR	95 % CI
Gender: Men vs Women (ref group)	0.79	[0.54, 1.15]
Age	0.98	[0.96, 1.00]
Treatment: Multimodal vs Single (ref group)	1.20	[0.85, 1.71]
Disease stage: High vs Low (ref group)	2.10	[1.45, 3.06]
Diagnose: Gyneacology vs Hematology (ref group)	0.30	[0.18, 0.49]
Diagnose: Headneck vs Hematology (ref group)	0.40	[0.24, 0.65]
Diagnose: Upper GI vs Hematology (ref group)	0.46	[0.30, 0.71]
Country: Other vs Sweden (ref group)	0.83	[0.54, 1.24]
Education: Not high vs High (ref group)	1.08	[0.78, 1.51]
Living situation: Alone vs Not alone (ref group)	1.22	[0.86, 1.71]
Occupation: Working vs Retired (ref group)	0.69	[0.39, 1.20]
Occupation: Other vs Retired (ref group)	1.08	[0.59, 1.94]

Odds Ratio (OR)

FIGURE 5 Factors that are associated with total number of all-cause unplanned re-admissions within 30 days, during first year of cancer diagnose.. Independent variable with odds ratio (OR) and 95% confidence interval (CI). Odds ratios with confidence intervals 0.15 to 2.65 on the X-axis.

hand, the results are strengthened by the population-based study design with data from excellent coverage registries (Carlsson et al., 2013; Emilsson et al., 2015; Lofgren et al., 2019).

Most research on healthcare utilisation is conducted in the United States, and both similarities and differences have been reported between North America and Europe (Bekelman et al., 2016). Our results reflect healthcare utilisation for four group of cancer patients in the Stockholm-Gotland region. Data from other patient groups, regions or countries may differ, as healthcare utilisation may be impacted by contextual factors. Another reflection is that even if the rate of unplanned care is an indicator of poor performance of integration and quality (Kaasa et al., 2018) it might be appropriate and not always avoidable (Numico et al., 2015). However, drivers of cancer healthcare utilisation, challenges and complexity are most likely not completely unique for a region or a country.

5 | Conclusion

Several sociodemographic and clinical factors, such as living alone and disease stage is associated with higher levels of healthcare utilisation, specifically unplanned hospital admissions. Patients with specialised palliative home care concurrent with acute cancer care, report lower levels of HRQoL and higher levels of unplanned hospital admissions. Since higher levels of unplanned hospital admissions are associated with both sociodemographic and clinical factors, our findings stress the importance of a holistic view when planning care. In order to organise and coordinate care, as well as support the patients in the best possible way, we need to consider those factors, and further explore reasons for multiple unplanned hospital admissions.

CONFLICT OF INTEREST

The funding source did not in any way influence design, analysis or interpretation of results, and the authors have no conflict of interest to declare.

DATA AVAILABILITY STATEMENT
Research data are not shared.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.