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Factors influencing treatment burden in colorectal cancer patients undergoing curative surgery: A cross-sectional study

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Abstract

Objective: To describe the severity of treatment burden in surgically treated colorectal cancer (CRC) patients and examine associations between treatment burden and demographic and clinical variables.

Methods: This cross-sectional study recruited 134 patients diagnosed with Dukes' stage A-C CRC between 2016 and 2018 who underwent curative surgery. The Patient Experience with Treatment and Self-management (PETS) questionnaire assessed treatment burden domains of 'workload', 'stressors' and 'impact' between 6 weeks and 18 months after primary surgery.

Results: Highest scores were observed for difficulty with healthcare services (median score 33.3), physical and mental fatigue (median score 30.0) and medical information (median score 26.8). Younger age, low education level or no cohabitants were significantly associated with higher workload PETS scores ($p < 0.05$, 0.013, $p = 0.047$, respectively). Higher PETS stressors scores were significantly associated with younger age ($p = 0.006$), lower education level ($p = 0.016$), and high comorbidity ($p = 0.013$). Higher PETS impact scores were significantly associated with the female sex ($p = 0.050$), younger age ($p = <0.001–0.003$), lower education ($p = 0.003$), no cohabitants ($p = 0.003$), high comorbidity ($p = 0.003$) and cancer stage Dukes A ($p = 0.004$).

Conclusions: A seamless and supportive healthcare system beyond hospitalisation targeting CRC subpopulations in danger of high treatment burden may improve patients' self-management experience.

KEYWORDS
colorectal cancer, patient-reported outcome, post-discharge, supportive care, treatment burden

1 | INTRODUCTION

Treatment burden is defined as 'the impact of health care on patients' functioning and wellbeing' (Eton et al., 2012, p. 40). It accounts for the work, that is, self-care and self-monitoring,

managing therapeutic regimens, organising doctor visits, and managing transitions from hospital to home, delegated by health professionals to chronically ill patients. Poor health and well-being are considered the predominant consequences of treatment burden in patients with long-term illness (Eton et al., 2019; Lippiett et al.,

2019; Tran et al., 2015). Moreover, non-adherence to treatment (May et al., 2014), costly re-admissions (Spencer-Bonilla et al., 2017) and burden placed on significant others, add to the magnitude of burden (Boehmer et al., 2018). The concept of treatment burden is highly relevant to cancer patients. In a recent systematic review, experienced treatment burden in lung cancer patients was associated with managing treatment side effects, burdensome cognitive decision-making processes and multiple treatment appointments, among other factors (Lippiett et al., 2019). Cheng and Levy (2016) found in breast cancer patients that a more severe cancer stage was associated with a higher number of healthcare service encounters, which again translated into higher experienced treatment burden. Eton et al. (2019) found that a low education level was associated with increased physical and mental exhaustion due to self-management in cancer patients. Moreover, these authors observed that treatment burden was related to the number of chronic conditions experienced through limitations imposed on patients' social role and function, thus negatively affecting health-related quality of life (HRQOL). In non-cancer populations, treatment burden is associated with being female and being younger (Duncan et al., 2018) and having a higher number of chronic conditions (Eton et al., 2017; Rogers et al., 2017).

CRC ranks as the 3rd most common cause of cancer-related death irrespective of gender, with a particular increasing incidence in ageing populations (Cancer Registry of Norway, 2017). The post-hospital discharge may represent a vulnerable time for CRC survivors because of treatment side effects experienced at home and emotional distress resulting from cancer and its treatment (Jakobsson et al., 2017). In a systematic review, 51% of support care requirements following CRC treatment concerned information and education, including communication issues between patients and healthcare providers (Kotronoulas et al., 2017).

Treatment burden in CRC patients remains unexplored, and to our knowledge, aspects of treatment burden has not yet been investigated in patients surgically treated for CRC. Additionally, the novelty of this study lies in the application of the Patient Experience with Treatment and Self-management (PETS) questionnaire, one of few instruments validated for treatment burden assessment (Eton et al., 2017) and yet to be used in a CRC patient population (Spencer-Bonilla et al., 2017). The primary purpose of the study was to describe the treatment burden experienced by CRC patients surgically treated with curative intent and to explore whether there were any associations between treatment burden and demographics, clinical characteristics or time since primary treatment.

2 | METHODS

2.1 | Study design

The study applied a retrospective cross-sectional design and included patients treated for CRC with curative intent who underwent surgery between June 2016 and June 2018.

2.2 | Study context and participants

In Norway, routine primary treatment of patients with non-metastatic resectable CRC is based on surgical resection, with adjuvant (i.e. postoperative) chemotherapy offered to most lymph node-positive colon cancer patients; neoadjuvant (i.e. pre-operative) chemo-radiation treatment is selectively employed in some rectal cancer patients (Schmoll et al., 2012). CRC survivors are enrolled in a coordinated treatment pathway from diagnosis. After primary treatment, patients with rectal cancer are usually scheduled for regular hospital appointments; in the case of colon cancer, patients are followed up by their general practitioner (GP), with expected imaging at the hospital.

One hundred sixty-six patients surgically treated for CRC between June 2016 and June 2018 were identified from the electronic hospital records of a university hospital in the southwestern part of Norway with a primary catchment population of approximately 380,000 individuals. Eligible patients were between 18 and 80 years of age, had been surgically treated for either colon or rectal cancer with curative intent, had no distant metastasis (i.e. Dukes' class A-C or stage I–III), had undergone primary surgery 2 months—2 years prior, and were able to communicate orally and in written Norwegian. Excluded were patients diagnosed with metastatic CRC (Stage IV disease), patients who had experienced severe postoperative surgical complications (i.e. Grade >3 according to the Clavien-Dindo Surgical Complications Score (Clavien et al., 2009)), and patients with mental illness or cognitive impairment that made participation impossible. The main reasons for non-eligibility were age (≥ 80 years) or metastatic cancer.

2.3 | Ethical considerations

The study was approved by the Regional Committees for Medical and Health Research Ethics (No. 2017/284). Eligible patients were offered both written and oral information about the study, including the required secure handling of the database. Participants provided written consent to participate and had the right to withdraw from the study at any time without giving a reason.

2.4 | Measures

2.4.1 | Patient experience with treatment and self-management

The study uses the Patient Experience with Treatment and Self-management (PETS) questionnaire, a generic scale developed by Eton et al. (2017) to measure treatment burden in individuals experiencing chronic illness. The Norwegian version of the PETS questionnaire originally comprised 59 items distributed across 12 dimensions of treatment burden. The translation and adaption of the Norwegian version have been reported elsewhere (Husebø et al., 2018). This

study utilises a 48-item version measuring treatment burden across nine dimensions (Eton et al., 2017). Of the nine PETS dimensions, the dimensions 'medical information (MINF)', 'medications (MEDS)', 'medical appointments (MAP)' and 'monitoring health (MH)' pertains to *workload*, while the dimensions 'relationship with others (ROL)', 'medical and health care expenses (MEXP)' and 'difficulties with health care services (HCS)' pertain to *stressors* aggravating burden. The dimensions 'role and social activity limitations' (RAL) and 'physical and mental fatigue from self-management' (PMF) pertains to the *impact* of burden. Responses are given on either a 4- or a 5-point Likert scale, with a recall period of 4 weeks. Each dimension is scored separately. Raw scores are converted so that each domain scale has a scoring range of 0–100, with a higher score indicating a higher treatment burden (Rogers et al., 2017). A total score is not available for the PETS, and users of the instrument are recommended to apply the subscales relevant to the research or clinical practice (Eton et al., 2017).

The PETS has shown good psychometric properties in prospective studies of chronically ill patients conducted in the USA (Eton et al., 2017, 2019; Rogers et al., 2017). This is the first study to use the PETS in a cancer population outside the United States and in a Norwegian healthcare services context. Reliability testing of the Norwegian version using data generated from the study sample showed satisfactory Cronbach's alphas ranging from 0.71 to 0.93 across subscales.

2.4.2 | Demographic data

Demographics were obtained by a questionnaire developed for this study that included items about age, gender, living conditions, education and employment.

2.4.3 | Clinical data

Clinical data concerning diagnosis, cancer stage, treatment received, number of comorbidities and date of primary surgical treatment were retrieved from hospital records. The variable 'time since primary surgical treatment' was coded into three categories: '<6 months since primary surgery', '6–12 months since primary surgery' and '12–18 months since primary surgery'.

2.5 | Data collection

The study applied two different recruitment procedures. Patients surgically treated between June 2016 and September 2017 were recruited by a mailed request containing an information letter, a consent form and the survey inventory. Patients surgically treated between October 2017 and June 2018 were consecutively contacted by a study nurse during postoperative follow-up appointments at the surgical outpatient clinic. Patients were informed about study aims and principles of voluntary participation and confidentiality. Written information was provided to patients, including the consent form and the survey inventory, which respondents were asked to complete at home. Non-responders received one reminder by letter 2 weeks following the initial invitation.

2.6 | Data analysis

Data input and descriptive statistical analysis were performed with Statistical Package for the Social Sciences (SPSS) software version 25 (IBM Corp., 2017). If less than 50% of the values for a treatment burden dimension were missing, the missing values were imputed with the mean of the remaining items from the same subscale (Eton et al., 2017). Beyond that, we used all available cases for each analysis and indicated the number of patients included for each result. The main reason for missing data was that the item was deemed not applicable. Study variables were described via the frequency, percentage, median and interquartile range (IQR). The Kolmogorov–Smirnov test revealed non-normally distributed data. Associations between treatment burden dimensions and patient and treatment variables were estimated using univariable and multivariable regression models. Due to the skewness observed in the treatment burden dimensions, Poisson regression models were used, with standard errors calculated by the sandwich method (Zou, & Donner, 2013). The reported effects are exponentiated regression coefficients, which may be interpreted as ratios of means (RM). These are presented with 95% confidence intervals (CI) and with p values derived from Wald tests. If RM > 1, the mean scores of the group in question is more extensive than of the comparator group, and vice versa if RM < 1. Employment status was not included in the multiple regression analyses, since it might have been affected by treatment burden (i.e. higher treatment burden equals reduced ability to work). Regression modelling was performed in Stata version 16 with the Poisson function and applying the vce(robust) option (StataCorp, 2019).

The reported *p* values were two-sided, and *p* < 0.05 were considered statistically significant.

3 | RESULTS

Among 166 eligible cancer patients, 134 patients returned the written consent and the survey inventory, resulting in a response rate of 84%. Data on non-participants were not collected due to ethics legislation.

3.1 | Patient characteristics

Descriptive demographic and clinical data are displayed in Table 1. Among respondents, there were more men (*N* = 83, 62.9%) than

TABLE 1 Demographic and clinical characteristics of the study sample (N = 134)

Characteristics	N (%)
Age, median (IQR)	67 (40–78)
Age groups	
40–59	66 (49.3)
60–79	68 (50.7)
Gender	
Male	83 (61.9)
Female	51 (38.1)
Ethnicity	
Norwegian	131 (97.8)
Other	3 (2.2)
Living conditions	
Living alone	23 (17.2)
Living with partner	107 (79.8)
Living with others	8 (3.0)
Education	
High school	66 (49.3)
College	21 (15.7)
University	46 (34.3)
Missing	1 (0.7)
Currently employed	
Full time	28 (20.9)
Part time	20 (14.9)
No	82 (61.2)
Missing	4 (3.0)
Time since primary surgical treatment	
<6 months	62 (46.3)
6–12 months	41 (30.6)
12–18 months	31 (23.1)
Primary tumour location	
Colon cancer	80 (59.7)
Rectal cancer	54 (40.3)
Dukes' cancer stage	
A	39 (29.1)
B	46 (34.3)
C	49 (36.6)
Treatment modality	
Neoadjuvant	14 (10.4)
Adjuvant	28 (20.9)
Surgery only	92 (68.7)
Comorbidity	
Yes	100 (74.6)
No	34 (25.4)
Number of comorbid conditions	
0	40 (29.9)

(Continues)

TABLE 1 (Continued)

Characteristics	N (%)
1	35 (26.1)
2	28 (20.9)
3	24 (17.9)
≥4	7 (5.2)

Note: Statistics given as counts (%) unless otherwise specified.
Abbreviation: IQR, interquartile range.

TABLE 2 Treatment burden in colorectal cancer patients as measured by the PETS questionnaire

Treatment burden dimensions	N	Median (IQR)
Workload of health care		
Medical information	110	26.8 (14.3–39.3)
Medications	76	3.4 (0.0–25.0)
Medical appointments	125	4.1 (0.0–20.8)
Monitoring health	114	25.0 (0.0–37.5)
Stressors aggravating the burden		
Relationships with others	129	0.0 (0.0–12.5)
Medical and healthcare expenses	112	0.0 (0.0–25.0)
Difficulty with healthcare services	80	33.3 (7.1–42.9)
Impact of burden		
Role and social activity limitations	126	12.5 (0.0–34.4)
Physical and mental fatigue from self-management	126	30.0 (15.0–45.0)

Abbreviations: IQR, interquartile range; PETS, patient experience with treatment and self-management.

women, and the median age was 67 (range 40–78) years. The majority of respondents were ethnic Norwegians (N = 131, 97.8%) and lived with a partner or significant other (N = 115, 82.9%). Fifty per cent (n = 67) of respondents had received higher education. Most respondents were currently not employed (N = 82, 61.2%). Nearly half (N = 62, 46.3%) were surgically treated less than 6 months before responding to the survey. Most were diagnosed with colon cancer (N = 80, 59.7%), of whom 70.9% (N = 95) had Dukes' B or C. Approximately 69% (N = 92) of patients had surgery as the only treatment modality, without any additional systemic cancer treatment. Multimorbidity was documented in nearly 75% (N = 100) of respondents, with 43% (N = 59) having two or more chronic conditions in addition to cancer.

Treatment burden characteristics are presented in Table 2. In the workload domain, 'medical information' and 'monitoring health' had the highest scores (median scores ≥20.0), while the highest score for treatment burden stressors was observed for the dimension 'difficulty with health care services' (median scores ≥30.0). In the impact

TABLE 3 Unadjusted and adjusted associations between the demographic and clinical variables and the PETS workload domain

Variables	Medical information (n = 110) Unadjusted RM (95% CI)	p	Adjusted (n = 110) RM (95% CI)	P	Medications (n = 76) Unadjusted RM (95% CI)	P	Adjusted (n = 75) RM (95% CI)	P	Medical appointments (n = 125) Unadjusted RM (95% CI)	P	Adjusted (n = 124) RM (95% CI)	P	Monitoring health (n = 114) Unadjusted RM (95% CI)	P	Adjusted (n = 113) RM (95% CI)	p
Time since primary surgical treatment (ref. <6 months)																
6–12 months	1.25 (0.96, 1.63)	0.10	1.20 (0.94, 1.54)	0.15	1.13 (0.60, 2.12)	0.70	1.09 (0.58, 2.05)	0.78	1.41 (0.90, 2.23)	0.14	1.39 (0.88, 2.18)	0.16	1.26 (0.85, 1.89)	0.25	1.22 (0.81, 1.82)	0.34
>12 months	0.98 (0.68, 1.40)	0.90	1.04 (0.74, 1.46)	0.82	0.93 (0.43, 2.02)	0.85	0.90 (0.40, 1.99)	0.79	0.66 (0.35, 1.25)	0.20	0.79 (0.44, 1.40)	0.42	0.80 (0.50, 1.27)	0.34	0.81 (0.50, 1.30)	0.38
Female vs. male	0.97 (0.76, 1.25)	0.82	0.93 (0.71, 1.22)	0.61	1.01 (0.57, 1.78)	0.98	1.13 (0.64, 2.00)	0.67	0.81 (0.51, 1.28)	0.37	0.83 (0.51, 1.36)	0.46	0.82 (0.54, 1.25)	0.36	0.85 (0.58, 1.28)	0.44
Age per 5 years	1.00 (0.94, 1.05)	0.90	0.98 (0.93, 1.03)	0.45	**0.89 (0.79, 1.00)**	**0.044**	0.86 (0.69, 1.06)	0.15	**0.87 (0.79, 0.95)**	**0.003**	**0.88 (0.78, 0.98)**	**0.024**	**0.91 (0.84, 1.00)**	**0.043**	**0.90 (0.81, 1.00)**	**0.046**
Living alone vs. cohabitating	1.25 (0.93, 1.68)	0.14	1.27 (0.94, 1.73)	0.12	0.72 (0.35, 1.50)	0.38	0.81 (0.33, 1.98)	0.64	0.77 (0.43, 1.39)	0.39	1.09 (0.58, 2.06)	0.79	1.34 (0.83, 2.14)	0.23	**1.70 (1.01, 2.87)**	**0.047**
Higher education (vs. no higher education)	**0.74 (0.58, 0.95)**	**0.019**	**0.72 (0.56, 0.93)**	**0.013**	1.34 (0.78, 2.30)^{n = 75}	0.28	1.21 (0.63, 2.34)	0.57	1.14 (0.75, 1.74)^{n = 124}	0.53	1.07 (0.68, 1.67)	0.78	0.90 (0.62, 1.30)^{n = 113}	0.58	0.89 (0.59, 1.32)	0.56
Currently employed (vs. not currently employed)	1.05 (0.82, 1.35)^{n = 107}	0.70	–	–	1.18 (0.70, 2.05)^{n = 74}	0.56	–	–	1.42 (0.93, 2.16)^{n = 122}	0.10	–	–	1.00 (0.70, 1.45)^{n = 112}	0.99	–	–
Comorbidities (ref. 0 comorbidities)																
1 comorbidity	0.99 (0.73, 1.36)	0.97	1.03 (0.78, 1.35)	0.85	0.66 (0.25, 1.76)	0.41	0.90 (0.28, 2.86)	0.86	0.89 (0.49, 1.59)	0.68	1.12 (0.63, 1.99)	0.69	0.92 (0.56, 1.51)	0.73	1.05 (0.65, 1.70)	0.83
2 comorbidities	0.79 (0.55, 1.13)	0.20	0.82 (0.57, 1.19)	0.30	0.86 (0.42, 1.78)	0.69	0.33 (0.52, 3.40)	0.56	0.67 (0.37, 1.21)	0.18	0.96 (0.59, 1.57)	0.87	0.67 (0.41, 1.03)	0.11	0.84 (0.49, 1.46)	0.54
3 comorbidities	0.92 (0.65, 1.28)	0.61	0.86 (0.62, 1.19)	0.36	0.95 (0.43, 2.10)	0.90	1.48 (0.50, 4.34)	0.48	0.97 (0.55, 1.72)	0.93	1.34 (0.75, 2.40)	0.32	0.87 (0.55, 1.37)	0.54	0.98 (0.56, 1.70)	0.94
4 or more comorbidities	0.91 (0.53, 1.57)	0.74	0.84 (0.51, 1.37)	0.48	1.03 (0.38, 2.76)	0.96	1.27 (0.40, 4.06)	0.68	0.70 (0.24, 2.02)	0.51	0.90 (0.37, 2.19)	0.82	0.64 (0.31, 1.33)	0.23	0.61 (0.42, 1.97)	0.81
Dukes' cancer stage (ref. Dukes' A)																
Dukes' B	0.88 (0.65, 1.20)	0.42	0.93 (0.71, 1.21)	0.57	0.73 (0.35, 1.55)	0.42	0.6 (0.35, 1.37)	0.28	0.81 (0.47, 1.42)	0.46	0.84 (0.49, 1.44)	0.53	0.96 (0.62, 1.48)	0.85	1.13 (0.71, 1.78)	0.60
Dukes' C	0.89 (0.64, 1.16)	0.32	0.95 (0.67, 1.36)	0.79	0.87 (0.47, 1.61)	0.67	0.74 (0.34, 1.60)	0.44	0.87 (0.54, 1.38)	0.55	0.61 (0.34, 1.09)	0.096	0.75 (0.50, 1.12)	0.16	0.75 (0.44, 1.26)	0.28
Adjuvant/neoadjuvant vs. surgical treatment only	0.90 (0.69, 1.17)	0.42	0.9 (0.61, 1.34)	0.61	1.09 (0.62, 1.91)	0.77	1.01 (0.55, 1.85)	0.99	1.49 (0.97, 2.30)	0.071	1.72 (0.94, 3.15)	0.081	1.03 (0.70, 1.49)	0.90	1.21 (0.70, 2.09)	0.51

Abbreviations: CI, confidence interval; ref. reference; RM, ratio of means.
Bold values indicate associations of significance $p = 0.05$.

TABLE 4 Unadjusted and adjusted associations between the demographic and clinical variables and the PETS stressor domain

Variables	Relations with others (n = 129)				Medical and healthcare expenses (n = 112)				Difficulty with healthcare services (n = 80)			
	Unadjusted		Adjusted (n = 129)		Unadjusted		Adjusted (n = 111)		Unadjusted		Adjusted (n = 80)	
	RM (95% CI)	p	RM (95% CI)	p	RM (95% CI)	P	RM (95% CI)	P	RM (95% CI)	P	RM (95% CI)	p
Time since primary surgical treatment (ref. <6 months)												
6–12 months	1.10 (0.50, 2.43)	0.81	1.01 (0.53, 1.92)	0.98	0.83 (0.43, 1.61)	0.59	0.78 (0.45, 1.33)	0.36	1.45 (0.97, 2.16)	0.068	1.40 (0.99, 1.99)	0.054
>12 months	1.33 (0.66, 2.66)	0.43	1.55 (0.88, 2.74)	0.13	0.96 (0.51, 1.78)	0.89	0.30 (0.68, 1.48)	0.43	1.34 (0.87, 2.04)	0.18	1.43 (0.95, 2.16)	0.088
Female vs. male	0.81 (0.42, 1.54)	0.52	0.69 (0.38, 1.26)	0.23	1.09 (0.65, 1.84)	0.74	0.94 (0.57, 1.55)	0.81	1.03 (0.72, 1.47)	0.87	1.21 (0.84, 1.73)	0.31
Age per 5 years	**0.78 (0.69, 0.88)**	**<0.001**	**0.78 (0.68, 0.89)**	**<0.001**	0.89 (0.78, 1.01)	0.076	**0.85 (0.76, 0.96)**	**0.006**	1.00 (0.92, 1.09)	0.96	0.97 (0.90, 1.04)	0.38
Living alone vs. cohabitating	0.72 (0.33, 1.59)	0.42	1.57 (0.68, 3.64)	0.30	1.16 (0.65, 2.06)	0.62	1.71 (0.86, 3.34)	0.13	0.82 (0.53, 1.26)	0.37	0.73 (0.39, 1.35)	0.32
Higher education (vs. no higher education)	1.16 (0.64, 2.12)	0.62	0.90 (0.47, 1.72)	0.74	**0.52 (0.28, 0.95)**$^{n = 111}$	**0.035**	**0.49 (0.28, 0.88)**	**0.016**	0.73 (0.52, 1.04)	0.089	**0.66 (0.47, 0.92)**	**0.016**
Currently employed (vs. not currently employed)	1.39 (0.75, 2.58)$^{n = 125}$	0.29	–	–	0.71 (0.40, 1.26)$^{n = 110}$	0.25	–	–	0.83 (0.57, 1.20)$^{n = 79}$	0.31	–	–
Comorbidities (ref. 0 comorbidities)												
1 comorbidity	1.03 (0.46, 2.33)	0.94	1.52 (0.68, 3.41)	0.31	0.80 (0.42, 1.53)	0.51	1.06 (0.57, 1.97)	0.86	1.00 (0.64, 1.57)	1.00	1.10 (0.69, 1.74)	0.69
2 comorbidities	0.60 (0.26, 1.35)	0.21	1.07 (0.45, 2.55)	0.88	**0.41 (0.17, 0.98)**	**0.046**	0.67 (0.28, 1.61)	0.37	1.17 (0.79, 1.73)	0.44	1.31 (0.85, 2.01)	0.22
3 comorbidities	**0.39 (0.16, 0.95)**	**0.038**	0.65 (0.31, 1.35)	0.25	0.73 (0.34, 1.55)	0.41	0.87 (0.38, 1.98)	0.73	1.23 (0.62, 2.46)	0.56	1.68 (0.87, 3.25)	0.12
4 or more comorbidities	1.51 (0.58, 3.94)	0.40	**3.04 (1.26, 7.32)**	**0.013**	1.65 (0.78, 3.48)	0.19	2.02 (0.92, 4.60)	0.080	1.50 (0.65, 3.47)	0.34	1.08 (0.45, 2.56)	0.87
Dukes' cancer stage (ref. Dukes' A)												
Dukes' B	1.58 (0.69, 3.61)	0.27	1.41 (0.66, 3.01)	0.38	0.77 (0.40, 1.51)	0.45	0.88 (0.46, 1.68)	0.70	0.78 (0.52, 1.16)	0.22	0.77 (0.51, 1.15)	0.21
Dukes' C	1.90 (1.00, 3.62)	0.051	1.2 (0.42, 3.93)	0.65	0.83 (0.47, 1.48)	0.53	0.62 (0.29, 1.32)	0.21	0.67 (0.44, 1.01)	0.064	0.67 (0.42, 1.09)	0.11
Adjuvant/neoadjuvant vs. surgical treatment only	1.6 (0.88, 2.95)	0.12	1.53 (0.56, 4.14)	0.41	1.31 (0.77, 2.23)	0.31	1.70 (0.91, 3.17)	0.096	0.85 (0.58, 1.24)	0.40	0.96 (0.60, 1.54)	0.87

Abbreviations: CI, confidence interval; ref. reference; RM, ratio of means.
Bold values indicate associations of significance p = 0.05.

domain, 'physical and mental fatigue' from self-management had the highest score (≥30.0).

3.2 | Workload of health care and its associations with demographic and clinical factors

In Table 3, the unadjusted and adjusted results from the regression analysis examining associations between the PETS *health care workload* domain and the demographic and clinical variables are shown.

Workload related to accessing medical information was significantly associated with education level (RM: 0.72, 95% CI: 0.56–0.93,

p = 0.013), that is, patients with higher education levels had a 26% lower expected score. Workload related to managing medical appointments was significantly associated with age, with a 12% decrease in the anticipated sub-score per 5-year age increase (RM: 0.88, 95% CI: 0.78–0.98, p = 0.024). Workload related to monitoring health was significantly associated with age (RM: 0.90, 95% CI: 0.81–1.00, p = 0.046), with a 10% reduction per 5-year increase in age, and with living conditions (RM: 1.70, 95% CI: 1.01–2.87, p = 0.047), with patients living alone having a 70% higher expected sub-score than those living with others.

No significant associations were found between the workload of health care and gender, employment status, Dukes cancer stage, treatment mode, comorbidity or time since primary surgery.

TABLE 5 Unadjusted and adjusted associations between the demographic and clinical variables and the PETS impact domain

	Role and social activity limitations (n = 126)				Physical and mental fatigue (n = 126)			
	Unadjusted		Adjusted (n = 125)		Unadjusted		Adjusted (n = 126)	
Variables	RM (95% CI)	p	RM (95% CI)	P	RM (95% CI)	P	RM (95% CI)	p
Time since primary surgical treatment (ref. <6 months)								
6–12 months	0.76 (0.49, 1.19)	0.23	0.71 (0.47, 1.06)	0.095	1.08 (0.83, 1.40)	0.58	1.03 (0.81, 1.29)	0.83
>12 months	**0.50 (0.29, 0.89)**	**0.017**	**0.57 (0.35, 0.91)**	**0.019**	1.02 (0.76, 1.38)	0.88	1.07 (0.83, 1.36)	0.61
Female vs. male	1.01 (0.69, 1.46)	0.97	0.98 (0.69, 1.38)	0.70	1.22 (0.97, 1.53)	0.089	**1.23 (1.00, 1.50)**	**0.050**
Age per 5 years	**0.82 (0.76, 0.88)**	**<0.001**	**0.79 (0.73, 0.85)**	**<0.001**	**0.92 (0.87, 0.97)**	**0.002**	**0.90 (0.85, 0.95)**	**<0.001**
Living alone vs. cohabitating	1.02 (0.64, 1.62)	0.94	**1.68 (1.13, 2.52)**	**0.011**	1.00 (0.71, 1.41)	0.99	1.02 (0.74, 1.40)	0.91
Higher education (vs. no higher education)	1.00 (0.67, 1.49)[n = 125]	0.99	0.78 (0.54, 1.12)	0.18	**0.76 (0.58, 0.99)**	**0.043**	**0.68 (0.53, 0.87)**	**0.003**
Currently employed (vs. not currently employed)	1.25 (0.86, 1.83)[n = 122]	0.24	–	–	1.02 (0.81, 1.28)[n = 122]	0.89	–	–
Comorbidities (ref. 0 comorbidities)								
1 comorbidity	0.91 (0.59, 1.42)	0.69	1.18 (0.82, 1.70)	0.38	0.95 (0.72, 1.26)	0.73	1.08 (0.83, 1.41)	0.55
2 comorbidities	0.72 (0.40, 1.30)	0.28	1.26 (0.69, 2.30)	0.45	**0.66 (0.48, 0.93)**	**0.016**	0.80 (0.58, 1.11)	0.19
3 comorbidities	0.52 (0.25, 1.06)	0.070	0.65 (0.34, 1.26)	0.21	0.74 (0.50, 1.10)	0.13	0.84 (0.58, 1.22)	0.35
4 or more comorbidities	1.36 (0.85, 2.16)	0.20	**2.05 (1.28, 3.27)**	**0.003**	**1.36 (1.04, 1.79)**	**0.024**	1.24 (0.95, 1.62)	0.11
Dukes' cancer stage (ref. Dukes' A)								
Dukes' B	0.79 (0.47, 1.32)	0.38	0.78 (0.50, 1.23)	0.29	**0.71 (0.52, 0.97)**	**0.030**	**0.67 (0.51, 0.88)**	**0.004**
Dukes' C	1.11 (0.72, 1.72)	0.63	0.80 (0.49, 1.33)	0.39	0.98 (0.77, 1.23)	0.81	0.91 (0.69, 1.21)	0.53
Adjuvant/neoadjuvant vs. surgical treatment only	**1.47 (1.02, 2.12)**	**0.038**	1.32 (0.78, 2.24)	0.29	1.14 (0.92, 1.41)	0.23	0.93 (0.71, 1.20)	0.57

Abbreviations: CI, confidence interval; ref. reference; RM, ratio of means.
Bold values indicate associations of significance p = 0.05.

3.3 | Treatment burden stressors and their associations with demographic and clinical characteristics

The unadjusted and adjusted results from the regression analysis examining associations between *stressors aggravating the burden* and the demographic and clinical variables are shown in Table 4. There was a significant association between the stressor 'medical and health care expenses' and age (RM: 0.85, 95% CI: 0.76–0.96, $p = 0.006$), with a decrease in the expected score of 15% per 5-year age increase, and education (RM: 0.49, 95% CI: 0.28, 0.88, $p = 0.016$), with patients with higher education levels having a 51% lower expected sub-score. Patients with higher education levels also had a 34% lower expected score for the stressor 'difficulties with health care services' (RM: 0.66, 95% CI: 0.47–0.92, $p = 0.016$). Patients with ≥4 comorbid conditions had an expected subscale score for the stressor 'relations with others' that was three times higher than that of patients with no comorbid conditions (RM: 3.04, 95% CI: 1.26–7.32, $p = 0.013$).

No significant associations were found between stressors aggravating treatment burden and gender, living conditions, employment status, Dukes cancer stage, treatment mode or time since primary surgical treatment.

3.4 | Impact from treatment burden and its associations with demographic and clinical characteristics

Table 5 displays the unadjusted and adjusted results from the regression analysis examining associations between *impact from the burden* and the demographic and clinical variables. Significant associations were found between 'role and social activity limitations' and age (RM: 0.79, 95% CI: 0.73–0.85, $p = <0.001$), with 21% lower scores per 5-year age increase; living conditions (RM: 1.68, 95% CI: 1.13–2.52, $p = 0.011$), with patients living alone scoring on average 68% higher than those living with others; and comorbidity (RM: 2.05, 95% CI: 1.28–3.27, $p = 0.003$), with patients with ≥4 comorbid conditions having expected sub-scores twice as high as those of patients with no comorbid conditions.

Significant associations were found between 'physical and mental fatigue' and gender (RM: 1.23, 95% CI: 1.00–1.50, $p = 0.050$), with female patients having expected scores 23% higher than those of male patients; age (RM: 0.90, 95% CI: 0.85–0.95, $p = <0.001$), with 10% lower scores per 5-year age increase; education level (RM: 0.68, 95% CI: 0.53–0.87, $p = 0.003$), with patients with higher education levels having 32% lower expected scores; and cancer stage, with patients with Dukes' B cancer having 33% lower subscale scores than patients with Dukes' A (RM: 0.67, 95% CI: 0.51–0.88, $p = 0.004$).

Employment status and time since primary surgical treatment were not significantly associated with the impact domain of treatment burden.

4 | DISCUSSION

This study describes the perceived burden of CRC treatment and self-management and differences in aspects of this burden (i.e. workload, stressors and impact) between groups according to demographic and clinical characteristics as well as time since primary surgery.

The results identified that CRC subpopulations who are younger, have low education levels and have no cohabitants experience higher burden in three workload dimensions, that is, assessing medical information, medical appointments and monitoring health. In our study, younger age was associated with experiencing a higher burden of organising medical appointments. A likely explanation is that the disease interferes more with the daily life of younger cancer patients or that their situation is in greater contrast to the expectations of their life situation. Younger CRC patients often have more extraordinary work- and family-related responsibilities, leaving less time for self-management tasks, such as organising medical appointments (Mansfield et al., 2018).

Our observations suggest that low education is a risk factor for having difficulties accessing medical information needed to cope with the illness and treatment regimens. In previous research, education level is acknowledged as an important predictor of health literacy and are found to predict positive coping behaviour in CRC patients (Jin et al., 2019). In addition, a low education level was significantly associated with stress from dealing with 'Difficulties with health care services', a self-management task required to stay healthy and avoid illness deterioration and that, if not managed effectively, may result in poor care coordination and overwhelmed patients (Durcinoska et al., 2017). CRC patients can benefit from health information being made readily available before and after surgical treatment (Jin et al., 2019). Furthermore, evaluating CRC patients' health literacy levels and information needs in the early stages of primary therapy, and adapt information given the individual patient might ameliorate feelings of self-management burden, and facilitate navigating the healthcare system throughout the illness trajectory.

Cancer survivors may experience uncertainty and increased stress associated with self-monitoring of symptoms and changes in health condition (Muntlin Athlin et al., 2018). In line with this, findings from our study indicate burden from monitoring health was among the essential sources of BoT, especially among young patients. CRC incidence is growing in younger adults (Cavestro et al., 2018), and younger patients more often encounter advanced disease and more likely to undergo adjuvant chemotherapy than older patients (Rodriguez et al., 2018). Kotronoulas et al. (2017) identified younger age as a significant predictor of unaddressed care needs following CRC surgery due to less experience with coping with long-term conditions. The results showed that burden from monitoring health was also more present in CRC patients living alone, most likely due to the lack of a close person with whom to share the treatment burden, access to emotional support and concerns about illness deterioration. Younger individuals and those without cohabitants should be targeted for additional, personalised help with monitoring routines and reassurance regarding recovery.

Our results indicate that younger patients are more vulnerable to the healthcare-related financial burden of CRC. Younger age at the time of cancer diagnosis can cause higher financial distress because younger people have fewer assets and fewer savings and an economically demanding work and family life situation (Snyder & Chang, 2019). Even in a high-income country such as Norway, where healthcare services to a large extent are refunded, younger CRC patients may need help to develop financial plans.

Facing a cancer diagnosis involving upcoming treatments may be overwhelming to many cancer patients and create feelings of helplessness, insecurity and decreased role competency in relationships with others (Grassi & Nanni, 2016). Our results suggest that particularly in CRC patients with multimorbidity, treatment burden may be more pronounced due to stressful relationships with others and limit their social life. Many cancer patients are often co-morbid, and this adds to the workload created by cancer treatment and self-management (Snyder et al., 2015). This in turn may create more tension in close relations, and patients may experience a lack of a supportive environment for self-management. Eton et al. (2019) found that having multiple chronic conditions represented a limitation to cancer survivors' role and social activity involvement.

Several CRC patient subgroups experienced higher levels of physical and mental fatigue due to self-management. The findings that younger CRC patients and those with a low education level experienced more fatigue from self-management reflects our results on the treatment burden dimensions of workload and stressors. The self-management tasks of accessing medical information, monitoring health and engaging with healthcare services and stress related to medical expenses and in close relations may overwhelm some patients. Health professionals should include screening measures to predict CRC patients at risk of being overwhelmed by treatment burden. Although gender did not appear to be a decisive factor in how CRC patients experienced treatment burden, females reported higher fatigue levels than males. Our findings support the notion that variations may be more significant within genders than between genders. However, it is essential to include gender as a determinant of self-management capacity (Peate, 2015).

In this study, a patient's cancer stage was significantly associated with fatigue due to self-management. Surprisingly, no significant difference was identified in self-management fatigue between patients diagnosed with Dukes' C and patients with Dukes' A cancer stage. Compared to those with a Dukes' A stage, patients with Dukes' C stage (i.e. Node-positive tumours) require adjuvant treatment and a cancer treatment pathway of longer duration, most likely exposing the patient to a higher treatment burden. On the other hand, patients with Dukes' C were being followed up by the outpatient clinic. Thus, these patients may experience more self-management support and may not experience fatigue related to undertaking self-management. Perceiving antitumor treatment as useful has been shown to have a positive impact on cancer patients' quality of life, a belief that warrants a supportive and trusting relationship with cancer care professionals (Sibeoni et al., 2018).

Some limitations should be mentioned. First, it was not adjusted for multiple testing due to a relatively low N. This could have led to random significant results (Type I error). On the other hand, a low N and consequently, low explanatory power may have increased the risk of type II errors. Second, the study was completed at a single institution with a population-based referral pattern of consecutive patients, so the generalisability of the results to other geographic regions may still be questionable. Third, the study inclusion criteria of age between 18 and 79 years excluded the treatment burden experiences of CRC patients ≥ 80 years of age. Fourth, the psychometric properties of the Norwegian version of the PETS have yet to be assessed before satisfactory levels of reliability can be confirmed. This study shows modest levels of treatment burden in this CRC sample, which may be due to the appropriateness of PETS for capturing patients' treatment burden. The original version of the PETS was developed and validated in multi-morbid patient populations (Eton et al., 2017), and further research is warranted to further establish the applicability of the PETS in cancer populations. Nonetheless, the study includes treatment burden self-reported data and from CRC patients only, which may be considered a strength.

5 | CONCLUSIONS

This survey of treatment burden has provided new knowledge on self-management workload, stressors contributing to burden, and how treatment burden affects patients with CRC. It also identified potential subgroups of patients in need of special attention for ameliorating their treatment burden. The overall treatment burden levels of CRC patients were modest and associated with age, gender, education level, living conditions, multimorbidity and cancer stage. To identify CRC subpopulations at risk of treatment burden, there is a need to incorporate screening of patients' self-management challenges and treatment burden experiences throughout the cancer treatment pathway. Support should be adapted to identified self-management challenges and treatment burden. Information on treatment burden may provide a better understanding of the work required by CRC patients to self-manage following primary treatment and the conditions most likely to influence patients' ability to self-manage. In general, more research is needed on CRC treatment burden to develop interventions customised to meet patients' support needs following primary treatment and optimise self-management in vulnerable subpopulations.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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