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ORIGINAL ARTICLE

Socioeconomic status and quality of life in patients with locally advanced head and neck cancer

S. Tribius[1] · **M. S. Meyer**[2] · **C. Pflug**[3] · **H. Hanken**[4] · **C.-J. Busch**[5] · **A. Krüll**[2] · **C. Petersen**[2] · **C. Bergelt**[6]

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Abstract

Purpose Socioeconomic aspects play an important role in health care. Patients with locally advanced head and neck cancer (LAHNC) experience detrimental effects on their quality of life (QoL). This prospective study examines QoL differences between patients with different socioeconomic status (SES) after intensity-modulated radiation therapy (IMRT).

Patients and methods In all, 161 patients were questioned at the end of IMRT and at 12 and 24 months follow-up using the questionnaires of the European Organization for Research and Treatment of Cancer (EORTC) QLQ-30 and QLQ-HN35. Patients' QoL 2 years after IMRT was compared to a population reference sample and QoL of patients from lower, middle, and higher social class 2 years after IMRT was analyzed by ANCOVA using baseline QoL (end of radiation treatment) as a covariate.

Results Patients with high SES report worse QoL at the end of IMRT in the domains global health status (–15.2; $p=0.005$), role function (–23.8; $p=0.002$), and social function (–19.4; $p=0.023$) compared to patients with middle and low SES. QoL improved during the first 12 and 24 months. However, 2 years after IMRT, middle and low SES patients report lower QoL in the domains global health status, physical function, and role function, and report a higher general (fatigue, pain, dyspnea) and head and neck cancer-specific symptom burden (pain, swallowing, senses, speech, social eating, opening mouth, and felt ill) than patients with high SES.

Conclusion After IMRT for LAHNC, patients with high SES report worse QoL compared to patients with middle or low SES. There is a marked improvement within the first 24 months in many domains. However, the magnitude of improvement in patients with middle or low SES is significantly smaller compared to patients with high SES.

Keywords Quality of life · Head and neck cancer · Intensity-modulated radiotherapy · Rehabilitation · Socioeconomic status

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✉ S. Tribius, MD, PhD
s.tribius@asklepios.com

[1] Department of Radiation Oncology, Asklepios Hospital St. Georg, Lohmühlenstraße 5, 20099 Hamburg, Germany

[2] Department of Radiation Oncology, University Medical Center Hamburg-Eppendorf, Hamburg, Germany

[3] Department of Voice, Speech and Hearing Disorders, Center for Clinical Neurosciences, University Medical Center Hamburg-Eppendorf, Hamburg, Germany

[4] Department of Oral & Maxillofacial Surgery, Center for Clinical Neurosciences, University Medical Center Hamburg-Eppendorf, Hamburg, Germany

[5] Department of Otolaryngology, Center for Clinical Neurosciences, University Medical Center Hamburg-Eppendorf, Hamburg, Germany

[6] Department of Medical Psychology, University Medical Center Hamburg-Eppendorf, Hamburg, Germany

Sozioökonomischer Status und Lebensqualität bei Patienten mit lokal fortgeschrittenen Kopf-Hals-Tumoren

Zusammenfassung

Zielsetzung Sozioökonomische Aspekte spielen bei vielen Erkrankungen und deren Therapie eine nicht zu unterschätzende Rolle, so auch bei Patienten mit lokal fortgeschrittenen Kopf-Hals-Tumoren (LFKHT). Diese Patienten erfahren durch Erkrankung und Therapie Einbußen in ihrer Lebensqualität (QoL). Diese prospektive Studie untersucht den Zusammenhang zwischen QoL und sozioökonomischem Status (SES) bei LFKHT-Patienten nach intensitätsmodulierter Strahlentherapie (IMRT).

Patienten und Methoden Am Ende der Bestrahlung, nach 6–8 Wochen sowie 6, 12, 18 und 24 Monate nach Abschluss der IMRT haben 161 Patienten die standardisierten Fragebögen der EORTC (European Organization for Research and Treatment of Cancer) QLQ-C30 und QLQ-HN35 ausgefüllt. Nach 2 Jahren wurde die QoL der Gesamtpopulation mit der einer Referenzpopulation verglichen und der Zusammenhang zwischen QoL am Ende der IMRT und SES analysiert (ANCOVA).

Ergebnisse Patienten der Gruppe mit hohem SES hatten eine deutlich schlechtere QoL in den Domänen globaler Gesundheitsstaus (–15,2; $p = 0{,}005$), Rollenfunktion (–23,8; $p = 0{,}002$) und soziale Funktion (–19,4; $p = 0{,}023$) verglichen mit Patienten der mittleren und niedrigen SES-Gruppen. Nach 12 und 24 Monaten verbesserte sich die QoL in vielen Domänen. Patienten mit mittlerem und niedrigem SES berichten 2 Jahre nach IMRT eine schlechtere QoL in den Domänen globaler Gesundheitszustand, körperliche Funktion und Rollenfunktion und eine höhere Symptomlast (Fatigue, Schmerzen, Dyspnoe). Im spezifischen Kopf-Hals-Tumor-Modul berichteten Patienten mit hohem SES signifikant weniger häufig Symptome im Vergleich zu Patienten mit mittlerem oder niedrigem SES (Schmerzen, Schlucken, Sinne, Sprechen, Essen in Gesellschaft, Mundöffnung und Krankheitsgefühl).

Zusammenfassung Am Ende der Radio(chemo)therapie für LFKHT schätzen Patienten mit höherem SES ihre QoL schlechter ein als Patienten mit mittlerem oder niedrigem SES. Nach 24 Monaten zeigt sich eine Verbesserung der QoL in vielen Domänen, wobei diese bei niedrigem SES deutlich weniger ausgeprägt ist als bei hohem SES.

Schlüsselwörter Lebensqualität · Kopf-Hals-Tumor · Intensitätsmodulierte Strahlentherapie · Rehabilitation · Sozioökonomischer Status

Introduction

Over the past decade, quality of life (QoL) has become increasingly important in cancer care. In patients with locally advanced head and neck cancer, the tumor itself as well as the treatment can have a profound impact on QoL [1–3]. Therefore, long-term QoL has become an important endpoint alongside the classical survival endpoints [4, 5]. Patients with a low socioeconomic status (SES) have an increased risk of not only developing head and neck cancer, but also to be diagnosed in a more advanced stage of the disease and to have a worse survival compared to patients with a high SES [6–8]. The SES index includes education, income, occupation, and cost of living [9].

It is an ethical challenge to balance the consequences of societal and social deprivation on one side and to manage the economic burden caused by malignant diseases on the other [10]. Mackenbach et al. found that economic deprivation and it is consequential health-related impact causes 700,000 deaths per year and 33 million newly diagnosed diseases per year in the European Union [11]. This impact on disease incidence accounts for approximately 20% of overall health care costs and reduced national productivity. However, it is not appropriate to consider QoL only in economic terms [11].

Head and neck cancer is the sixth most common cancer worldwide, including in Germany [12]. It is prudent to consider and understand sociodemographic variables as well as health aspects, including QoL, in this patient population. Knowledge and understanding of the imbalances in health care in Germany is of utmost importance and societal relevance, and has become an important research field in Germany during recent years [10].

Data on QoL and SES in patients with locally advanced head and neck cancer are scarce. Short and Mallonee et al. looked in the US at QoL and differences in household income for various malignancies using the Functional Assessment of Cancer Therapy-General (FACT-G) and the SF-12 questionnaires and found that cancer patients with higher income not only have a better survival but also have a better QoL [13].

It has been reported that individuals with high SES are most likely more conscious about health and preventive measures. This is of importance in populations of low SES, in which the incidence of head and neck cancer is not only higher but people are much less conscious about this disease [8, 14, 15].

The aim of the present study was to analyze QoL in patients with locally advanced head and neck cancer (LAHNC) as a function of their SES, and to see if it differs up to 24 months after completion of intensity-modulated radiation therapy (IMRT) for LAHNC.

Patients and methods

Study design and sampling

Before adjuvant radio(chemo)therapy (R(C)T), eligible patients were enrolled into a prospective study by the radiation oncologist. Eligible patients with LAHNC had to have M0 disease, squamous cell histology, no contraindication to R(C)T, and be able to complete the QoL questionnaires and be compliant to follow-up appointments. QoL was measured at the end of IMRT and at 12 and 24 months follow-up. Questionnaires were self-completed in the physician's office at the time of the visit.

The IMRT dose prescription followed the recommendations of the ICRU (International Commission on Radiation Units and Measurement) report, 83 [16]. In the adjuvant setting, patients received a total dose of 60–66 Gy at 2 Gy per fraction. If indicated, risk-adapted concurrent RCT was applied with cisplatin weekly with 30–40 mg/m^2 or 100 mg/m^2 every 3 weeks. In the primary setting, a total dose of 70 Gy was given with 5 fractions per week at 2 Gy per fraction.

Approval was obtained from the local ethics committee. All patients provided written informed consent.

Sociodemographic variables

At the beginning of RT, patients reported on age, marital status, education level, occupation, and monthly household net income. An adapted version of a composite social class indicator based on primary and secondary education, type of occupation and monthly household net income was calculated to assess social class [17]. Based on this index, patients can be classified into upper, middle, or lower social class.

Disease- and treatment-related variables

Disease- and treatment-related variables such as tumor diagnosis, tumor stage, and type of treatment were assessed and documented by the treating physicians.

Quality of life

Cancer-related quality of life was measured by applying the German version of the European Organisation for Research and Treatment of Cancer Quality of Life Questionnaire-Core 30 (EORTC) QLQ-C30 [18]. The core module consists of 30 items from which a global quality of life score can be calculated as well as five functioning scales (emotional, physical, cognitive, social, and role functioning), three multi-item scales for cancer-related symptoms (fatigue, nausea and vomiting, pain) and six single-item scales for cancer-related symptoms (dyspnea, insomnia, appetite loss, constipation, diarrhea, financial difficulties).

Specific cancer-related QoL was measured with the EORTC Head and Neck Module H&N35 [19]. From the 35 items of the module, seven head and neck-specific multi-item scales can be derived (pain, swallowing, senses, speech, social eating, social contact, and sexuality) as well as six single-item scales (problems with teeth, problems opening mouth, dry mouth, sticky saliva, coughing, felt ill). In addition, the questionnaire comprises five yes/no items (use of painkillers, nutritional supplements, feeding tube, weight loss, and weight gain).

The EORTC QLQ-C30 and H&N35 questionnaires were scored according to the EORTC scoring manual [20]. Scores on each scale range from 0–100. Higher scores in functioning scales indicate higher health-related QoL; higher scores in symptom scales indicate more severe symptoms and thus lower QoL. Score differences of 10 points or more between patient subgroups are considered to be clinically relevant [21]. It has been demonstrated that EORTC QLQ-C30 and H&N35 are valid and reliable instruments for the measurement of QoL in head and neck cancer patients [22–25].

A score of 100 indicates perfect QoL on the functional scales, whereas for the symptom scales a score of 100 indicates a heavy burden. Score differences of 10 points or more between patient subgroups are considered to be clinically relevant [21]. The reliability and validity of the C30 and HN35 scales are considered acceptable [24, 25].

Data analysis

Descriptive analyses were carried out to examine sociodemographic and medical characteristics of the sample. Group differences based on patients' socioeconomic status were analyzed by univariate analysis of variance for metric variables or chi-square tests for categorical variables.

To compare the sample's quality of life to the norm population, we created an age- and gender-adjusted comparison sample from the German norm population sample by matching each patient with the norm sample's value from the same age category and gender, and performed two-sample t-tests [22].

Regarding cancer-related QoL and head and neck-specific QoL 2 years after the end of RT, we compared functioning scale scores and symptom scale scores of the EORTC QLQ-C30 and H&N35 of patients from lower, middle, and higher social classes by analyses of covariance using baseline QoL (end of RT) as a covariate.

For comparisons of means between groups we calculated effect sizes Cohen's d and partial eta-squared. As suggested by Cohen (1988), effect sizes are categorized as small ($d = 0.2$, partial $eta^2 = 0.01$), medium ($d = 0.5$, partial $eta^2 = 0.06$), and large ($d = 0.8$, partial $eta^2 = 0.14$; [26]).

All data analyses were performed using SPSS (Windows) version 18.0 (IBM Corporation, Armonk, New York, USA).

Results

Patients

Between March 2009 and May 2014, 242 patients were enrolled into the study. 163 (67.4%) of those patients were alive 24 months after completion of radio(chemo)therapy, 62 (25.6%) had died, and 17 (7.0%) patients were lost to follow-up. Due to missing data on socioeconomic status, 2 patients had to be excluded from further analyses. Out of 161 patients included in the final analyses, 111 (68%) were male and 117 (72%) were married. The median age of the entire patient population was 60.9 years (range 22.7–82.9) and 71% of the sample presented with stage IV non-metastatic disease. Tumors of the oropharynx (38%) and the oral cavity (29%) were most prevalent. Patients with low socioeconomic status (SES) had significantly lower physical functioning scores and were more frequently diagnosed with a lower Karnofsky Performance Status (KPS) than patients with medium or high SES. They were also significantly more often widowed or divorced, more frequently retired, and denied more frequently current alcohol consumption (Table 1).

Treatment

114 patients (70%) had surgery initially and were referred for adjuvant treatment with curative intent. Of the patients receiving definitive RCT, 17 (15%) had prior chemotherapy. In total, 50% of patients had concurrent RCT.

SES as predictor for changes in QoL

At the end of radiation therapy (RT), patients with high SES reported significantly lower mean scores in their quality of life (EORTC QLQ-C30) than patients with low SES in regard to global health status (minus 15.2, $p = 0.005$), role function (minus 23.8, $p = 0.002$), and social function (minus 19.4, $p = 0.023$). Mean scores reported for physical, emotional, and cognitive function and symptom burden did not differ significantly between SES groups (univariate analysis data not shown). Nearly all patients (97%) reported fatigue symptoms at the end of R(C)T and a substantial part of the sample reported symptoms such as pain (86%), insomnia (76%), appetite loss (76%) and nausea/vomiting (69%), dyspnea (58%), constipation (53%), and financial problems (58%). Frequencies of reported symptoms did not differ by SES (Table 2).

Twelve and 24 months after radio(chemo) therapy, mean scores reported for function and symptom scales for general quality of life (EORTC QLQ-C30) recovered remarkably. Patients with low SES reported less advantageous changes in quality of life scores over time in many function and symptom scales than patients with medium or high SES (Table 2).

Similarly, regarding specific quality of life issues (EORTC head and neck module HN35), patients report substantial symptom burden in all symptom scales at the end of treatment and less impairments at 12 and 24 months after the completion of R(C)T (Table 3). Univariate analyses show that mean symptom scores at the end of R(C)T do not significantly differ by SES (data not shown).

ANCOVA analyses show that at 24 months after treatment, patients with high SES report significantly higher quality of life scores than patients with medium or low SES for their global health status and physical and role function. They also report significantly lower symptom burden regarding fatigue, pain, and dyspnea. Effect sizes of these group differences were medium (partial eta^2 between 0.040 and 0.090; Table 4).

Considering specific quality of life scores (EORTC head and neck module), patients with high SES report significantly lower symptom burden than patients with medium or low SES for the items: pain, swallowing, senses, speech, social eating, opening mouth, and feeling ill. Effect sizes of these group differences were medium (partial eta^2 between 0.040 and 0.085; Table 5).

All patients reported significantly impaired functioning scores as well as significantly increased symptom burden in all functioning and symptom scales of the EORTC QLQ-C30 24 months after the end of R(C)T compared to a population reference group. Effect sizes of these differences were mainly medium to large (d between 0.229 and 0.824; Table 6).

Table 1 Sample characteristics—sociodemographic, disease-related, and lifestyle characteristics of *N* = 161 patients at the beginning of radiation treatment

		SES					
	Whole sample (*N* = 161)	Low (*n* = 50)	Middle (*n* = 75)	High (*n* = 36)	Group difference (F/χ^2)	df	*p*-value
Age[a] (years; M, SD) (range *N*: 22.7–82.8; median *N* = 60.9)	60.4 (10.4)	62.9 (9.6)	58.6 (11.3)	60.8 (8.6)	2.576	2	0.079
Medical							
BMI[a] (M, SD)	25.0 (4.5)	24.7 (4.9)	25.2 (4.7)	24.9 (4.0)	0.243	2	0.784
Hemoglobin[a] (mg/dl; M, SD)	12.0 (1.9)	11.9 (1.6)	12.0 (1.9)	11.8 (2.1)	0.130	2	0.878
Karnofsky (%)							
≤70	29.8	44.0	25.3	19.4	13.193	6	0.040*
≤80	23.6	24.0	24.0	22.2			
≤90	27.3	18.0	34.7	25.0			
100	19.3	14.0	16.0	33.3			
Tumor stage (%)							
UICC I/II	8.7	2.0	17.3	0	13.300	2	0.001*
UICC III/IV	91.3	98.0	82.7	100			
Nodal stage (%)							
N0/1	42.9	42.0	45.3	38.9	0.434	2	0.805
N2/3	57.1	58.0	54.7	61.1			
Previous chemotherapy (%)	15.5	14.0	13.3	22.2	1.594	2	0.451
Previous surgery (%)	69.6	66.0	74.7	63.9	1.770	2	0.413
Tumor site (%)							
Oral cavity	29.2	32.0	26.7	30.6	3.674	6	0.721
Oropharynx	37.9	36.0	36.0	44.4			
Hypopharynx/larynx	23.6	26.0	24.0	19.4			
Others	9.3	6.0	13.3	5.6			
Sociodemographic							
Sex (%)							
Male	68.3	66.0	68.0	72.2	0.381	2	0.826
Female	31.7	34.0	32.0	27.8			
Marital status (%)							
Single	11.8	20.0	8.0	8.3	26.643	4	<0.001*
Married	72.0	46.0	86.7	77.8			
Widowed/divorced	16.1	34.0	5.3	13.9			
Employment status (%)							
Employed/self-employed	44.7	26.5	47.3	63.9	14.998	4	0.005*
Unemployed	11.3	16.3	13.5	0.0			
Retired	44.0	57.1	39.2	36.1			
Schooling (%)							
9 years	45.8	87.0	40.8	2.8	99.573	4	0.001*
10 years	24.8	10.9	40.8	11.1			
12–13 years	29.4	2.2	18.3	86.1			
Monthly household net income (%)							
Up to 1000 €	16.2	45.8	4.2	0.0	106.625	6	<0.001*
1001–2000 €	35.7	50.0	38.9	8.8			
2001–3000 €	22.7	4.2	37.5	17.6			
3001 € and more	25.3	0.0	19.4	73.5			

Table 1 (Continued)

	Whole sample (N = 161)	SES Low (n = 50)	Middle (n = 75)	High (n = 36)	Group difference (F/χ^2)	df	p-value
Lifestyle							
Smoking status (%)							
Smoker	24.7	31.3	21.6	22.2	3.584	4	0.465
Former smoker	54.4	56.3	54.1	52.8			
Non-smoker	20.9	12.5	24.3	25.0			
Alcohol consumption (%)							
Regularly	10.8	4.2	14.9	11.1	13.795	4	0.008*
Sometimes	34.2	22.9	32.4	52.8			
Currently no consumption	55.1	72.9	52.7	36.1			

M mean, *SD* standard deviation, *SES* socioeconomic status, *BMI* body mass index, *df* Cohen's d
*Statistically significant p-value
[a]Univariate analysis of variance was performed to assess group differences for metric variables and the F statistic is reported; all other variables are categorical and were assessed using chi-square tests

Discussion

Our study demonstrated that patients with a high SES undergoing IMRT for the treatment of head and neck cancer report significantly worse global and cancer-specific QoL compared to patients with a low SES at the end of R(C)T. Our data suggest that during the first 24 months after treatment, the recovery in patients with high SES is of a significantly larger magnitude compared to patients with low SES (panel 1 and 2, Supplementary Material). Patients with low SES report less significant changes in their role function and symptom burden at 12 and 24 months after treatment. This is in line with previous reports on SES as predictor for QoL and outcome in head and neck cancer patients as well as in cancer patients in general [7, 27–30].

To the best of our knowledge, this is the first study evaluating SES as a predictor for QoL using the EORTC questionnaires in head and neck cancer patients after R(C)T with curative intent in a patient population with LAHNC. A study looking at the impact of monthly income on QoL in cancer patients using the Functional Assessment of Cancer Therapy-General (FACT-G) and the SF-12 module as QoL measures found that patients with an affluent background had a significantly better QoL after surviving cancer [13].

It is worth noting that most studies on SES and cancer care outcome in general, as well as in head and neck cancer patients, define SES solely by a single item: income as the determinant of SES [6, 8, 14, 29, 31–33]. Using income alone as SES indicator has several limitations; it doesn't account for employment status (retired versus employed/unemployed), comorbidities, wealth, living situation/support system, and is less stable than education [34]. In our study, we used the adapted version of a composite social class indicator based on primary and secondary education, type of occupation, and monthly household net income [17].

Contrary to other reports, the distribution of UICC stage in our study did not significantly differ between SES groups: Chu et al. showed that patients with low SES present significantly more often with more advanced disease at first diagnosis [29]. A US American study published by Naghavi et al. in 2016 reported that in Afro-Americans with head and neck cancer, there is an association between SE, employment status, and marital status on one side and delayed diagnosis and begin of therapy on the other [35].

In contrast to countries where socioeconomic imbalances are accompanied by limited or no access to healthcare, in Germany, every individual has access to health care coverage through the solidarity system. A Canadian study stating that Canadian citizens have access to universal healthcare [8] reported that low SES was associated with more advanced disease stage at diagnosis. Patients with low SES were more likely to consume alcohol and tobacco and were more likely to have cancer of the oral cavity and greater comorbidity [28]. This also partially applied to our patient population, which had more patients with oral cancers in the low and middle SES groups. In our patient population, more than two thirds of patients were grouped into low and middle SES groups and 22% into the high SES group. It was shown that the incidence of head and neck cancer is higher in deprived populations [6].

Being single, poorly educated, with low income (annual household income of less than 20,000 US$) were found to be the main determinants of SES [36]. Low SES was not shown to be predictive for malignant diseases in general but specific for head and neck cancer [36]. An increased incidence of head and neck cancer in low-income populations was also described in other Canadian studies [6, 8, 14, 32].

Table 2 Course of quality of life, measured using the EORTC QLQ-C30 at the end of treatment, after 12 and 24 months

	SES	End of radiation treatment		12 months after radiation		24 months after radiation	
		M	SD	M	SD	M	SD
EORTC QLQ-C30							
Function scales							
Global health status	Low	45.5	24.8	57.3	21.2	56.8	26.0
	Middle	34.1	23.1	68.3	20.3	67.2	22.3
	High	30.3	19.5	72.0	16.6	71.6	21.6
Physical function	Low	64.5	24.1	66.9	26.2	71.5	24.8
	Middle	63.6	23.1	78.3	23.5	81.9	20.3
	High	64.3	23.5	86.9	17.8	87.8	17.0
Role function	Low	55.3	34.1	68.0	28.2	64.7	34.4
	Middle	38.7	31.4	71.8	27.4	70.6	30.8
	High	31.5	29.2	83.3	18.7	81.9	26.7
Emotional function	Low	47.3	28.1	65.8	25.3	66.7	27.4
	Middle	48.1	24.7	68.8	25.6	69.7	27.1
	High	56.3	25.0	77.9	17.6	74.5	24.8
Cognitive function	Low	71.0	27.5	76.9	23.0	74.0	24.6
	Middle	69.6	25.2	80.9	21.2	79.2	22.5
	High	74.1	23.4	85.6	17.9	84.8	19.0
Social function	Low	52.7	36.2	74.5	28.1	66.7	33.7
	Middle	42.6	31.2	73.3	27.5	72.9	31.2
	High	33.3	28.2	78.7	20.9	77.0	26.6
Symptom scales							
Fatigue	Low	57.6	27.7	39.7	27.7	38.2	26.2
	Middle	63.9	25.9	34.1	25.7	34.3	26.6
	High	62.0	28.7	24.4	20.4	25.8	25.8
Nausea/vomiting	Low	37.7	35.4	3.7	9.8	5.3	13.2
	Middle	30.9	29.5	3.8	9.8	3.0	8.5
	High	33.8	35.5	3.7	12.7	3.9	13.0
Pain	Low	46.3	30.0	31.6	31.4	35.7	31.8
	Middle	58.4	32.6	20.5	23.2	25.0	30.4
	High	52.8	35.7	15.3	21.2	20.1	28.9
Dyspnea	Low	32.7	31.2	25.2	27.7	33.3	28.6
	Middle	32.4	33.8	19.8	27.0	22.2	30.6
	High	29.6	30.6	15.7	24.5	15.7	28.7
Insomnia	Low	48.0	33.1	37.4	33.8	36.0	31.5
	Middle	48.6	35.4	29.3	28.6	30.1	31.2
	High	47.2	38.5	23.1	27.4	26.5	32.6
Appetite loss	Low	60.5	37.1	20.4	30.3	19.3	27.0
	Middle	64.4	36.7	17.6	29.3	20.4	32.4
	High	70.5	34.1	15.7	25.8	11.1	24.5
Constipation	Low	25.3	33.4	17.7	32.0	13.3	26.1
	Middle	34.2	37.2	13.2	27.6	14.4	27.9
	High	38.9	36.1	8.3	14.6	7.8	16.5
Diarrhea	Low	24.0	33.7	6.1	17.6	8.7	23.1
	Middle	14.7	25.8	5.9	16.9	6.0	18.8
	High	20.4	29.0	13.0	25.5	10.8	22.8
Financial problems	Low	40.7	37.1	35.4	36.9	38.7	38.3
	Middle	39.4	38.1	32.4	36.3	26.4	33.5
	High	24.1	31.5	14.3	25.9	15.7	29.9

EORTC European Organisation for Research and Treatment of Cancer, *QLQ-C30* Quality of Life Questionnaire Core module, *QoL* quality of life, *SD* standard deviation, *M* mean, *SES* socioeconomic status

Table 3 Course of quality of life, measured using the EORTC H&N35 at the end of treatment, after 12 and 24 months

	SES	End of radiation treatment		12 months after radiation		24 months after radiation	
		M	SD	M	SD	M	SD
EORTC H&N35							
Multi-item symptom scales							
Pain	Low	50.0	28.6	25.7	27.2	25.2	26.1
	Middle	58.2	26.7	16.6	17.5	14.5	17.6
	High	53.7	26.5	17.1	16.9	15.7	23.9
Swallowing	Low	58.8	28.3	31.0	27.0	31.3	25.0
	Middle	66.4	25.5	20.8	22.4	23.0	24.7
	High	71.0	24.6	20.1	22.1	20.8	25.0
Senses	Low	58.7	30.2	38.1	29.1	41.0	32.8
	Middle	57.3	28.6	26.9	26.4	25.0	26.1
	High	59.3	28.3	25.5	19.7	24.5	23.7
Speech	Low	54.9	32.9	25.2	23.0	30.1	26.4
	Middle	54.5	30.7	25.2	24.8	20.2	22.0
	High	58.7	31.4	18.7	15.8	21.9	21.3
Social eating	Low	60.5	31.6	34.0	31.0	38.5	36.6
	Middle	64.9	28.0	26.1	25.8	24.7	31.1
	High	66.7	28.7	26.9	25.1	28.7	31.7
Social contact	Low	28.0	28.4	16.2	23.1	18.4	27.1
	Middle	31.5	25.6	14.0	18.6	11.4	18.7
	High	32.8	26.1	10.2	12.6	11.8	18.4
Sexuality	Low	59.2	39.0	38.3	35.3	42.8	35.3
	Middle	67.4	37.3	41.3	36.4	37.9	36.1
	High	76.6	36.6	35.9	36.1	30.3	38.5
Single-item symptom scales							
Teeth	Low	29.1	35.9	49.0	42.5	44.7	40.7
	Middle	29.3	32.4	27.6	34.4	28.2	37.0
	High	22.9	35.9	25.0	34.2	35.4	38.1
Opening mouth	Low	54.7	38.5	34.0	34.0	42.4	36.9
	Middle	58.7	37.9	28.0	33.8	28.2	33.9
	High	62.0	40.0	38.9	36.1	31.4	36.6
Dry mouth	Low	66.0	35.3	60.5	31.7	53.5	36.2
	Middle	66.7	36.3	54.1	30.6	48.1	33.0
	High	68.5	32.8	54.6	31.0	55.9	33.6
Sticky saliva	Low	77.6	32.2	49.0	35.4	54.9	35.4
	Middle	81.8	28.1	47.1	32.5	42.6	32.7
	High	79.6	31.1	40.7	29.9	48.0	34.0
Coughed	Low	60.0	32.3	36.1	27.9	39.7	32.3
	Middle	61.8	31.3	35.1	26.2	33.3	25.0
	High	58.3	31.2	31.5	31.8	26.5	29.3
Felt ill	Low	56.5	34.8	25.0	24.3	34.0	35.8
	Middle	66.2	32.2	20.9	24.4	24.5	29.1
	High	60.0	34.1	13.9	16.7	18.6	22.0

EORTC European Organization for Research and Treatment of Cancer, *EORTC H&N35* Quality of Life Questionnaire Head and Neck Cancer specific module, *QoL* quality of life, *SD* standard deviation, *M* mean, *SES* socioeconomic status

Table 4 Quality of life 24 months after radiation by socioeconomic status in $n=161$ head and neck cancer survivors. ANCOVA of functioning scales and symptom scales of the EORTC QLQ-C30 with baseline QoL (end of radiation) as covariate

	SES	24 months after radiation		ANCOVA^{a}			
		M	SD	F	df	*p*-value	Partial eta^2
Global health status	Low	56.8	26.0	5.994	2	0.003*	0.074
	Middle	67.2	22.3				
	High	71.6	21.6				
Physical function	Low	71.5	24.8	7.484	2	0.001*	0.090
	Middle	81.9	20.3				
	High	87.8	17.0				
Role function	Low	64.7	34.4	4.533	2	0.082	0.056
	Middle	70.6	30.8				
	High	81.9	26.7				
Emotional function	Low	66.7	27.4	0.266	2	0.767	0.003
	Middle	69.7	27.1				
	High	74.5	24.8				
Cognitive function	Low	74.0	24.6	2.276	2	0.106	0.029
	Middle	79.2	22.5				
	High	84.8	19.0				
Social function	Low	66.7	33.7	2.148	2	0.120	0.027
	Middle	72.9	31.2				
	High	77.0	26.6				
Fatigue	Low	38.2	26.2	3.180	2	0.044*	0.040
	Middle	34.3	26.6				
	High	25.8	25.8				
Nausea/vomiting	Low	5.3	13.2	0.562	2	0.571	0.007
	Middle	3.0	8.5				
	High	3.9	13.0				
Pain	Low	35.7	31.8	4.708	2	0.010*	0.010
	Middle	25.0	30.4				
	High	20.1	28.9				
Dyspnea	Low	33.3	28.6	4.587	2	0.012*	0.012
	Middle	22.2	30.6				
	High	15.7	28.7				
Insomnia	Low	36.0	31.5	1.064	2	0.348	0.014
	Middle	30.1	31.2				
	High	26.5	32.6				
Appetite loss	Low	19.3	27.0	1.345	2	0.264	0.018
	Middle	20.4	32.4				
	High	11.1	24.5				
Constipation	Low	13.3	26.1	1.214	2	0.300	0.016
	Middle	14.4	27.9				
	High	7.8	16.5				
Diarrhea	Low	8.7	23.1	0.455	2	0.635	0.006
	Middle	6.0	18.8				
	High	10.8	22.8				
Financial problems	Low	38.7	38.3	2.791	2	0.065	0.036
	Middle	26.4	33.5				
	High	15.7	29.9				

ANCOVA Analysis of Covariance, *df* Cohen's d, *EORTC* European Organisation for Research and Treatment of Cancer, *QLQ-C30* Quality of Life Questionnaire Core module, *QoL* quality of life, *SD* standard deviation, *M* mean, *SES* socioeconomic status

*Statistically significant *p*-value

[a] Baseline QoL (end of radiation) as covariate

Table 5 Quality of life 24 months after radiation by socioeconomic status in $n=161$ head and neck cancer survivors. ANCOVA of symptom scales of the EORTC QLQ-H&N35 with baseline QoL (end of radiation) as covariate

	SES	24 months after radiation		ANCOVA[a]			
		M	SD	F	df	*p*-value	Partial eta^2
Pain	Low	25.2	26.1	7.016	2	0.001*	0.085
	Middle	14.5	17.6				
	High	15.7	23.9				
Swallowing	Low	31.3	25.0	4.640	2	0.011*	0.059
	Middle	23.0	24.7				
	High	20.8	25.0				
Senses	Low	41.0	32.8	6.689	2	0.002*	0.082
	Middle	25.0	26.1				
	High	24.5	23.7				
Speech	Low	30.1	26.4	3.309	2	0.039*	0.043
	Middle	20.2	22.0				
	High	21.9	21.3				
Social eating	Low	38.5	36.6	3.548	2	0.031*	0.046
	Middle	24.7	31.1				
	High	28.7	31.7				
Social contact	Low	18.4	27.1	2.583	2	0.079	0.033
	Middle	11.4	18.7				
	High	11.8	18.4				
Sexuality	Low	42.8	35.3	2.310	2	0.103	0.035
	Middle	37.9	36.1				
	High	30.3	38.5				
Teeth	Low	44.7	40.7	2.777	2	0.066	0.037
	Middle	28.2	37.0				
	High	35.4	38.1				
Opening mouth	Low	42.4	36.9	3.160	2	0.045*	0.040
	Middle	28.2	33.9				
	High	31.4	36.6				
Dry mouth	Low	53.5	36.2	0.705	2	0.496	0.009
	Middle	48.1	33.0				
	High	55.9	33.6				
Sticky saliva	Low	54.9	35.4	2.367	2	0.079	0.031
	Middle	42.6	32.7				
	High	48.0	34.0				
Coughed	Low	39.7	32.3	1.959	2	0.145	0.026
	Middle	33.3	25.0				
	High	26.5	29.3				
Felt ill	Low	34.0	35.8	4.072	2	0.019*	0.052
	Middle	24.5	29.1				
	High	18.6	22.0				

SES socioeconomic statuse, *EORTC* European Organization for Research and Treatment of Cancer, *EORTC H&N35* Quality of Life Questionnaire Head and Neck Cancer specific module, *M* mean, *SD* standard deviation, *ANCOVA* Analysis of Covariance, *df* Cohen's d

*Statistically significant *p*-value

[a] Baseline QoL (end of radiation) as covariate

It was also shown that patients with high SES have a better chance of surviving cancer independent of tumor stage and consumption of nicotine or alcohol [8, 28]. Differences between ethnicity, SES, and survival could not be explained simply with demographic data, comorbidity, or differences in treatment strategies [37].

The incidence of oropharyngeal cancer is increasing, independent of SES. However, the greatest increase is seen in the patient population with high SES [6, 8]. A US Ameri-

Table 6 General quality of life in $N = 161$ patients 24 months after the end of radiation treatment compared to a population reference group. Functioning scales and symptom scales of the EORTC QLQ-C30

	Sample		Reference group[a]					
	M	SD	M	SD	T	df	*p*-value	d
Global health status	64.6	24.0	67.0	5.3	–1.209	170.927	0.228	0.138
Physical function	79.7	22.0	87.3	6.8	–4.154	185.075	<0.001*	0.467
Role function	70.9	31.7	85.3	5.8	–5.581	166.385	<0.001*	0.632
Emotional function	69.4	26.9	79.0	2.4	–4.434	158.485	<0.001*	0.503
Cognitive function	78.2	23.5	89.6	4.3	–5.968	166.282	<0.001*	0.675
Social function	71.4	31.4	89.1	3.3	–7.003	159.391	<0.001*	0.793
Fatigue	33.9	26.6	19.1	6.6	6.761	175.351	<0.001*	0.764
Nausea/vomiting	4.4	12.3	2.4	1.0	2.012	158.051	0.046*	0.229
Pain	27.6	31.0	19.2	6.3	3.336	168.842	0.001*	0.376
Dyspnea	24.4	30.0	10.9	5.5	5.558	166.541	<0.001*	0.626
Insomnia	31.4	31.6	19.9	7.3	4.431	172.586	<0.001*	0.501
Appetite loss	18.2	29.2	5.6	2.1	5.345	156.647	<0.001*	0.609
Constipation	12.5	25.2	4.4	2.3	4.052	158.523	<0.001*	0.453
Diarrhea	7.9	21.1	2.7	0.8	3.091	156.409	0.002*	0.348
Financial problems	28.5	35.6	7.7	2.6	7.301	157.675	<0.001*	0.824

EORTC European Organisation for Research and Treatment of Cancer, *QLQ-C30* Quality of Life Questionnaire Core module, *SD* standard deviation, *M* mean, *df* Cohen's d

*Statistically significant *p*-value

[a]Reference group data was derived from Schwarz and Hinz [22]

can study reported that Afro-Americans with high SES are more likely to have HPV-associated oropharyngeal cancers than Afro-Americans with low SES [38]. In our population, HPV assessment was not routinely implemented until a few years ago. Therefore, we are unable to provide any reliable data for our sample. However, 38% (61 patients) of our population are patients with an oropharyngeal primary cancer. According to available epidemiological data, the prevalence of HPV (human papilloma virus) in northern Germany [39] is about 20–30% in oropharyngeal cancer, thus probably affecting less than 20 patients of our study population only and is therefore likely to be of negligible impact.

Critical comments

First, contrary to other reports, in our patient population there were less alcohol consumers and more smokers in the low SES group. This phenomenon might be underreporting of alcohol consumption. In addition, contrary to the United States, where nicotine consumption has dramatically reduced, smoking habits have remained practically unchanged in Europe [40]. In a study from Canada by Chu et al., smoking and heavy alcohol consumption were associated with more comorbidities and low SES [28]. Each risk factor is associated with a worse prognosis in general. Guo et al. showed that increased nicotine consumption is a significant negative predictor for cancer-specific survival. Particularly a high number of pack-years is associated with worse survival in low SES groups [41].

Second, in our patient population, 91% of patients were diagnosed with locally advanced cancers (UICC III/IV), and thus, by definition, were treated with R(C)T in the primary or adjuvant setting. Therefore, we cannot draw any conclusions about SES and stage of disease at diagnosis. Chu et al. looked at more than 4700 head and neck cancer patients and analyzed Asian-Pacific Islanders—the fastest growing population in California [29]. Low SES patients were diagnosed with more advanced disease and had a 24% increased risk of dying from head and neck cancer. In this population-based study, the potential survival benefit of adding chemotherapy to radiotherapy was superseded by low SES. QoL was not examined in this study. However, since QoL is a major predictor for cancer survival, it can be assumed that QoL in this patient population is likely to be poor [37, 38].

Finally, only native German speakers were included in the study, which might be a selection bias and results might not apply to other patient populations.

One of the strengths of this study is that few patients were lost to follow-up, strengthening the conclusions drawn from the data. Observational studies, while less rigorously controlled than randomized clinical trials, have the advantage of more accurately reflecting the real-life clinical situation because they suffer less frequently from selection bias that can result from excluding patients based on factors such as comorbidity and age.

Conclusion

Most head and neck cancer patients experience a negative impact on their quality of life after R(C)T and report scores below the reference population as long as 24 months after treatment. This prospective study shows that socioeconomic factors have a strong influence on quality of life in this patient group, especially in patients with low SES who show the strongest impairment [42, 43]. The potential association between SES and QoL as well as possible interventions such as counseling at the start of therapy and offering programs to support patients with lower SES should be investigated in future studies.

Conflict of interest S. Tribius, M.S. Meyer, C. Pflug, H. Hanken, C.-J. Busch, A. Krüll, C. Petersen, and C. Bergelt declare that they have no competing interests.

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