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Education level and survival after oesophageal cancer surgery: a prospective population-based cohort study

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ABSTRACT

Objectives: This study aimed to investigate whether a higher education level is associated with an improved long-term survival after oesophagectomy for cancer.
Design: A prospective, population-based cohort study.
Setting: Sweden—nationwide.
Participants: 90% of all patients with oesophageal and cardia cancer who underwent a resection in Sweden in 2001–2005 were enrolled in this study (N=600; 80.3% male) and followed up until death or the end of the study period (2012). The study exposure was level of education, defined as compulsory (≤9 years), moderate (10–12 years) or high (≥13 years).
Outcome measures: The main outcome measure was overall 5-year survival after oesophagectomy. Cox regression was used to estimate the associations between education level and mortality, expressed as HRs with 95% CIs, with adjustment for sex, age, tumour stage, histological type, complications, comorbidities and annual surgeon volume. The patient group with highest education was used as the reference category.
Results: Among the 600 included patients, 281 (46.8%) had compulsory education, 238 (39.7%) had moderate education and 81 (13.5%) had high education. The overall 5-year survival rate was 23.1%, 24.4% and 32.1% among patients with compulsory, moderate and high education, respectively. After adjustment for confounders, a slightly higher, yet not statistically significantly increased point HR was found among the compulsory educated patients (HR 1.08, 95% CI 0.80 to 1.47). In patients with tumour stage IV, increased adjusted HRs were found for compulsory (HR 2.88, 95% CI 1.07 to 7.73) and moderately (HR 2.83, 95% CI 1.15 to 6.95) educated patients. No statistically significant associations were found for the other tumour stages.
Conclusions: This study provides limited evidence of an association between lower education and worse long-term survival after oesophagectomy for cancer.

Strengths and limitations of this study

- Nationwide population-based design with high participation rate and completeness of the follow-up, consequently reducing the risk for selection bias.
- Robust definitions of exposure and outcome reducing the risk of misclassification.
- Limited statistical power to detect weak or moderate differences, particularly in the stratified analyses.

INTRODUCTION

Oesophageal cancer is characterised by an increasing incidence in many Western populations, and the 5-year overall survival is less than 15% in Europe.[1 2] A low socioeconomic position is a risk factor for two main histological types of oesophageal cancer, that is, adenocarcinoma and squamous cell carcinoma. The role of the socioeconomic position in the development of oesophageal carcinoma can only partly be explained by the main risk factors, that is, gastro-oesophageal reflux and obesity for adenocarcinoma and tobacco smoking and heavy alcohol intake for squamous cell carcinoma.[1 3 4] A recent study indicated that the mortality rates for oesophageal cancer were lower in patients with a higher education level.[5] Education has been studied more extensively in relation to survival of other types of cancer,[6–10] showing a beneficial effect of higher education on survival that might be explained by the differences in comorbidity burden, lifestyle factors, health awareness, adherence to treatment and healthcare seeking behaviour, factors which are also likely to influence the timing of referral and tumour stage at diagnosis.[6–10] The impact of education on survival after oesophageal cancer diagnosis has been examined in cohort studies,[3 11 12] but no clear associations were found. Two studies have evaluated the influence of the socioeconomic position on survival after oesophagectomy for cancer,[13 14] where one showed no long-term survival advantage of higher socioeconomic position,[13] while the other study showed a better short-term survival.[14] Thus, the prognostic role of socioeconomic position in patients with oesophageal cancer remains uncertain. A better insight into this association might improve preoperative decision-making and information, and postoperative management, survival and health-related quality of life. The objective of this study was to clarify the influence of education level on the overall and disease-specific survival after curatively intended oesophageal cancer surgery using a nationwide population-based design with a long-term follow-up.

PATIENTS AND METHODS

Study design and data sources

This was a nationwide Swedish prospective, population-based cohort study. All surgically treated patients with oesophageal or cardia cancer in Sweden during the period April 2001 and December 2005 were eligible for the study. The follow-up for survival ended in August 2012.

Data sources

In September 2012, the following Swedish registers were linked:

The Swedish Esophageal and Cardia Cancer database (SECC): SECC was used to identify the study cohort and assess the data on clinical factors. This database is our all-encompassing, nationwide Swedish research database, including 90% of all patients with oesophageal and cardia cancer treated with surgery in Sweden during the inclusion period. The organisation of the nationwide network of clinicians and the design of this study have been described in detail elsewhere.[15 16] In brief, SECC contains prospectively collected and detailed information about tumour pathology and localisation, tumour stage, surgical procedures and complications.[16]

The Swedish Patient Registry: The Patient Register comprises information on all in-hospital care and outpatient specialist care in Sweden, including codes for diagnoses and surgical procedures. It has a complete nationwide coverage of inpatient data since 1987, and complete outpatient specialist care data since 2001. The validity of oesophageal cancer surgery in the Patient Registry has recently been assessed. Among 1358 patients with a code representing oesophageal resection in the Patient Registry in 1987–2005, the positive predictive value was 99.6%.[17] Data on comorbidity at the time of surgery were collected from this registry.

The National Education Registry: This registry was established by Statistics Sweden in 1985, and is annually updated with information on the highest formal education attained by each individual, from elementary to postgraduate level.[18] Data on the study exposure and education level were collected from this registry.

Swedish Causes of Death Registry: This registry contains information on date of death for all deceased Swedish residents since 1952, and has a 99.2% completeness of cause-specific death.[19] Data on mortality were collected from this registry.

Study exposure

The study exposure was the highest attained education level (partially or fully completed) at the time of surgery, and was classified into three categories based on the Swedish National School Administration and Statistics Sweden: (1) 'compulsory' education or ≤9 years: primary and lower secondary education (up to the age of 16 years), (2) 'moderate' education or 10–12 years: upper secondary education (standard is 3 years) and (3) 'high' education or ≥13 years: postsecondary education.

Study outcomes

The outcomes were (1) overall mortality up to 5 years after oesophagectomy for oesophageal or cardia cancer, the main outcome measure, (2) conditional mortality, defined as mortality within 5 years of surgery after exclusion of the first 90 days (short-term mortality) after surgery, (3) disease-specific mortality, representing all deaths with oesophageal or cardia cancer as an underlying or contributing cause of death within 5 years of surgery, (4) conditional and disease-specific 5-year mortality and (5) short-term mortality (within 90 days of surgery), which was analysed for completeness.

Statistical analyses

Cox regression was used to assess the association between the level of education and mortality, expressed as HRs with 95% CIs. The patient group in the highest category of education was used as the reference group. Three regression models were used (1) a crude model without any adjustments, (2) a second model adjusted for sex, age (<60, 60–74 or ≥75 years) and tumour stage (0–I, II, III or IV) and (3) a fully adjusted model further adjusted for histological type (adenocarcinoma or squamous cell carcinoma), the number of major complications (0, 1 or >1), the number of comorbidities (0, 1 or >1) and surgeon volume (<8 or ≥8 oesophagectomies/year). Tumour stage was categorised according to the TNM classification presented by the 'Union Internationale Contre le Cancer'.[20] Predefined major medical and surgical complications which occurred within 30 days of surgery were extracted from the SECC database and included the following: anastomotic leakage, serious infections, respiratory insufficiency, cardiac failure, renal or liver failure, technical complications, damage to the recurrent laryngeal nerve or the thoracic duct, early anastomotic stricture and others (embolus, deep venous thrombosis, rupture of the wound, intestinal obstruction, myocardial infarction or stroke, all with a need for intervention). Data on comorbidity present at the time of surgery were extracted from the patient register, and included the following: diabetes mellitus, cardiovascular disease, pulmonary disease, hepatic or renal disease, renal failure and other cancer. Comorbidities within the same group (eg, two different cardiovascular diseases) were counted only once. Surgeon volume was categorised into two equally sized groups based on the median number of operations per surgeon and year.[21 22] To assess effect modification, stratified survival analyses were performed for tumour stage and histological type. The same three regression models were used in the stratified analyses, but without adjustment for the stratifying variable. To test for interaction, a fully adjusted model was used with the patient group in the highest category of education with tumour stage I as the reference group.

RESULTS

Patients

From the study cohort, 616 patients were originally identified, which corresponded to 90% of all eligible patients in Sweden who underwent oesophageal or cardia cancer surgery during the inclusion period. Of these, 16 patients were excluded from the analyses because of missing values for education (N=6), tumour stage (N=9) or histology (N=1), leaving 600 patients for final analysis. Some characteristics of the study patients are described in table 1. Of all patients, 281 (46.8%) had compulsory education, 238 (39.7%) had moderate education and 81 (13.5%) had high education. Compared with the compulsory educated group, patients in the higher educated groups were younger, but the sex distribution was similar in all groups (approximately 80% male). Distribution of tumour stage was comparable among the three education groups, while the proportion of squamous cell carcinoma was slightly higher in the compulsory educated group compared with the highly educated group (26% vs 22%). The highly educated group had a lower frequency of comorbidity compared with the compulsory educated group (53% vs 64%). The proportions of patients operated on by surgeons with high or low

Table 1 Demographic, treatment and tumour characteristics and mortality after oesophagectomy for cancer, categorised by the education level

	Level of education*			
	≥13 years N (%)	10–12 years N (%)	≤9 years N (%)	Total N (%)
Total	81 (13.5)	238 (39.7)	281 (46.8)	600 (100.0)
Age (years)				
<60	27 (33.3)	74 (31.1)	43 (15.3)	144 (24.0)
60–74	48 (59.3)	126 (52.9)	161 (57.3)	335 (55.8)
≥75	6 (7.4)	38 (16.0)	77 (27.4)	121 (20.2)
Sex				
Male	64 (79.0)	188 (79.0)	230 (81.9)	482 (80.3)
Female	17 (21.0)	50 (21.0)	51 (18.2)	118 (19.7)
Tumour stage				
I	19 (23.5)	45 (18.9)	49 (17.4)	113 (18.8)
II	19 (23.5)	73 (30.7)	84 (29.9)	176 (29.3)
III	34 (42.0)	91 (38.2)	117 (41.6)	242 (40.3)
IV	9 (11.1)	29 (12.2)	31 (11.0)	69 (11.5)
Histology				
Adenocarcinoma	63 (77.8)	183 (76.9)	208 (74.0)	454 (75.7)
Squamous cell carcinoma	18 (22.2)	55 (23.1)	73 (26.0)	146 (24.3)
Comorbidity				
None	38 (46.9)	95 (39.9)	101 (35.9)	234 (39.0)
One	28 (34.6)	92 (38.7)	88 (31.3)	208 (34.7)
More than one	15 (18.5)	51 (21.4)	92 (32.7)	158 (26.3)
Surgical volume				
Low (<8 operations/year)	42 (51.9)	119 (50.0)	153 (54.5)	314 (52.3)
High (≥8 operations/year)	39 (48.2)	119 (50.0)	128 (45.5)	286 (47.7)
Postoperative complications				
None	46 (56.8)	158 (66.4)	175 (62.3)	379 (63.2)
One	20 (24.7)	53 (22.3)	68 (24.2)	141 (23.5)
More than one	15 (18.5)	27 (11.3)	38 (13.5)	80 (13.3)
Mortality				
Within 90 days	5 (6.2)	19 (8.0)	24 (8.5)	48 (8.0)
Overall within 5 years	55 (67.9)	180 (75.6)	216 (76.9)	451 (75.2)
Conditional within 5 years†	50 (65.8)	161 (73.5)	192 (74.7)	403 (73.0)

*Level of education: ≥13 years: postsecondary education; 10–12 years: upper secondary education; ≤9 years: compulsory education.
†Conditional mortality: excluding first 90 days after surgery.

annual volume were similar between the education groups. No major differences in the number of postoperative complications were found between the educational levels. In total, 451 (75.2%) patients died within 5 years of surgery, of whom 425 (94.2%) had oesophageal or cardia cancer as an underlying or contributing cause of death.

Education level and mortality

All tumour stages

The frequencies of overall 5-year mortality, conditional 5-year mortality and short-term mortality were highest in the compulsory educated group, closely followed by the moderately educated group and lowest in patients with high education (table 1). The overall 5-year survival rates were 23.1%, 24.4% and 32.1% among patients with compulsory, moderate and high education, respectively. Table 2 presents the HRs for mortality after oesophagectomy according to the education level of all included patients. The crude model showed increased overall point HRs in the compulsory (HR 1.30, 95% CI 0.97 to 1.74) and moderately educated groups (HR 1.16, 95% CI 0.85 to 1.56) compared with the reference group (high education), but without statistical significance. The point HRs became slightly attenuated after adjustment in the second model (HR 1.11, 95% CI 0.81 to 1.51) and the third, fully adjusted model (HR 1.08, 95% CI 0.80 to 1.47). The HRs for mortality within 5 years of surgery were similar when only disease-specific deaths were considered, as well as when the first 90 days were excluded from the analyses (table 2). Regarding short-term (90 days) mortality, no difference was identified between the compulsory educated and the highly educated in the fully adjusted model (HR 0.98, 95% CI 0.36 to 2.67).

Specific tumour stages

The tumour stage-specific analyses addressing the overall 5-year mortality indicated some differences in survival between the education groups (table 3). In tumour stage I, the fully adjusted point HRs for compulsory and moderately educated patients were increased compared with patients in the highest level of education, but no statistically significant differences were found (HR 2.39, 95% CI 0.81 to 7.07 and HR 1.53, 95% CI 0.49 to 4.78, respectively). In tumour stage IV, the fully adjusted HRs were almost threefold increased in compulsory and moderately educated patients compared with highly educated patients (HR 2.88, 95% CI 1.07 to 7.73 and HR 2.83, 95% CI 1.15 to 6.95). When the patient group with tumour stage I and the highest level of education was used as the reference group, survival was significantly worse in all groups with tumour stages II–IV (table 4).

Specific histological types

The crude 5-year overall survival analyses stratified for histological type indicated the associations between

Table 2 Multivariable Cox regression models analysing the association between education level and mortality after oesophagectomy for cancer, expressed as HR with 95% CI

	Level of education*		
	≥13 years (Reference)	10–12 years HR (95% CI)	≤9 years HR (95% CI)
Overall 5-year mortality			
Model 1	1	1.16 (0.85 to 1.56)	1.30 (0.97 to 1.74)
Model 2	1	1.04 (0.77 to 1.41)	1.08 (0.80 to 1.46)
Model 3	1	1.08 (0.80 to 1.47)	1.11 (0.81 to 1.51)
Conditional overall 5-year mortality†			
Model 1	1	1.14 (0.83 to 1.57)	1.29 (0.95 to 1.76)
Model 2	1	1.03 (0.75 to 1.42)	1.09 (0.79 to 1.50)
Model 3	1	1.07 (0.78 to 1.48)	1.13 (0.82 to 1.57)
Disease-specific 5-year mortality‡			
Model 1	1	1.15 (0.85 to 1.57)	1.32 (0.98 to 1.79)
Model 2	1	1.04 (0.76 to 1.42)	1.12 (0.82 to 1.53)
Model 3	1	1.09 (0.80 t o1.48)	1.16 (0.85 to 1.59)
Conditional† and disease-specific‡ 5-year mortality			
Model 1	1	1.16 (0.84 to 1.61)	1.32 (0.96 to 1.82)
Model 2	1	1.06 (0.76 to 1.46)	1.13 (0.81 to 1.56)
Model 3	1	1.09 (0.79 to 1.52)	1.19 (0.85 to 1.65)
Overall 90-day mortality			
Model 1	1	1.28 (0.48 to 3.42)	1.37 (0.52 to 3.59)
Model 2	1	1.08 (0.40 to 2.92)	1.00 (0.37 to 2.70)
Model 3	1	1.25 (0.46 to 3.42)	0.98 (0.36 to 2.67)

Values are expressed as HRs.
*Level of education: ≥13 years: postsecondary education; 10–12 years: upper secondary education; ≤9 years: compulsory education.
†Conditional mortality: excluding first 90 days after surgery.
‡Disease-specific mortality: oesophageal or cardia cancer as underlying or contributing cause. Model 1: unadjusted. Model 2: adjusted for sex, age and tumour stage. Model 3: adjusted for sex, age, tumour stage, histology, major complications, comorbidity and surgeon volume.

Table 3 Multivariable Cox regression models analysing the association between education level and all-cause 5-year mortality after oesophagectomy for cancer, stratified by tumour stage and expressed as HRs with 95% CIs

	Level of education*			
	≥13 years (Reference)	10–12 years HR (95% CI)	≤9 years HR (95% CI)	Total number (%)
Model 1				
Stage I	1	1.55 (0.51 to 4.70)	2.71 (0.94 to 7.84)	113 (18.8)
Stage II	1	1.31 (0.72 to 2.39)	1.18 (0.65 to 2.14)	176 (29.3)
Stage III	1	0.85 (0.56 to 1.30)	1.03 (0.69 to 1.55)	242 (40.3)
Stage IV	1	1.47 (0.67 to 3.24)	1.33 (0.61 to 2.92)	69 (11.5)
Model 2				
Stage I	1	1.64 (0.53 to 5.06)	2.56 (0.88 to 7.51)	113 (18.8)
Stage II	1	1.12 (0.61 to 2.06)	0.89 (0.48 to 1.64)	176 (29.3)
Stage III	1	0.81 (0.53 to 1.24)	0.98 (0.65 to 1.49)	242 (40.3)
Stage IV	1	1.52 (0.69 to 3.38)	1.30 (0.58 to 2.90)	69 (11.5)
Model 3				
Stage I	1	1.53 (0.49 to 4.78)	2.39 (0.81 to 7.07)	113 (18.8)
Stage II	1	0.96 (0.51 to 1.79)	0.81 (0.43 to 1.54)	176 (29.3)
Stage III	1	0.89 (0.58 to 1.37)	1.03 (0.67 to 1.57)	242 (40.3)
Stage IV	1	2.83 (1.15 to 6.95)	2.88 (1.07 to 7.73)	69 (11.5)

Values are expressed as HRs or as number of patients (%).
Model 1: unadjusted; model 2: adjusted for sex and age; model 3: adjusted for sex, age, histology, major complications, comorbidity and surgeon volume.
*Level of education: ≥13 years: postsecondary education; 10–12 years: upper secondary education; ≤9 years: compulsory education.

compulsory education and survival in patients with adenocarcinoma, but the HRs were attenuated after full adjustments (HR 1.13, 95% CI 0.79 to 1.62 and HR 1.11, 95% CI 0.77 to 1.58; table 5). The adjusted point HRs for squamous cell carcinoma were also increased among compulsory and moderately educated groups compared with the highly educated group, but no statistically significant differences were identified (HR 1.18, 95% CI 0.61 to 2.30 and HR 1.26, 95% CI 0.65 to 2.44, respectively).

DISCUSSION

This study does not provide much evidence for the hypothesis that the education level influences the long-term survival after surgery for oesophageal cancer, with the exception of worse survival in compulsory educated groups with advanced tumours (stage IV).

The strengths of this study include the nationwide population-based design with a high participation rate and completeness of the follow-up, consequently reducing the risk for selection bias. The results have also been adjusted for confounding by known prognostic factors. Moreover, the exposure and outcome measures were robust, especially because we limited our study to one exposure as proxy for socioeconomic status. We also considered using income or occupation-based measures of socioeconomic position but chose individual educational level as it is robust and easy to measure. Income is rather complex to measure as one has to take the wealth and the numbers supported by the income into account. The last updated Census in Sweden on an occupation-based measure was in 1990.[23 24] Therefore, we limited this study to the education status only.

A weakness is the limited statistical power to detect weak or moderate differences, particularly in the

Table 4 Multivariable Cox regression models analysing the association between education level and all-cause 5-year mortality after oesophagectomy for cancer, stratified by tumour stage, and expressed as HRs with 95% CIs, with tumour stage I in the high educated group as reference

	Level of education*			
	≥13 years	10–12 years HR (95% CI)	≤9 years HR (95% CI)	Total number (%)
Model 3				
Stage I	1	1.56 (0.51 to 4.76)	2.43 (0.84 to 7.05)	113 (18.8)
Stage II	5.47 (1.77 to 16.87)	6.13 (2.22 to 16.92)	5.54 (2.00 to 15.39)	176 (29.3)
Stage III	10.31 (3.62 to 29.39)	9.01 (3.28 to 24.74)	9.87 (3.61 to 26.94)	242 (40.3)
Stage IV	12.65 (3.78 to 42.38)	19.03 (6.63 to 54.62)	15.49 (5.41 to 44.33)	69 (11.5)

Values are expressed as HRs or as number of patients (%).
Model 3: adjusted for sex, age, histology, major complications, comorbidity and surgeon volume.
*Level of education: ≥13 years: postsecondary education; 10–12 years: upper secondary education; ≤9 years: compulsory education.

Table 5 Multivariable Cox regression models analysing the association between education level and all-cause 5-year mortality after oesophagectomy for cancer, stratified by tumour histology and expressed as HRs with 95% CI

	Level of education*			
	≥13 years (Reference)	10–12 years HR (95% CI)	≤9 years HR (95% CI)	Total number (%)
Overall 5-year mortality	55/81 (67.9)	180/238 (75.6)	216/281 (76.9)	451/600 (75.2)
Model 1				
Adenocarcinoma	1	1.20 (0.85 to 1.70)	1.41 (1.00 to 1.98)	454 (75.7)
Squamous cell carcinoma	1	1.00 (0.55 to 1.83)	0.99 (0.55 to 1.78)	146 (24.3)
Model 2				
Adenocarcinoma	1	1.03 (0.72 to 1.46)	1.07 (0.75 to 1.52)	454 (75.7)
Squamous cell carcinoma	1	1.06 (0.57 to 1.97)	1.01 (0.55 to 1.87)	146 (24.3)
Model 3				
Adenocarcinoma	1	1.11 (0.77 to 1.58)	1.13 (0.79 to 1.62)	454 (75.7)
Squamous cell carcinoma	1	1.26 (0.65 to 2.44)	1.18 (0.61 to 2.30)	146 (24.3)

Values are expressed as HRs or as number of patients (%).
Model 1: unadjusted; model 2: adjusted for sex and age; model 3: adjusted for sex, age, tumour stage, major complications, comorbidity and surgeon volume.
*Level of education: ≥13 years: postsecondary education; 10–12 years: upper secondary education; ≤9 years: compulsory education.

stratified analyses. Despite the inclusion of the vast majority of all patients operated in Sweden during the nearly 5-year inclusion period, who it was possible to follow-up for at least 5 years, the low incidence of oesophageal cancer in Sweden combined with a low resection rate (25%) reduced the sample size. A post hoc power analysis showed that if the HR would have been 1.43 or higher, the power for this study cohort would have been at least 80%. An adjusted HR of 1.19 (table 3) would, for example, require a sample size of 2500 patients in the study cohort assuming similar conditions as those of the present study. Therefore, even larger studies are needed to statistically verify the level of potential associations indicated in the present study.

Since the inclusion period was limited, differences in the therapeutic management are unlikely to have influenced the survival. The multicentre design, where several hospitals and surgeons were involved in the treatment of these patients, might have influenced the survival, but it is unlikely that the referral patterns would be different between the education groups. Finally, confounding by other factors than those adjusted for could influence the results.

An interesting question is why the differences in education in oesophageal cancer seem to be a less strong prognostic factor compared with other cancer types.[6–10] A British study compared the 'deprivation gap', or the percentage difference in a 5-year survival between the most affluent and most deprived patients in 17 different cancer types, and showed major differences for cancer of the larynx (17%), colon (6–7%), rectum (8–9%), prostate (7%), bladder (6%) and breast (6%), but not for the oesophagus (in men 1.9%, in women 0.2%), stomach (1.7%), pancreas (1%) or ovary (1%).[25] These results, supported by the findings of the present study, may suggest that the possible impact of the socioeconomic position might be restricted by the high overall mortality rates in oesophageal cancer.

Any baseline difference between the educational groups is deemed of limited impact, since the great majority of deaths within the 5 years after operation for oesophageal cancer (95%) are because of cancer recurrence.[26 27] We censored our data at 5 years after surgery, because deaths after this period are less likely to be related to cancer recurrence. Therefore the mortality rate should be similar as for the background population.

The reasons for the differences in survival between compulsory and highly educated patients with advanced tumour (stage IV) are unclear, and we can only speculate. Highly educated patients with advanced disease might receive (and possibly also request) a more aggressive preoperative and postoperative treatment, which might result in a longer average survival period that would influence the HR for overall mortality. These findings are supported by a recent study, which showed an increased survival for patients with higher income levels, and a correlation between higher income and receiving curative treatment (including surgery and radiotherapy).[28] Even a small increase in the length of survival in our group of patients with high education could be responsible for these significant results. Yet, although the prognosis is poor for patients with tumour stage 4, these differences are not purely due to the differences in the short-term survival, since 5.8% of these patients survive at least 5 years after surgery.

The clinical implications of this study are limited, since the overall results suggest that the impact of education on survival after oesophagectomy could be low or even absent. Yet, it could be discussed that more effort should be placed on the lower educated patients, as they could have more risk factors for mortality such as increased comorbidity, as shown in the present study. Nevertheless, continuous efforts are needed to guarantee an optimal treatment for all patients, including patients with suspected low compliance to treatment, follow-up and lifestyle recommendations.

To conclude, this population-based, nationwide and prospective cohort study provides a limited evidence of education being a prognostic factor after oesophagectomy for cancer. However, the increased mortality in lower educated groups with tumour stage IV warrants further attention. In addition, the generally increased point risk estimates combined with a limited statistical power indicate a need for studies with very large sample sizes that can allow for detailed stratification of the analyses.

Contributors All authors contributed equally to the study design and study protocol. PL and JL were responsible for the data collection. FM and NB performed the statistical analyses and interpreted the results. The writing and revisions of the manuscript have been performed by NB. Critical evaluation of the manuscript was performed equally by all authors.

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Patient consent Obtained.

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