



Contents lists available at ScienceDirect

European Journal of Surgical Oncology

journal homepage: [www.ejso.com](http://www.ejso.com)

# The impact of a patient's social network on emergency surgery for colon cancer

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## ARTICLE INFO

### Article history:

Received 21 June 2022

Received in revised form

21 August 2022

Accepted 28 September 2022

Available online xxx

### Keywords:

Colon cancer

Emergency surgery

Social network

Social support

## ABSTRACT

**Aim:** The aim of this study was to investigate if patients with a weak social network and colon cancer are more likely to be operated as an emergency than those with a strong social network.

**Methods:** Data from patients living in Västerbotten County, Sweden, who underwent colon cancer surgery between 2007 and 2020 were extracted from the Swedish Colorectal Cancer Registry (SCRCR). Patients identified were matched against the Västerbotten Intervention Program (VIP) and the longitudinal study Monitoring of Trends and Determinants in Cardiovascular Disease (MONICA). These two databases include a survey that includes questions regarding quality and size of the patient's social network. Multivariable logistic regression was used for analysis.

**Results:** Six items from the questions on social network, and the composite variables *availability of social integration* (AVSI) and *availability of attachment* (AVAT) were analysed. Data from 801 patients were analysed. The odds ratio for emergency surgery was significantly higher for divorced patients (OR 2.01 (CI 1.03–3.91)) and for male gender (OR 1.51 (CI 1.02–2.24)). A higher OR was seen amongst those with no one to share feelings with (OR 1.57 (CI 0.82–3.03)) or to comfort them (OR 1.33 (CI 0.78–2.28)). Quantitative aspects of social life such as the number of people greater than 10 that feel relaxed at the patient's home, showed a lower OR (OR 0.71 (CI 0.35–1.43)).

**Conclusion:** The impact of social network on the risk for emergency surgery for colon cancer is limited. Divorced status and male gender were associated with an increased risk for emergency surgery.

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## 1. Introduction

Emergency procedures constitute a considerable proportion of colon cancer surgery. In Sweden, 21.5% of colon cancer surgeries are performed as an emergency [1] with inferior short- and long-term survival rates partly due to impaired cancer-specific survival compared to elective cases [2–5]. Obstruction is the usual reason for emergency surgery followed by perforation and hemorrhage [6]. Those operated as an emergency usually have a more advanced tumor [4,7]. It is also known that if the delay in surgery exceeds 40 days in elective cases, overall survival is impaired [8]. Reasons for patient and/or physician delay differ, but the diffuse character of tumor symptoms is one cause [9–15].

Studies have shown that low socioeconomic status is associated with delayed diagnosis as well as emergency surgery [16,17].

Persons living alone are known to delay seeking medical care for symptoms of colon cancer [18].

A well-functioning social network is an important part of our lives. It involves personal relationships and social interactions, including friends, relatives, and acquaintances. Living alone does not rule out a well-functioning social network. Measuring the number of contacts in a person's social network is a quantitative measurement. A qualitative measurement is attachment *i.e.*, the way persons relate to their closest contacts. Another important aspect is how satisfied people are with their personal contacts; experienced as the adequacy of their social network [19]. One explanation for the higher proportion of emergency surgeries for patients with lower socioeconomic status might be that they delay seeking medical help or have difficulty in obtaining healthcare due to the expense. The question is, could this also be the case for patients with a weak social network.

When colon cancer is diagnosed at an early stage, emergency surgery might be avoided, and surgery often results in better outcome. People with a strong social network are more likely to

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<https://doi.org/10.1016/j.ejso.2022.09.019>

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discuss their symptoms with others or recognize the disease by sharing experiences with others in the social network. Friends may see the signs of colon cancer and encourage the individual to seek healthcare.

The aim of this study was to investigate the impact of a well-functioning social network on the proportion of colon cancer patients operated as an emergency.

## 2. Method

This is a unique registry-based study comparing data from three registries. Two of these registries containing information on social networks were matched with the Swedish National Colon Cancer Registry.

The Västerbotten Intervention Program (VIP) has the primary goal to reduce mortality and morbidity from metabolic and cardiovascular disease [20]. As part of this program, all inhabitants of Västerbotten County are invited to a clinical examination and to answer a questionnaire screening for risk factors such as alcohol and tobacco, physical activity, and self-reported health status at 40, 50, and 60 years of age. One part of the questionnaire is designed to measure social support, and is a shortened version of the Interview Schedule for Social Interaction (ISSI) [19,21–23]. Since the start in 1985, 107 000 individuals have participated in VIP. The Monitoring of Trends and Determinants in Cardiovascular Disease (MONICA) study started in 1985 [24] is a longitudinal population-based study monitoring risk factors for cardiovascular disease. The primary goal was to investigate trends in cardiovascular events and relate them to trends in risk factors. Woman and men between 25 and 74 years of age were included randomly. The study included the same questions targeting social support as in the VIP. By 2014, when the last participant was enrolled, a total of 12 000 participants had been included in MONICA.

Since the VIP questionnaire is answered for the last time when the patient is 60 years old and the average age for colon cancer diagnosis in Sweden is 74 years [25] there was an expected time gap between when the questionnaire was answered and the diagnosis of colon cancer. The MONICA questionnaire was answered at different ages. The VIP registry and the MONICA registry were therefore combined to generate a cohort of patients who first answered a questionnaire at 49–64 years of age and a subsequent questionnaire at >68 years (Fig. 1). For each item in the questionnaire, concordance between the first and second answers

to the questionnaire was calculated using Cohen's kappa. Answers to questions that were stable over time were used for further uni- and multivariable analyses.

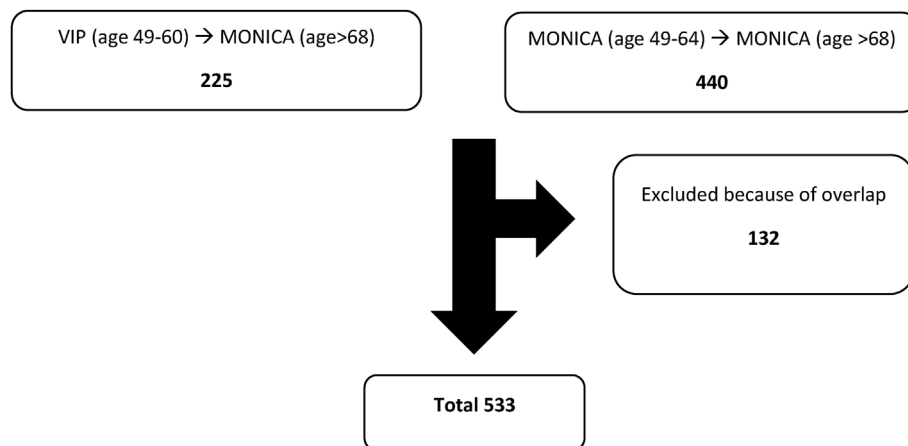
The combined questionnaire comprised 15 questions (see Appendix). From these questions the availability of attachment (AVAT) score and availability of social integration (AVSI) score were calculated. AVAT measures quality whereas AVSI measures the quantity of social support. In the more quantitative AVSI questions, points are given for the number of persons that apply to various social network aspects e.g., *How many friends, not relatives, can visit you and feel at home?* For the binary qualitative AVAT questions, one point is given for each positive response variable e.g., *Does anyone hold or embrace you to give comfort and support?* – yes (1p) no (0p). In this study the strength of the social network was based on these questionnaires in an attempt to capture both quality and quantity of social support.

After exclusion of questions showing a kappa <0.4, six of the 15 questions remained for analysis. AVSI (kappa .37) and AVAT (kappa .54) were also analysed. These two items were included because of their central importance to the study and their categorization of questions.

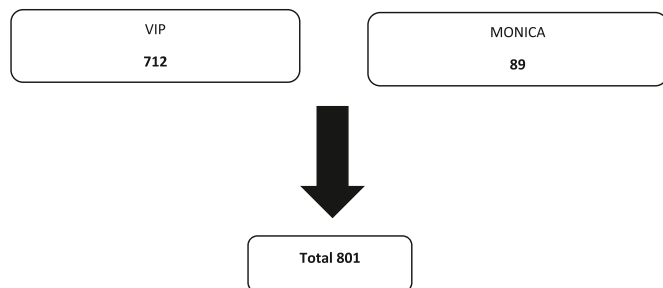
Data on civil status, education, and cohabitation were extracted from the VIP survey. Civil status was divided into four categories: unmarried; married or in a partner relationship; widow/widower; and divorced/separated. Cohabitation was divided into five categories: living alone; living with one other adult only; living with children only; living with one other adult plus children; or living in some other constellation. Education was divided into compulsory school, training school, higher secondary school, and university.

We divided age into four categories because of the nonlinear incidence of emergency surgery for colon cancer. Studies have shown that the youngest and the oldest patients present more often as an emergency [17,18].

The Swedish Colorectal Cancer Registry (SCRCR) is a nationwide quality registry which includes all patients diagnosed with rectal and colon cancer. It began in 1995 with rectal cancer and since 2007 has also included patients diagnosed with colon cancer. Coverage is 99% and reports are published annually [26]. Data on all patients who had undergone surgery for colon cancer 2007–2020 were retrieved from the SCRCR. These were matched against VIP and MONICA. Most of the matched patients were from VIP (89%) (Fig. 2). For those who had answered more than one questionnaire (VIP and/or MONICA), only the latest answers were included.



**Fig. 1.** Flowchart over data used to analyze stability of answers to questions on social network over time. Overlap = same patient answered questionnaires for both VIP (age 49–60) and MONICA (age 49–64) (in addition to answering a questionnaire in MONICA (age >68)). In case of overlap, data from the questionnaires with the longest time between response where kept.



**Fig. 2.** Flowchart over data from which register data is used when matched against SCRCR.

## 2.1. Statistics

Cohens kappa was used to calculate concordance between questionnaire answers at 49–64 years of age and those at >68 years (quadratic weighted kappa for ordinal variables). The composite variables (AVSI and AVAT) and all other variables with a kappa of 0.4 or more were used for further analyses.

Uni- and multivariable logistic regression were used to calculate the risk for emergency surgery.

All analyses were performed using STATA version 16.1 (Stata-Corp LP, College Station, TX, US).

## 2.2. Ethics

Ethical approval for this study was obtained from the Regional Ethics Committee in Umeå 2018-03-20 (Dnr 2018/58-31.). Participants had given consent once when included in VIP or MONICA, no new informed consent was required for this study; the participants were anonymized before extraction of data.

## 3. Results

A total of 801 individuals who had answered questions targeting social network in VIP or MONICA were identified in the SCRCR.

The mean age was 70 years and 46% were female. Fifteen per cent of all surgeries were emergency operations. At the time of the survey, the most common social traits were: living with one adult and no children (58%); married or in a partner relationship (77%); and compulsory school as highest level of education (33%).

The 801 patients who had completed the social network questionnaire in VIP or MONICA and included in this study represented 56% (801/1418) of patients operated for colon cancer in Västerbotten County during the period 2007–2020.

Sixty-three per cent (501/801) of the patients gained maximum scores for quality of social network (AVAT). Those with maximum AVAT scores had a lower OR for emergency surgery (OR 0.72 (CI 0.47–1.10)). Quantity measures of social network (AVSI) showed a greater distribution than AVAT scores. All AVSI score categories >10 had an OR below 1 when compared with those with an AVSI score ≤10.

Scores regarding quality aspects of the social network revealed an overall higher OR for emergency surgery amongst those who did not have anyone to share their inner thoughts with (OR 1.02, CI 0.47–2.22), anyone to share happy feelings with (OR 1.57, CI 0.82–3.03), or anyone to comfort them (OR 1.33, CI 0.78–2.28).

Patients with level of education higher than compulsory school showed an OR below 1 for all categories but did not reach significance: training school (OR 0.86, CI 0.53–1.42); higher secondary school (OR 0.74, CI 0.41–1.34); and University (OR 0.89, CI 0.51–1.56).

Quantitative answers showed that those with more people in their social network had a lower OR for emergency surgery. The OR differences were overall small, with the largest difference being those with more than 10 people feeling relaxed at the patient's home (OR 0.70, CI 0.34–1.47).

The only significant social network risk factor for emergency surgery was divorced status (OR 2.01 (CI 1.03–3.91)). Male gender also had a higher risk (OR 1.51 (CI 1.02–2.24)  $p = 0.04$ ) (Table 1).

Multivariable logistic regression analysis, with compensation for gender, age, and civil status, did not identify any significant impact of social network on risk for emergency surgery (Table 2).

Emergency surgery was avoided by stoma or stent as bridge to surgery in 14 cases (13 stomas and 1 stent). The inclusion of these cases in the emergency operated group did not substantially change the results.

## 4. Discussion

Social network had no impact on the risk for emergency surgery for colon cancer in this population-based study. The reasons for this could be that emergency surgery is primarily associated with the biology and characteristics of the tumor rather than patient-related factors. Studies have indicated several biological factors predictive of emergency presentation of colon cancer. More aggressive histopathology, and more mucinous and signet ring cell tumors have been reported in emergency cases [27,28]. The finding that emergency surgery for colon cancer is more common among men in this and previous studies, might also be due to biological differences rather than delay in diagnosis, even if women tend to seek medical advice earlier than men. It has also been shown that women have better compliance to screening programs for colorectal cancer [29]. However, since colorectal cancer screening had not been introduced to the Västerbotten County until 2022, screening had no impact on results from the present study. Now when a colorectal cancer screening program finally has reached national coverage in Sweden, time will tell if this will increase the gap between genders in frequency of emergency surgery in the future.

It could also be that patient-related factors other than social network increase the risk for emergency surgery, either by causing delay in diagnosis or some other mechanism. The results of this study differ from previous findings regarding socioeconomic factors [17]. Delay in diagnosis due to socioeconomic factors may be related to lack of patient access to healthcare and how the healthcare system works, rather than recognition and awareness of the severity of symptoms. The Swedish healthcare system has standardized care processes for many diagnoses, making the process from diagnosis to treatment faster and more uniform [30]. This is expected to lower the emergency surgery rate.

A previous study from our research group did not find any difference in the frequency of emergency surgery related to age or distance to nearest hospital (in a region with sparsely distributed healthcare facilities). In that study, however, there were large differences in emergency surgery rates for colon cancer between the catchment areas included [31]. This suggests that access to and function of the local healthcare system has a significant impact on the risk for an emergency procedure for colon cancer. Seasonal variations in emergency surgery rate could also indicate that investigation and care logistics could have an impact on emergency presentation. For example, access to healthcare is lower during the summer months when personnel take their vacation [5]. The higher emergency presentation rate for divorced individuals in this study is in accordance with previous studies on socioeconomic factors [17,18].

The group of patients undergoing emergency surgery is heterogeneous, with a J-shaped incidence, with higher rates among the

**Table 1**

Univariate logistic regression from answers to the ISSI questionnaire matched against CRC cases from the SCRCR 2007–2020. OR for emergency surgery. In AVAT 2 the group was divided in to 2 groups, one with maximum points vs the others.

		Emergency surgery			
		n	OR	CI 95%	p-value
Sex	Male	368	1.51	1.02–2.24	0.04
	Female	433	1.00	Ref	Ref
Age	<60	113	1.00	Ref	Ref
	60–69	237	0.71	0.38–1.34	0.30
	70–79	346	0.88	0.49–1.55	0.65
	80+	105	0.89	0.43–1.84	0.75
Civil status	Single	63	0.64	0.27–1.52	0.31
	Married	619	1.00	Ref	Ref
	Divorced	52	2.01	1.03–3.91	0.04
	Widow(er)	52	1.10	0.50–2.41	0.82
	Missing	15	0.93	0.21–4.18	0.92
Education	Compulsory	261	1.00	Ref	Ref
	Training school	232	0.86	0.53–1.42	0.57
	Higher secondary	145	0.74	0.41–1.34	0.32
	University	151	0.89	0.51–1.56	0.68
	Missing	12	1.04	0.22–4.93	0.96
Cohabitation	Alone	134	1.52	0.90–2.55	0.11
	One adult	470	1.00	Ref	Ref
	Children only	18	1.39	0.39–4.96	0.61
	Adult and children	126	1.31	0.76–2.28	0.33
	Other	47	1.88	0.90–2.55	0.11
	Missing	6	1.39	0.16–12.13	0.76
Same interests	0–5 persons	247	1.00	Ref	Ref
	6–10 persons	232	0.97	0.58–1.62	0.91
	>10 persons	307	1.00	0.63–1.62	0.98
	Missing	15	1.46	0.39–5.45	0.57
Relaxed at home	0–2 persons	112	1.00	Ref	Ref
	3–5 persons	291	1.24	0.69–2.26	0.47
	6–10 persons	221	0.75	0.39–1.44	0.38
	>10 persons	161	0.70	0.35–1.43	0.33
	Missing	16	1.29	0.33–5.01	0.71
Speak openly	0–2 persons	164	1.00	Ref	Ref
	3–5 persons	338	0.90	0.54–1.15	0.69
	>5 persons	287	0.86	0.50–1.47	0.58
	Missing	12	1.06	0.22–5.13	0.94
Share feelings	Yes	722	1.00	Ref	Ref
	No	66	1.64	0.87–3.06	0.12
	Missing	13	0.51	0.07–3.94	0.52
Share thoughts	Yes	726	1.00	Ref	Ref
	No	55	1.13	0.54–2.38	0.74
	Missing	20	0.30	0.04–2.30	0.25
Comfort you	Yes	659	1.00	Ref	Ref
	No	121	1.46	0.88–2.42	0.14
	Missing	21	1.04	0.30–3.60	0.95
AVSI	>10	87	1.00	Ref	Ref
	10	91	0.87	0.40–1.90	0.74
	11	126	0.79	0.38–1.63	0.52
	12	157	0.88	0.44–1.75	0.72
	13	131	0.49	0.22–1.08	0.08
	14	181	0.68	0.34–1.35	0.27
	Missing	28	0.74	0.23–2.43	0.62
	AVAT	>9	77	1.00	Ref
9	30	0.98	0.32–3.05	0.98	
10	61	1.47	0.63–3.41	0.37	
11	86	0.96	0.42–2.19	0.92	
12	501	0.76	0.40–1.45	0.41	
Missing	46	0.47	0.14–1.54	0.21	
AVAT 2	>12	254	1.00	Ref	Ref
	12	501	0.70	0.46–1.05	0.09
	Missing	46	0.43	0.15–1.26	0.12

**Table 2**

Multivariate logistic regression from answers to the ISSI questionnaire matched against CRC cases from the SCRCR 2007–2020. OR for emergency surgery. Compensated for age, gender, and civil status. In AVAT 2 the group was divided in to 2 groups, one with maximum points vs the others.

		Emergency surgery			
		n	OR	CI 95%	p-value
Sex	Male	368	1.51	1.02–2.24	0.04
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	11	126	0.79	0.38–1.63	0.52
	12	157	0.88	0.44–1.75	0.72
	13	131	0.49	0.22–1.08	0.08
	14	181	0.68	0.34–1.35	0.27
	Missing	28	0.74	0.23–2.43	0.62
	AVAT	>9	77	1.00	Ref
9	30	0.98	0.32–3.05	0.98	
10	61	1.47	0.63–3.41	0.37	
11	86	0.96	0.42–2.19	0.92	
12	501	0.76	0.40–1.45	0.41	
Missing	46	0.47	0.14–1.54	0.21	
AVAT 2	>12	254	1.00	Ref	Ref
	12	501	0.70	0.46–1.05	0.09
	Missing	46	0.43	0.15–1.26	0.12

youngest and to oldest [32]. This makes it more difficult to find a universal explanation for route to surgery and any delays involved. Healthcare seeking patterns vary substantially between those aged 55 and those over 80 years. Patients living alone and widow/widowers in the older group tend to have a weaker social network.

Our results showed no significant differences based on social network factors, but collectively there was a trend towards lower ORs for those with close relationships and a stronger social network. The complexity of social networks and their impact on our lives and our behavior requires further study.

Healthcare in Sweden is run by the state and costs little for the individual. Those older than 85 years are even offered free primary health care. There is also a large public trust backing the Sweden healthcare system [33]. This make it easier to seek healthcare advice and probably compensates for differences in the individual's social network that would be easier to detect in countries without a subsidized healthcare system. In Sweden, 22% of the population live alone and the corresponding proportion among those over 80 years exceeds 50% [34]. Despite the high volume of single households, it seems that most people have a well-functioning social network, with high ratings especially regarding network quality. It is therefore possible that differences might occur in countries or areas where social networks are not so strong.

Of all surgeries for colon cancer in this study, 15% were emergency cases. This emergency surgery rate is lower than in previous studies [1,31] and the mean age was lower (70 years vs. 74 years) indicating possible selection bias [1]. A plausible explanation may be our selection of patients willing to participate in the VIP and Monica studies. However, it is unlikely that patients with a poor social network who turn out to have a higher or lower risk for emergency surgery differ in their willingness to participate, and we consider the risk for clinically relevant selection bias to be low. Another possible weakness was disparity in age of the patient between the time of last response to the questionnaire and mean age at time of diagnosis of colon cancer. To minimize this risk for bias, we only included variables that had at least moderate concordance over time.

A major strength of this study is the large population-based cohort of patients who had completed a validated questionnaire on aspects of social network before being diagnosed with colon cancer. To our knowledge, these unique registries and their combination has enabled us to report the largest detailed study to date on social networks and their impact on the emergency presentation of colon cancer.

## 5. Conclusion

The impact of a patient's social network on the rate of emergency surgery for colon cancer is limited. The only factors with a significantly increased OR were divorced status and male gender.

## CRediT authorship contribution statement

**Niillas Blind:** Writing – original draft, Formal analysis, Visualization, Investigation, Methodology. **Ulf Gunnarsson:** Writing – review & editing, Supervision, Funding acquisition, Methodology, Project administration. **Karin Strigård:** Methodology, Writing – review & editing, Supervision, Project administration. **Fredrik Brännström:** Writing – review & editing, Supervision, Funding acquisition, Formal analysis, Methodology, Conceptualization.

## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have

appeared to influence the work reported in this paper.

## Acknowledgments

This study was funded by research grants from the Magtarmfonden, Bengt Ihre Foundation and from Umeå University, through a regional agreement between Umeå University and Västerbotten County Council (ALF, nr VLL-54500).

## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.ejso.2022.09.019>.

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