# Chapter

# 4

## Frailty and malnutrition predictive of mortality risk in older patients with advanced colorectal cancer receiving chemotherapy

A.A. Aaldriks*, L.G.M. van der Geest*, E.J. Giltay, S. le Cessie,
J.E.A. Portielje, B.C. Tanis, J.W.R. Nortier, E. Maartense

* A.A. Aaldriks and L.G.M. van der Geest contributed equally to the study.

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## Abstract

***Introduction:*** In general, geriatric assessment (GA) provides the combined information on comorbidity and functional, nutritional and psychosocial status and may be predictive for mortality outcome of cancer patients. The impact of geriatric assessment on the outcome of older patients with colorectal cancer treated with chemotherapy is largely unknown.

***Methods:*** In a prospective study, 143 patients with colorectal cancer who were 70 years and older were assessed before chemotherapy by Mini Nutritional Assessment (MNA), Informant Questionnaire on Cognitive Decline in the Elderly (IQCODE), Groningen Frailty Indicator (GFI) and Mini Mental State Examination (MMSE).

***Results:*** Fifty-four (38%) patients received adjuvant chemotherapy and 89 (62%) patients received palliative chemotherapy. Malnutrition and frailty were prevalent in 39 (27%, assessed by MNA) and 34 (24%, by GFI) patients, respectively; whereas cognitive impairment was prevalent in 19 (13%, by IQCODE) and 11 (8%, by MMSE) patients, respectively. In patients with palliative chemotherapy, poor MNA scores were associated with receiving less than 4 cycles of chemotherapy ***(p*** = 0.008). Poor MNA and GFI scores were associated with increased hazard ratios (HRs) for mortality for patients with palliative chemotherapy: HR = 2.76 (95% confidence interval [CI]: 1.60-4.77; p < 0.001) and HR = 2.72 (95% CI: 1.58–4.69; p < 0.001), respectively, after adjustment for several clinical parameters.

***Conclusions:*** Malnutrition and frailty were strongly associated with an increased mortality risk in patients who underwent palliative chemotherapy. Furthermore, a poor score on MNA was predictive for less tolerance of chemotherapy. Our findings may help the oncologist in future decision making and advice for elderly patients with colorectal cancer.


## Introduction

Colorectal cancer is one of the most frequent types of cancer in Western countries, and the incidence and mortality of patients increases with age. In the Netherlands, 54% of patients diagnosed with colorectal cancer and 66% of patients



who died of colorectal cancer were above 70 years of age [1]. These data are almost similar to data from the United States [2]. In the past two decades, patients with colorectal cancer showed a substantial improvement in survival, which has been attributed largely to the increased administration of chemotherapy. However, this increased survival – and the increased use of chemotherapy – was less pronounced in elderly patients in comparison with younger patients [3–5]. The process of aging is associated with a loss of functional reserve of multiple organ systems, increased prevalence of chronic diseases and enhanced susceptibility to stress [6]. This process occurs at a different pace in individuals resulting in a large heterogeneity within the elderly patients with cancer group. For elderly patients, cancer treatments should be adapted to life expectancy and the increased risk of toxicity. Therefore, 'functional age' rather than chronological age is important for cancer treatment planning. Geriatric Assessment (GA) may be a useful tool in the management and follow-up of elderly patients with cancer. A GA provides the combined objective and subjective information on comorbidity, nutrition, cognition, functional and psychosocial status [6, 7]. Previous studies showed that several GA domains were associated with poor treatment tolerance and poor survival, independent of age and stage of disease [8, 9]. However, studies of GA in cohorts comprising of only patients with colorectal cancer are scarce [10]. In the present study, we have performed a GA in 143 patients with colorectal cancer aged 70 years and above, with the aim to assess its predictive value for tolerance and feasibility of treatment with adjuvant and palliative chemotherapy.

## Patients and Methods

### *Patients*

Between May 2004 and February 2010, four hospitals in the western part of the Netherlands participated in a geriatric oncology study. Because of time needed for training of personnel in the technique of GA, the hospitals started at different time points. Patients of 70 years of age and older and regarded eligible for chemotherapy treatment by their medical oncologist, were prospectively included. Common eligibility criteria used by medical oncologists included adequate performance status by Eastern Cooperative Oncology Group (ECOG 0-3), sufficient organ function and absence of severe comorbidity. For the current study we selected all patients (n = 143) diagnosed with colorectal cancer and treated with chemotherapy. Of these, 60 patients (42%) were also included in a previous analysis with several types of cancer combined [11]. According to the Dutch

national evidence-based guidelines for colon cancer, adjuvant chemotherapy is recommended for patients with colon cancer with lymph node metastases (stage III) and for patients with high risk stage II colon cancer [12]. Patients with colon and rectal cancer with distant metastases usually received chemotherapy with palliative intent and at least four cycles of chemotherapy were considered to be necessary to reach the palliative goal of treatment. Whether the administration of chemotherapy was 'adjuvant' or 'palliative' was left to the discretion of the oncologist.

***Geriatric Assessment (GA) and Clinical Data***

A GA was performed by specially trained nurses before the start of chemotherapy treatment. The used tests with their accompanying cut-off points have been described previously [11]. In brief (Table 1):

- Mini Nutritional Assessment (MNA) [13], makes it possible to identify patients at risk for malnutrition, before severe changes in weight or albumin levels occur [14];
- Groningen Frailty Indicator (GFI) [15] screens on physical, cognitive, social and emotional items (see Appendix);
- Informant Questionnaire on Cognitive Decline in the Elderly (IQCODE) [16], screens for cognitive decline by interviewing family members or care givers, for which we used the short Dutch translation IQCODE-N [17];
- Mini Mental State Examination (MMSE) [18] is considered to be a screening test for detecting current cognitive dysfunction.

Patients completing at least four cycles of chemotherapy were assessed a second time using the GFI and MMSE at the end of chemotherapy or at six months after the start of chemotherapy. The number of comorbidities and number of regularly used medications, performance status according to the Eastern Cooperative Oncology Group (ECOG) and laboratory values (serum-albumin, -creatinine, -lactate dehydrogenase (LDH) and hemoglobin before start of chemotherapy) were collected from the medical records of patients, as well as chemotherapy regimen, number of cycles, toxicity and mortality. Comorbidity was recorded according to the Charlson Index [19]. The vital status of patients was cross-checked with the municipal registry at the end of the data collection period.

***Statistical Analysis***

Categorical variables are presented as numbers and percentages, and chi-square tests were used to compare subgroups. Continuous variables were presented as means ± standard deviations (SD) and subgroups were compared by unpaired t-tests. In the right-skewed LDH-values, a log-transformation was performed before analyses. Chi-square and Fisher Exact tests were used to analyze the associations between dichotomized GA-variables and receiving more or less than four chemotherapy cycles. In multivariate logistic regression analyses these associations were adjusted for sex, age, number of co-morbidities and laboratory values (hemoglobin, serum-creatinine and LDH levels). Patients receiving adjuvant chemotherapy and those receiving palliative chemotherapy treatment were analysed separately. Changes in GA-scores over time (before chemotherapy and after at least four cycles) were analysed using the paired sample t-test. Survival probabilities were estimated using Kaplan Meier curves and the log-rank test was used to test for differences in survival rates among subgroups of GA. Cox proportional hazard analyses were used to estimate hazard ratios for mortality for each of the four GA tests, adjusted for sex, age, number of co-morbidities and laboratory values (hemoglobin, serum-creatinine and LDH). The analyses were repeated for adjustment on performance status, number of medications and albumin values, because of a larger number of missing values for these variables. A final Cox proportional hazard analysis was performed to assess independent mortality risks for the MNA and GFI scores. A p-value less than 0.05 was considered significant. SPSS 17.0 for Windows® (SPSS inc. Chicago, IL) was used for statistical analyses.



## Results

***Patient and Tumour Characteristics***

Baseline characteristics of all 143 elderly patients with colorectal cancer are shown in Table 2. The mean age was 75 years (range 70-92), 12% of patients were 80 years and older. Forty-nine percent of patients had multiple comorbidities (mean = 1.6 ± 1.3). Most common were hypertension (35%), cardiac diseases (30%), chronic obstructive pulmonary disease (COPD) (22%), diabetes mellitus (20%), vascular diseases (17%), and previous malignancies (13%). With respect to polypharmacy, 50% of patients used four or more kinds of medication (mean = 3.7 ± 2.8). According to the ECOG functional score, at least one-fifth of patients were functionally restricted. However, a functional performance score was not documented in 11% of patient records. Seventeen percent of patients had a diagnosis of rectal cancer. Fifty-four patients (38%) received chemotherapy with

curative intent (adjuvant: stage II-III), of whom 96% were patients with colon cancer. Another eighty-nine patients with colorectal cancer (62%) were treated with palliative intent (synchronous or metachronous distant metastases). Baseline characteristics of adjuvant or palliatively treated patients were significantly different with respect to sex, hemoglobin- and LDH-values.

***Geriatric Assessment***

Assessment showed that 28% of patients were at risk for malnutrition or malnourished (measured by MNA). Frailty, measured by the GFI, was present in 24% of patients, 13% of patients were suspect for cognitive decline (IQ-code), and 8% had serious cognitive dysfunction (measured by MMSE). Of patients with palliative chemotherapy, 33% were at risk for malnutrition, versus 20% of patients with adjuvant chemotherapy (p = 0.10) (Table 1).

***Chemotherapy Treatment***

The majority of elderly patients received poly-chemotherapy, mainly capecitabine-oxaliplatin (CapOx; 39%) or fluorouracil-leucovorin-oxaliplatin (FOLFOX4; 13%). Forty-two percent of patients received mono-chemotherapy, either capecitabine (36%) or fluorouracil-leucovorin (6%). Of adjuvant treated patients, 48% received poly-chemotherapy, compared to 64% of palliatively treated patients (p = 0.06). In addition, 20% of palliatively treated patients received bevacizumab. Mean number of chemotherapy cycles was 6.2 (±4.4, range 1-29), and were similar for adjuvant and palliatively treated patients (6.2 and 6.3, respectively; p = 0.41). Seventy-three percent of patients received four or more cycles of chemotherapy. Fifteen percent of patients received their chemotherapy according to protocol. Deviations of protocol included a lower dose or medication change (16%), a delay and/or discontinuation of chemotherapy (47%) or both (37%). The majority of patients (78%) experienced one or more toxicities due to their chemotherapy. Most important toxicities were (poly)neuropathy (29%), diarrhoea (23%), and fatigue (14%). Patients treated with adjuvant chemotherapy seemed to experience slightly more haematological toxicities (9%) than patients treated with palliative intent (2%; p = 0.06). In palliatively treated patients, patients at risk of malnutrition or who were malnourished (MNA < 24) less frequently completed four or more cycles of chemotherapy than well nourished patients (p = 0.008; Table 3). This finding persisted after adjustment for age, sex, number of co-morbidities and laboratory values (odds ratio [OR] for ≥4 vs <4 cycles = 0.29, 95% Confidence Interval [CI]: 0.11-0.81). In 62 patients, a second assessment of MMSE and GFI was performed. Compared to baseline scores, there was a significant deterioration in GFI-scores in patients receiving palliative chemotherapy (mean change-0.86; standard error [SE] 0.32; p = 0.01). When we sub-classified GFI in a physical- and psychosocial part, deterioration was found in the physical part (p = 0.001) but not in the psychosocial part (p = 0.85).



***Risk of Mortality***

During a median follow-up of 15 months (range 0.5-62) a total of 76 patients (53%) died. Among patients receiving palliative chemotherapy, those with poor MNA- and GFI-scores showed significantly higher hazard ratios (HRs) of mortality (p-values <0.001; Table 4). The median survival difference for the MNA (well nourished vs. malnourished) and GFI (not frail vs. frail) was 9 and 10 months, respectively (Fig. 1). The increased risk of mortality for palliatively treated patients with poor baseline MNA- and GFI-scores persisted after adjustment for age, sex, number of comorbidities, and laboratory values of hemoglobin, creatinine and LDH (hazard ratio [HR] = 2.76, 95% CI: 1.60-4.77 and HR = 2.72, 95% CI: 1.58-4.69, respectively; Table 4). In sensitivity analyses, in which we additionally adjusted for performance status, numbers of medications and serum albumin, results remained similar (data not shown). In a multivariate model with both MNA and GFI, the risk of mortality was significant for patients with poor baseline MNA-scores (HR = 2.54, 95% CI: 1.49-4.33), and borderline significant for patients with poor GFI-scores (HR = 1.66, 95% CI: 0.94-2.94). No interaction effect was found (i.e. MNA*GFI: p for interaction 0.40).

## Discussion

Our study reports the results of GA in 143 patients aged 70 years and older with colorectal cancer who received chemotherapy with either adjuvant or palliative intent. We found that in palliatively treated patients, poor MNA scores were associated with less tolerance of chemotherapy, and GFI-test scores of physical functioning deteriorated over time. Furthermore, poor baseline scores on MNA and GFI were associated with an increased mortality risk in case of chemotherapy with palliative intent. This tumour specific analysis with a larger number of elderly patients with colorectal cancer extends our previous findings among patients with different kinds of tumours combined [11]. Comorbidity, disability and geriatric syndromes were found prevalent in many elderly patients with colorectal cancer [20]. In two recent studies, various geriatric assessment variables were identified to be associated with severe chemotherapy toxicity [21, 22], independ-

ent from laboratory test values, patient, tumour and treatment characteristics. Common predictive geriatric parameters seem to encompass decreased physical activity, social activity and nutrition status. In a previous study, activities of daily living (ADL) impairment and malnutrition were also independently associated with changes of the cancer treatment plan [23]. With increasing age, comorbidities and general aspects of ageing increase the risk of toxicities of chemotherapy and competing causes of death gain importance. The majority of elderly patients may benefit from chemotherapy treatment, but therapeutic margins are small in many of them, and require a careful evaluation of biological and clinical markers of aging, aggressiveness of the tumour, the biological and psychosocial costs of treatment and its perception by the patient [24]. The administration of chemotherapy increases survival in the elderly in the same way as in younger patients [25, 26] and there is no evidence that the susceptibility of colon cancer to chemotherapy differs in younger and older patients [27]. However, scientific evidence from prospective clinical trials taking into account the heterogeneity of elderly patients with colorectal cancer is scarce [10, 28] and therefore our knowledge of the performance of the appropriate therapeutic strategies in this age group is often severely limited [10]. Chronological age as an indicator for health risks in the elderly is not a very sensitive and specific risk marker. The concept of frailty may be more valuable [29]. A geriatric screening should distinguish between fit and frail patients, of which the first group of patients should receive standard adult chemotherapy treatment [26, 27, 30, 31] while the latter may require a more in-depth evaluation of their functional reserve and a tailored chemotherapy treatment plan [9, 32, 33].

In two recent studies of the prognostic value of GA in elderly patients with cancer, nutritional status was found to be predictive of early mortality and overall survival in multivariate models [34,35]. The prevalence of (or risk of) malnutrition in our study was almost similar to an overview of 7 studies with 2798 community dwelling elderly persons assessed by MNA (29%, range 15%–44%) [13]. Our study showed that malnutrition was associated with poor tolerance of chemotherapy and increased mortality in elderly patients with colorectal cancer treated with palliative intent. Adjustment for several clinical parameters did not alter these results. Compared to frailty (by GFI), malnutrition seemed to be the stronger predictor of mortality. More research is needed in palliatively treated patients concerning the relation between nutritional status, tumour behaviour, the type of chemotherapy and mortality. Furthermore, in malnourished patients it is unclear whether they benefit more from palliative chemotherapy than from comprehensive palliative care. In adjuvant treated patients, the number of patients appeared too small to show significant associations.



In our study physical and psychosocial frailty (assessed by GFI) was associated with an about 2.5 times increased mortality risk in patients treated with palliative intent. In addition, especially the physical aspects (ADL and instrumental activities of daily living [IADL] variables) showed a clear decline after at least four cycles of chemotherapy. This probably shows that tolerance to chemotherapy plays an important role for elderly patients with colorectal cancer. A loss of (instrumental) activities of everyday living may have a great impact on their quality of life. Therefore, in future studies of GA a more sensitive ADL/IADL test may be used to assess a possible decline of physical functioning [36, 37].

The MMSE and IQCODE did not differentiate between patients who underwent less than four cycles of chemotherapy or four or more cycles and did not clearly predict mortality. Moreover, we found no decline in the MMSE-scores after at least four cycles of chemotherapy. This is in agreement with a meta-analysis of 16 studies in which small to moderate but non-significant negative effects of chemotherapy were found in various domains of cognitive function [38]. There are some limitations that need to be discussed. First, the patients in our study underwent GA after the oncologist decided they were eligible for receiving chemotherapy, which may have introduced some selection bias. The assessed patients may have relatively better GA-scores. Compared to an Asian study in an outpatient geriatric oncology clinic, our study comprised of few patients with ECOG ≥ 2 [35]. Furthermore, population-based studies showed that the proportion of elderly patients who received chemotherapy was lower in patients with stage III colon cancer than in patients with colorectal cancer with distant metastases [4, 5]. Therefore, selection bias may be more apparent in elderly patients with adjuvant chemotherapy. Despite this bias, we consider our findings as valid and informative. Even after selection by oncologists, the GA revealed considerable frailty as assessed with the GFI and MNA. Second, our finding of the increased risk of mortality associated with higher levels of frailty at baseline may be partly explained by residual confounding factors like alcohol consumption, smoking and socio-economic status. Furthermore, we did not screen for geriatric syndromes like depression, delirium, incontinence, falls, dizziness and syncope as was done by others [9], and unfortunately serum albumin values and performance status were lacking in one-tenth of our patients. However, contrary to most studies of GA our patient group was homogeneous with respect to tumour type and we performed analyses separately in adjuvant and palliatively treated patients. Third, the decline in GA test results was likely underestimated. To minimize the bur-

den of testing, only patients who completed at least four cycles of chemotherapy were re-assessed with GFI and MMSE. However, many patients who received four or more chemotherapy cycles refused to complete a second assessment and patients with better GA scores were more likely to remain included, leading to some attrition bias. Furthermore, the course of the nutritional status of our patients during chemotherapy treatment was not assessed. At last, MNA as well as GFI were independently associated with an increased mortality risk. However, MNA and GFI correlated moderately (Sr = 0.43), suggesting that the tests showed some construct overlap and therefore partially identified the same group of frail patients. However, the ECOG-performance status also showed correlation with inferior scores for MNA and GFI. Nevertheless, with MNA and GFI more in depth information is gathered than is obtained with ECOG performance score, thereby augmenting the possibilities to interfere with care for the elder patient [39].

Our findings may help to better identify those patients with colorectal cancer with poor prognosis, which is of clinical importance for counselling, psychosocial support, and management of elderly patients receiving chemotherapy for colorectal cancer. Specific and timely nutritional interventions may improve nutritional status, tolerability of chemotherapy and survival in some elderly patients, which is also suggested by other investigators [34].

## Conclusion

In conclusion, poor scores for MNA and GFI were independently associated with increased hazard ratios for mortality, and poor MNA-scores were predictive for a less than planned number of chemotherapy cycles in palliatively treated patients.

Table 1 – Characteristics and scores of the geriatric assessment.

| Geriatric Assessment | | Adjuvant Chemotherapy n = 54 | Palliative Chemotherapy n = 89 | |
|---|---|---|---|---|
| | **Scale** | **Mean (SD)** | **Mean (SD)** | **p-value** |
| MNA[$] | 0-14 pts (S)<br>0-16 pts (A) | 11.3 (2.6) | 11.5 (2.3) | 0.71 |
| GFI | 0-15 | 2.3 (1.9) | 2.6 (2.1) | 0.31 |
| IQCODE | 1-5 | 3.1 (0.3) | 3.1 (0.2) | 0.10 |
| MMSE | 0-30 | 28.3 (2.5) | 28.3 (2.0) | 0.58 |
| | **Subgroup with impaired Geriatric Assessment scores (cut-off points)** | **n (%)** | **n (%)** | **p-value** |
| MNA[$] | 17-23.5 pts: At risk of malnutrition, or, < 17 pts: Malnourished | 10 (20) | 29 (33) | 0.10 |
| GFI | ≥ 4 pts: Frail | 11 (20) | 23 (26) | 0.46 |
| IQCODE | > 3.31 pts: Cognitive Decline | 6 (11) | 13 (15) | 0.53 |
| MMSE | ≤ 24 pts: Cognitive Dysfunction | 5 (9) | 6 (7) | 0.60 |

Abbreviations: MNA, Mini Nutritional Assessment, a stepwise test: when the score in the screening section (S) is less than 12 points, indicating the possibility of malnutrition, the assessment section (A) is filled in; IQCODE, Informant Questionnaire on Cognitive Decline; GFI, Groningen Frailty Indicator; MMSE, Mini Mental State Examination; SD, standard deviation; pts, points.
$ excluding n = 6 (4%) missing values.

Table 2 – Baseline characteristics of 143 patients with colorectal cancer.

| | Total N = 143 (%) | Adjuvant N = 54 (%) | Palliative N = 89 (%) | p-value |
|---|---|---|---|---|
| **Sex – No. (%)** | | | | 0.02 |
| male | 84 (59) | 25 (46) | 59 (66) | |
| Female | 59 (41) | 29 (54) | 30 (34) | |
| **Age – No. (%)** | | | | 0.28 |
| 70-74 years | 68 (48) | 29 (54) | 39 (44) | |
| 75-79 years | 57 (40) | 21 (39) | 36 (40) | |
| ≥ 80 years | 18 (12) | 4 (7) | 14 (16) | |
| **ECOG Performance Status – No. (%)** | | | | 0.15# |
| 0 | 98 (69) | 38 (84) | 60 (73) | |
| 1 | 26 (18) | 7 (16) | 19 (23) | |
| 2 + | 3 (2) | 0 | 3 (4) | |
| Unknown | 16 (11) | 9 (-) | 7 (-) | |
| **No. of Comorbid Organ Systems – No. (%)** | | | | 0.66 |
| 0 | 31 (22) | 12 (22) | 19 (21) | |
| 1 | 42 (29) | 18 (33) | 24 (27) | |
| 2 + | 70 (49) | 24 (44) | 46 (52) | |
| **Number of Medications – No. (%)** | | | | 0.65# |
| 0 | 20 (14) | 9 (18) | 11 (12) | |
| 1-3 | 49 (34) | 18 (35) | 31 (35) | |
| 4 + | 71 (50) | 24 (47) | 47 (53) | |
| Unknown | 3 (2) | 3 (-) | 0 | |
| **Tumour Location – No. (%)** | | | | 0.001 |
| Colon | 119 (83) | 52 (96) | 67 (75) | |
| Rectum | 24 (17) | 2 (4) | 22 (25) | |
| Albumin (g/L)$ – Mean ± SD | 37.1 ± 9.9 | 37.2 ± 6.9 | 37.1 ± 11.5 | 0.18 |
| Hemoglobin (Hb, mmol/L) – Mean ± SD | 7.6 ± 0.87 | 7.4 ± 0.79 | 7.7 ± 0.89 | 0.02 |
| Creatinine (µmol/L) – Mean ± SD | 87.2 ± 22.0 | 86.7 ± 17.5 | 87.5 ± 24.6 | 0.64 |
| LDH (U/L)& – Median (P25-P75) | 319 (208-402) | 239 (174-367) | 357 (250-489) | < 0.001 |

Data are presented as numbers and percentages. ECOG denotes Eastern Cooperative Oncology Group. LDH denotes lactate dehydrogenase.

# excluding category 'unknown'; $ excluding n = 17 (12%) missing values; & excluding n = 2 (1%) missing values.



Table 3 – Comparison of geriatric assessment scores according to receiving less than four versus four or more cycles of chemotherapy in patients with colorectal cancer.

| Test | Adjuvant Chemotherapy (n = 54) | | | | Palliative Chemotherapy (n = 89) | | | |
|---|---|---|---|---|---|---|---|---|
| | Total N=54 (%) | <4 cycles N=13 (%) | ≥4 cycles N=41 (%) | p-value | Total N = 89 (%) | < 4 cycles N = 26 (%) | < 4 cycles N = 63 (%) | p-value |
| **MNA** | | | | 0.42 | | | | 0.008$ |
| Well Nourished | 40 (80) | 9 (69) | 31 (84) | | 58 (67) | 12 (46) | 46 (75) | |
| (Risk of) Malnutrition | 10 (20) | 4 (31) | 6 (16) | | 29 (33) | 14 (54) | 15 (25) | |
| Unknown | 4 | | | | 2 | | | |
| **GFI** | | | | 0.26 | | | | 0.23$ |
| Not Frail | 43 (80) | 12 (92) | 31 (76) | | 66 (74) | 17 (65) | 49 (78) | |
| (Risk of) Frailty | 11 (20) | 1 (8) | 10 (24) | | 23 (26) | 9 (35) | 14 (22) | |
| **IQCODE** | | | | 0.32 | | | | 0.51 |
| Normal Risk | 48 (89) | 13 (100) | 35 (85) | | 75 (85) | 20 (80) | 55 (87) | |
| Cognitive Decline | 6 (11) | 0 | 6 (15) | | 13 (15) | 5 (20) | 8 (13) | |
| Unknown | | | | | 1 | | | |
| **MMSE** | | | | 0.08 | | | | 1.00 |
| Normal | 49 (91) | 10 (77) | 49 (95) | | 82 (93) | 24 (92) | 58 (93) | |
| Cognitive Dysfunction | 5 (9) | 3 (23) | 2 (5) | | 6 (7) | 2 (8) | 4 (7) | |
| Unknown | - | | | | 1 | | | |

Data are presented as numbers and percentages.

$ p-values by Pearson chi-squared test, all other p-values by Fisher Exact tests.

Table 4 – Association between baseline geriatric assessment scores and survival in patients with colorectal cancer.

| Test | | Adjuvant Chemotherapy (n = 54) | | | | Palliative Chemotherapy (n = 89) | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | n | Crude | p-value | Adjusted | n | Crude | p-value | Adjusted | p-value |
| **MNA** | | | | 0.89 | | | | <0.001 | | <0.001 |
| Well Nourished | | 40 | Ref | | Ref | 58 | Ref | | Ref | |
| (Risk of) Malnutrition | | 10 | 0.90 (0.19-4.23) | | 1.04 (0.20-5.25) | 29 | 2.95 (1.79-4.85) | | 2.76 (1.60-4.77) | |
| **GFI** | | | | 0.35 | | | | 0.001 | | <0.001 |
| Not Frail | | 43 | Ref | | Ref | 66 | Ref | | Ref | |
| (Risk of) Frailty | | 11 | 0.37 (0.05-2.94) | | 0.38 (0.05-3.08) | 23 | 2.38 (1.41-4.02) | | 2.72 (1.58-4.69) | |
| **IQCODE** | | | | 0.45 | | | | 0.30 | | 0.24 |
| Normal Risk | | 48 | Ref | | Ref | 75 | Ref | | Ref | |
| Cognitive Decline | | 6 | - | | | 13 | 1.14 (0.74-2.71) | | 1.51 (0.76-3.02) | |
| **MMSE** | | | | 0.11 | | | | 0.38 | | 0.39 |
| Normal | | 49 | Ref | | Ref | 82 | Ref | | Ref | |
| Cognitive Dysfunction | | 5 | 3.68 (0.70-15.54) | | 3.98 (0.76-20.93) | 6 | 1.54 (0.62-3.85) | | 1.51 (0.59-3.85) | |

Hazard ratios and p-values by Cox proportional hazard analysis adjusted for age, sex, number of co-morbidities and laboratory value's (hemoglobin, creatinine, LDH).

Figure 1.

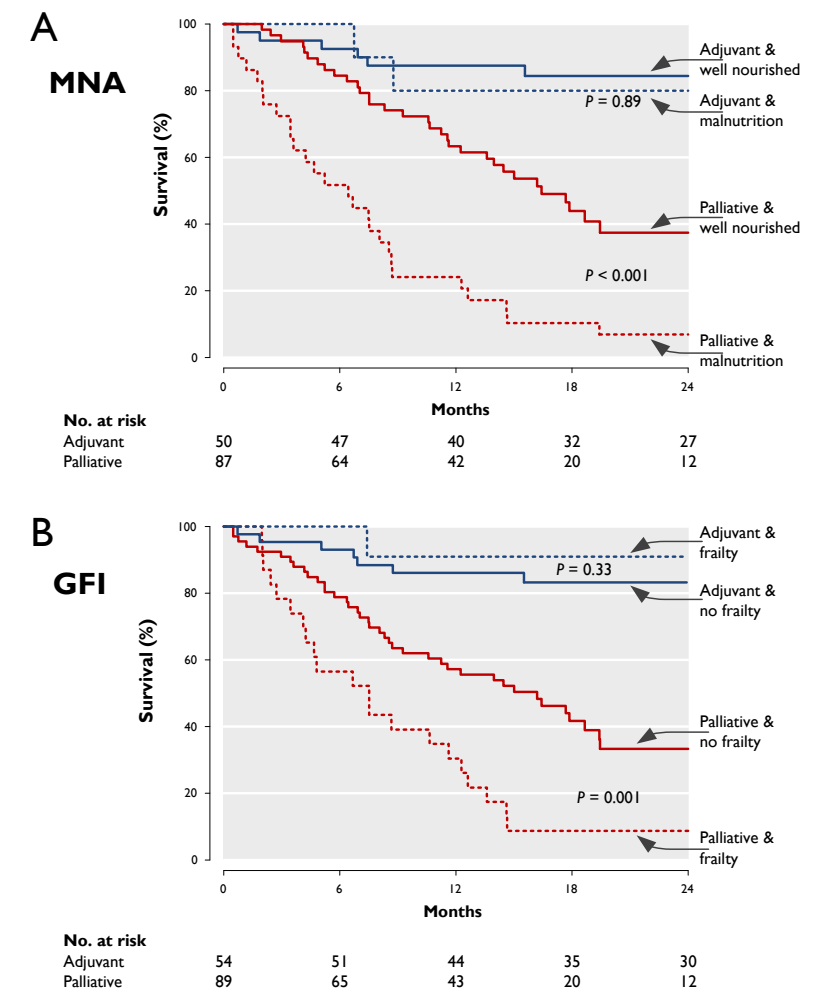


Fig. 1 – Kaplan–Meier curves of overall survival in 143 patients with colorectal cancer according to categories of [A] Mini Nutritional Assessment (MNA) and [B] Groningen Frailty Indicator (GFI). P-values by log-rank tests separately for patients undergoing adjuvant/curative chemotherapy (n = 54) and palliative chemotherapy (n = 89). MNA data was missing for 7 patients at baseline, whereas there were no missing data for the GFI.

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