Malnutrion in colorectal and pancreatic cancer patients : Prevalence and therapeutic need in an annual interval from 08/2020-08/2021

Dorsch, Judith

Master's thesis / Diplomski rad

2022

Degree Grantor / Ustanova koja je dodijelila akademski / stručni stupanj: **University of Split, School of Medicine / Sveučilište u Splitu, Medicinski fakultet**

Permanent link / Trajna poveznica: https://urn.nsk.hr/urn:nbn:hr:171:025793

UNIVERSITY OF SPLIT
SCHOOL OF MEDICINE

Judith Dorsch

MALNUTRITION IN COLORECTAL AND PANCREATIC CANCER PATIENTS: PREVALENCE AND THERAPEUTIC NEED IN AN ANNUAL INTERVAL FROM 08/2020-08/2021

Diploma Thesis

Academic year:
2021/2022

Mentor:
Assist. Prof. Christof Lamberti, MD, PhD

Coburg, August 2022

UNIVERSITY OF SPLIT
SCHOOL OF MEDICINE

Judith Dorsch

MALNUTRITION IN COLORECTAL AND PANCREATIC CANCER PATIENTS: PREVALENCE AND THERAPEUTIC NEED IN AN ANNUAL INTERVAL FROM 08/2020-08/2021

Diploma Thesis

Academic year:
2021/2022

Mentor:
Assist. Prof. Christof Lamberti, MD, PhD

Coburg, August 2022

TABLE OF CONTENTS

1. INTRODUCTION 1

1.1 GASTROINTESTINAL CANCER 2
1.2 PREVALENCE OF CANCER-ASSOCIATED MALNUTRITION 3
1.3 CAUSES OF CANCER-ASSOCIATED MALNUTRITION 4
1.4 CONSEQUENCES OF CANCER-ASSOCIATED MALNUTRITION 7
1.5 EVALUATION OF CANCER-ASSOCIATED MALNUTRITION 8
1.5.1 SCREENING 8
1.5.2 ASSESSMENT 9
1.5.2.1 Anthropometric Measures 10
1.5.2.2 Biochemical Measures 10
1.5.2.3 Functional Measures 11
1.6 TREATMENT OF CANCER-ASSOCIATED MALNUTRITION 12
1.6.1 NUTRITIONAL SUPPORT 12
1.6.1.1 Counseling and Oral Nutritional Supplements 13
1.6.1.2 Enteral Nutrition via Tube 13
1.6.1.3 Parenteral Nutrition 14
1.6.2 PHYSICAL ACTIVITY 15
1.6.3 PHARMACOLOGICAL INTERVENTIONS 15

2. OBJECTIVES 16

2.1 AIMS 17
2.2 HYPOTHESES 17

3. SUBJECTS AND METHODS 18

3.1 STUDY DESIGN 19
3.2 DATA COLLECTION 19
3.3 NUTRITIONAL EVALUATION 19
3.4 OUTCOME MEASURES 20
3.5 STATISTICAL ANALYSIS 21

4. RESULTS 22

4.1 PATIENT CHARACTERISTICS 23
4.2 NUTRITIONAL EVALUATION MEASUREMENTS 24
4.3 OUTCOME MEASURES AND INTERVENTION 25

5. DISCUSSION 28

6. CONCLUSIONS 35

7. REFERENCES 37

8. SUMMARY 47

9. CROATIAN SUMMARY 49

10. CURRICULUM VITAE 51

ACKNOWLEDGEMENT

I especially want to thank PD Dr. med Christof Lamberti as my mentor, for the support and guidance during the diploma thesis. He was an essential contributor to the completion of this work.

Furthermore, I want to thank Ms. Andrea Roth, who helped me collecting my data.

Of course, I would like to express my deepest thanks to my aunt Michaela, who was the first person telling me about the cooperation between REGIOMED and Split University. She actually was the initiator of my career as becoming a doctor.

I would like to deeply thank my Joshua. He always believed in me, was there when I needed some motivation, and he always could relate because we were on the same journey. We will end this chapter together and I'm looking forward starting the next chapter as medical doctors together. I am so proud of you!

Last but not least I can't put into words how grateful I am to my family, for always supporting me in any way possible. I wouldn't be where I am now without them. Thanks for always believing in me. And special thanks to my sister, who was a great help finishing this work.
Danke Mama, Papa, Johannes, Daniel und Miri!

LIST OF ABBREVIATIONS

ASPEN – American Society for Parenteral and Enteral Nutrition

BIA – Bioelectrical impedance analysis

BIVA – Bioelectrical impedance vector analysis

BMI – Body mass index

CNS – Central nervous system

CRC – Colorectal Cancer

CRP – C-reactive protein

CT – Computer Tomography

DXA – Dual-energy X-ray absorptiometry

EN – Enteral nutrition

ESPEN – European Society for Parenteral and Enteral Nutrition

GC – Gastrointestinal Cancer

GI – Gastrointestinal

IL – Interleukin

MNA – Mini Nutritional Assessment

MRI – Magnetic resonance imaging

MUST – Malnutrition Universal Screening Tool

NRS – Nutritional Risk Screening

ONS – Oral nutritional supplements

PC – Pancreatic Cancer

PG-SGA – Patient Generated Subjective Global Assessment

PN – Parenteral Nutrition

QoL – Quality of life

SGA – Subjective Global Assessment

SFT – Skinfold thickness

TNF – Tumor necrosis factor

UICC – Union Internationale Contre le Cancer

1. INTRODUCTION

1.1 Gastrointestinal cancer

Around the whole world the burden of cancer incidence and mortality is rapidly growing which reflects both aging and growth of the population (1). Regarding mortality in cancer patients, gastrointestinal cancer (GC) is one of the leading causes (2). Increasing age, genetic predispositions, family history and unhealthy lifestyle (obesity, smoking, and alcohol addiction) all play a major role in the progressively increasing incidence of GC (3).

In 2020 more than 1.9 million new colorectal cancer (CRC) cases and 935,000 deaths were estimated to occur, representing about one in 10 cancer cases and deaths. Overall, CRC ranks third in terms of incidence, but second in terms of mortality. CRC can be considered a marker of socioeconomic development (4,5). The increase in previously low-risk countries likely reflects changes in lifestyle factors and diet. Increased intake of animal-source foods, decreased physical activity and increased prevalence of excess body weight as well as heavy alcohol consumption and cigarette smoking are proclaimed risk factors for CRC, whereas calcium supplementation and adequate consumption of whole grains, fiber, and dairy products appear to decrease the risk (1,6).

CRC in early stage is commonly diagnosed by routine colonoscopy, which is an effective screening measure and the tool of choice for diagnosis. It is recommended to start regular screening colonoscopy at the age of 50 years, and as long as the previous examination was normal, the following should be done ten years later (7). Suspected CRC recognition and referral for further diagnosis are related to the occurrence of rectal bleeding, abdominal mass, abdominal pain, change in bowel habits, unexplained weight loss, loss of appetite and iron-deficiency anemia (8). On presentation approximately 80% of tumors are localized and 20% of individuals who are diagnosed with CRC have metastatic disease (8). Treatment as surgical resection, (neoadjuvant/adjuvant/palliative) chemotherapy and chemoradiation is adjusted to stage of disease. Computer tomography (CT) imaging of chest, abdomen and pelvis with contrast is needed for staging CRC patients and this has to be done prior to any treatment (8).

In pancreatic cancer (PC) incidence almost equals mortality due to the late onset of symptoms and because of its poor prognosis. With 4.7% it is the seventh leading cause of cancer deaths in both males and females (1). Given that PC is burdened with an aggressive tumor biology, no given cardinal symptoms, and no screening test for early detection, most of the patients are diagnosed in a metastasized stage with a poor prognosis, which explains the low 5-year survival rate of just 8% and a median survival of only 5 months (9,10).

Approximately 20% of patients present with disease that is limited to the pancreas and potentially resectable, while around 50% present with metastatic disease and the remaining 30% present with disease that interfaces with major vascular structures, making it either borderline resectable or locally advanced (10-12). Increasing age, smoking, obesity, heavy alcohol use, diabetes, family history, BRCA1 and BRCA2 gene carrier status and chronic pancreatitis have been identified to increase the risk of developing PC up to 10% (10,13,14). The stage of the disease, the performance status and the treatment goals of the patients and their families are the mainstay of the treatment, which consists of surgery, chemotherapy, radiotherapy and ablative therapies (10).

1.2 Prevalence of Cancer-associated Malnutrition

Cancer patients form a heterogeneous group, which is reflected in the prevalence of malnutrition. It is very significant, and has a wide range from 20-80%, depending on the location of the tumor, the patient's age and the stage of the disease (15). Previous studies have revealed that among the patients who had some degree of malnutrition 5% to 25% die directly from malnutrition, and not by the tumor itself (16,17).

Among cancer types, patients with GC are at an overall higher risk of developing nutritional deficiencies, due to their tumor entity. The risk can be as high as 80% for the patients at GC diagnosis. A decreased oral intake in esophageal and gastric cancers, disrupted metabolism seen in pancreatic cancer, and involvement of the gastrointestinal (GI) tract leading to increased GI-losses in CRC are proposed mechanisms for the high rate of malnutrition which can be seen in GI-malignancies (3,18).

In several different studies it has been shown that PC is almost always one of the leading types of cancer regarding malnutrition (presenting with or develop it during the course of disease) ranging from 50% to 80%. Whereas the prevalence of malnutrition for CRC ranges from 7% to 30% (15,19-23). Patients and their physicians have to deal with the problem of malnutrition from the beginning of the disease through the whole course and it is important to consider malnutrition rather a developing than a steady state, and treatment always has to be adjusted to patient's needs (24).

1.3 Causes of Cancer-associated Malnutrition

For developing nutritional support programs for patients with cancer-associated malnutrition it is essential to understand the different factors causing it. Those are very complicated, because there are not just the factors related to tumor itself contributing to the malnutrition development but also factors regarding the anticancer therapy (24). An upregulation of the host's innate immunity by the tumor may lead to an activation of systemic inflammation (25). In Figure 1. the different responses to this activation are illustrated (26). Not just loss of appetite, less food intake and loss of weight, but also pain, fatigue and depression are possible developing consequences (25,26).

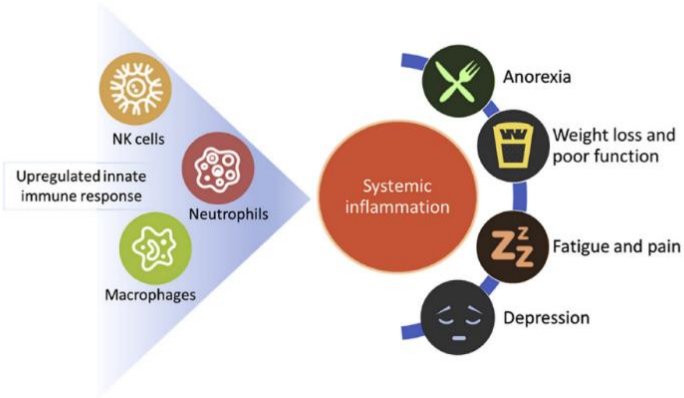

Figure 1. Association of immunologic, metabolic, and clinical phenomena in cancer
SOURCE: Arends J, Baracos V, Bertz H, Bozzetti F, Calder PC, Deutz NEP, et al. ESPEN expert group recommendations for action against cancer-related malnutrition. Clin Nutr. 2017;36:1187-96.

Metabolic changes due to the tumor which cause malnutrition can be seen in Figure 2. (26). The cancer patients' nutrition metabolism can experience great changes, in comparison to healthy individuals, mainly driven by cytokines and other metabolic mediators, leading to significant weight loss (24). Secretion of various cytokines and hormones in the host is stimulated by the tumor and this leads to changes in host's appetite and interferes with the absorption and metabolism of nutrients (24). There is an anabolic/catabolic imbalance, meaning reduced protein synthesis and increased proteolysis in skeletal muscle, which is also a consequence of the factors released by the tumor and leads to muscle wasting, reduce in muscle mass and strength, increasing fatigue, a negative nitrogen balance in the body and hypoproteinemia (24,26).

Circulating cytokines can also alter production of acute phase proteins by the liver, which can suppress drug clearance pathways and lead to risk for toxicity of anticancer agents (27). As cytokines stimulate lipolysis peripheral fat is increasingly mobilized and energy stores in fat deposits are depleted, which leads to defective lipogenesis, a maladaptive and wasteful response to low food intake (26). The abnormal metabolism of tumor cells is primarily manifested with enhanced glycolysis, dramatically increased glucose uptake and glucose consumption in order to maintain their energy homeostasis. Even in the presence of oxygen and fully functioning mitochondria glucose is converted to lactate. The glycolytic switch, which can be found in 70-80% of human cancers leading to aerobic glycolysis, is known as 'Warburg effect' (24,28). In a study by Vaupel *et al.* it was stated that this is "a crucial component of the malignant phenotype and a central feature of the 'selfish' metabolic reprogramming of cancer cells, which is considered a 'hallmark of cancer'" (28). This glycolytic phenotype occurs early in oncogenesis, i.e. before tissue hypoxia develops. The accumulation of lactate leads to a stimulation of sustained proliferation and to suppression of the anti-tumor immunity (28). Even if less ATP is generated, there is more provided per unit of time as long as the tumor gets enough glucose (29). Whereas hosts experience a poor glucose tolerance as a consequence of an often possessed insulin resistance (24).

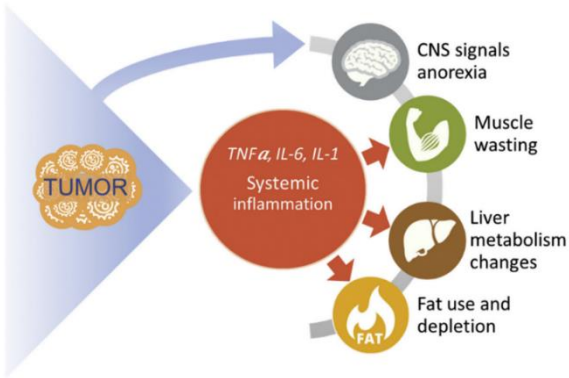

Figure 2. Pathophysiology and metabolism in the presence of a tumor
SOURCE: Arends J, Baracos V, Bertz H, Bozzetti F, Calder PC, Deutz NEP, et al. ESPEN expert group recommendations for action against cancer-related malnutrition. Clin Nutr. 2017;36:1187-96.

Changed metabolism due to released factors is not the only effect of the tumor. Also, the growth can lead to nutritional disturbances. Patients are unable to consume sufficient nutrients and develop eating disorders and loss of weight because of the physical obstruction of the GI-tract (24).

However, not just the tumor itself but also antitumor treatment, including surgery, chemotherapy, or radiotherapy may cause loss of appetite, nausea, vomiting, constipation, taste changes and dysphagia, resulting in an inadequate nutritional intake. These side effects can lead to a decrease in the intake and absorption of nutrients, and further result in malnutrition (Figure 3.) (3,24,30). Psychological factors, including depression and anxiety, can severely affect appetite and eating habits as well and can contribute to a decreased food intake and weight loss (24).

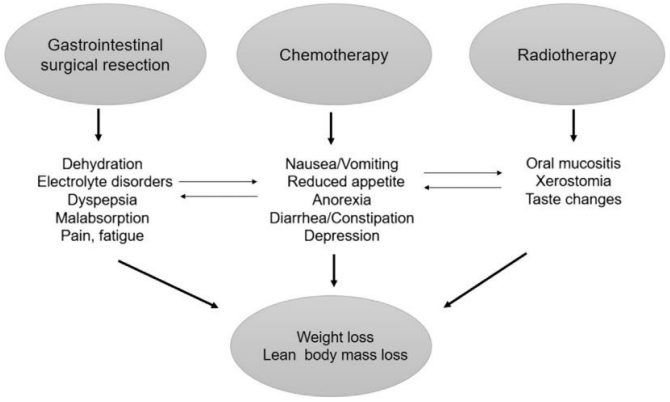

Figure 3. Consequences of anticancer-treatment
SOURCE: Garla P, Waitzberg DL, Tesser A. Nutritional therapy in gastrointestinal cancers. Gastroenterol Clin North Am. 2018;47:231-42.

Loss of appetite is one of the main causes of malnutrition in cancer patients and for those patients whose weight loss is predominantly due to anorexia, artificial nutritional support can be very successful (31,32). Unfortunately, this is not the situation in most cancer patients. The majority of weight-losing cancer patients probably have a mixture of anorexia and abnormal metabolism (31). This pattern of weight loss is different compared to simple starvation seen in otherwise healthy patients, in which loss of body fat with sparing of skeletal muscle occurs (33). This situation is more challenging to treat and it is clear that nutrition alone is not the way to treat the malnutrition in these patients (31).

One point which also should not be missed, except from tumor and treatment related factors contributing to the emergence of malnutrition, are the issues regarding healthcare personnel (absence of nutritional assessment, lack of knowledge and/or training to detect malnutrition, delay in initiating adequate nutritional treatment, etc.) (15). Figure 4. summarizes the factors contributing to the development of cancer-associated malnutrition (24). For the purpose of this study, the terms ‘cancer-associated malnutrition’ and ‘cachexia’ are not differentiated and are taken to designate the same pathophysiological condition.

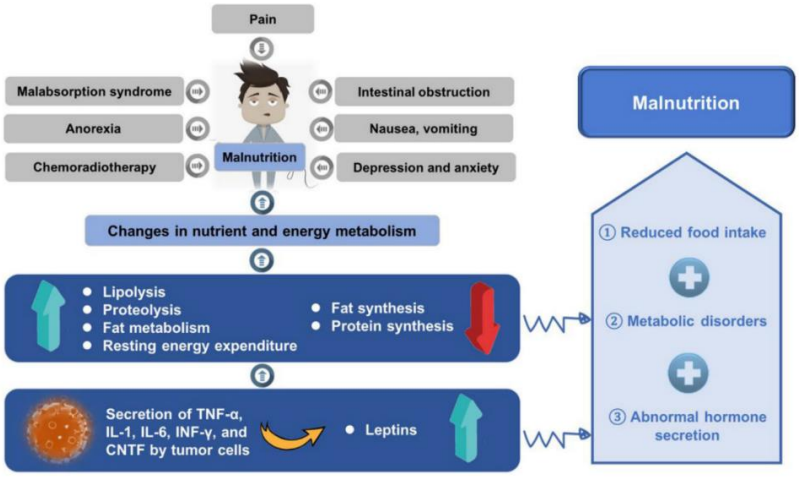

Figure 4. Factors contributing to the development of cancer-associated malnutrition
SOURCE: Wang Y, Zhang T, Liu R, Chang M, Wei W, Jin Q, et al. New perspective toward nutritional support for malnourished cancer patients: Role of lipids. Compr Rev Food Sci Food Saf. 2021;20:1381-421.

1.4 Consequences of Cancer-associated Malnutrition

The nutritional status of patients can influence the oncological process, and studies have reported an association between malnutrition and several different outcome measures. For cancer patients, who need surgery, severe malnutrition is a predisposing factor to increased complication rates and delayed functional recovery and also increased postoperative complications (22,34). The wounds of malnourished medical and surgical patients heal poorly and length of hospital stay is prolonged, which causes higher associated costs (35). Additionally, greater toxicity of treatments (36), poorer response to antineoplastic therapy and greater risk of morbidity and mortality are severe consequences of malnutrition (22). Other studies also mentioned an increase in risk of infection, due to the weakened immune system and a reduction in muscle strength, leading to loss of independence and reduced social functioning. Mood changes and the overall poorer general health have a negative impact on the patient`s quality of life (QoL) (37).

1.5 Evaluation of Cancer-associated Malnutrition

In a study by Correia *et al.* it was stated that according to European Society for Parenteral and Enteral Nutrition (ESPEN) guidelines "the purpose of nutritional screening is to predict the probability of a better or worse outcome due to nutritional factors, and whether nutritional treatment is likely to influence this" (38).

Whereas in the study by Mueller *et al.* according to the American Society for Parenteral and Enteral Nutrition (ASPEN) screening is referred to as "a process to identify an individual who is malnourished or who is at risk for malnutrition to determine if a detailed nutrition assessment is indicated" (39).

There is a worldwide consensus that nutrition support should be used if there is a state of malnutrition or evidence of some nutritional risk. But it should not be used routinely as an adjunct to chemotherapy or irradiation. As a consequence it is extremely important that oncologists are familiar with some methods of nutritional screening (40). Regular screenings for malnutrition are recommended in all oncology patients both at diagnosis and subsequently at regular intervals during the treatment, especially in cancer types with a high impact on nutritional status (21). The nutritional aim in patients with cancer is often about maintaining or improving nutritional status, function and survival. However, in patients with incurable cancer, the aim is changed and it is more about focusing on improving QoL and minimizing symptoms such as nausea and vomiting which may impair their nutritional intake (41).

1.5.1 Screening

Nutritional screening should not be too difficult, has to follow specific standards, has to be validated, efficient, inexpensive, with high sensitivity and good specificity (42). Screening tools are of great help when used in everyday practice for the detection of patients at risk or patients with manifest malnutrition. It helps to identify risk factors other than provide a diagnosis, which would be the function of the assessment. There should be standardized approaches in every setting and an algorithm according to the results (what to do in which situation e.g. assessment, nutritional intervention). Different screening tools were developed and are used in various clinical settings and patient groups (43). According to van Bokhorst-de van der Schueren *et al.*, there are more than 33 of such tools (44). It is beyond the scope of this study to cover these tools exhaustively, but a selection of clinically relevant and validated tools is presented.

The Nutritional Risk Screening (NRS) is a simple nutritional screening tool which comprises a pre- and a main-screening, which takes into account disturbances regarding nutritional status (loss of weight, decreased food intake, decreased body mass index (BMI)) and severity of disease. If the score is <3 no deeper nutritional assessment is needed at the moment and patients should be rescreened. A score ≥3 is considered worth requiring a further deeper nutritional assessment for a potential nutritional intervention. The patient is at risk to be malnourished and as a consequence a multidisciplinary team has to plan the next steps (43). NRS is a validated method and if it is used by a dietitian or other nutritional specialists, results have a great reliability (45).

Malnutrition Universal Screening Tool (MUST) was developed to identify malnourished persons in all different care settings and it takes into account the actual BMI, acute illness together with decreased food intake and weight loss, which was not intended (43). The Mini Nutritional Assessment (MNA) is the screening method which is most often used in older patients who are living in different kinds of institutions. It is a combination of screening and assessment features. Screening is done with the short-form of the test and for the assessment the full version has to be conducted (43).

1.5.2 Assessment

The next step in the evaluation of the patient's nutritional status would be the nutritional assessment, which should be done when the screening method indicates a nutritional risk. The information a physician or dietitian collect during an assessment are more detailed compared to screening information. Together with an adjusted (to nutritional problems) physical examination the extent of the patient's nutritional complaints are determined (46).

There is no gold standard for the nutritional assessment and sometimes this makes it complicated to identify the patients in need. To interpret gathered patient-information it is important that physicians and/or dietitians are experienced and trained (43). It is not just looking at single measured parameters but more the combination of those and putting them together with the patient's history, the appearance and also subjective sensations to get an overall picture of the nutritional problem (47).

There are clinical parameters which have been identified to increase the risk of malnutrition, such as the tumor's location and also the applied treatment. Increased risk is experienced by patients with GC or when different treatments are used simultaneously (47).

1.5.2.1 Anthropometric Measures

Body weight and height can be measured quite easily and BMI can be calculated by dividing body weight by height squared (43). To make results reliable it is important to find a way of standardization (time, amount of clothes etc.). The course of body weight is essential during assessment to evaluate possible changes (e.g. unintentional losses), which can be an indicator for the nutritional status (43). If patients are losing >5% in six months, anything has to be done to counteract this situation (48).

There are different ways to gather information about the body composition (43). Skin-fold measurements are easy to perform, cheap and non-invasive methods. Overall, four skin-folds need to be measured to estimate the total amount of body fat (43).

Another method of estimating body composition would be bioelectrical impedance analysis (BIA), which is simple to perform, cheap and non-invasive. Proportions of fat, muscle, and water can be measured, and as it is portable, bedside measurements are easy to perform (43). For a detailed assessment of the hydration status and cell mass bioelectrical impedance vector analysis (BIVA) sometimes may be more suitable (25). The determination of phase angle seems to be a predictive outcome parameter in cancer patients (49).

Lean mass determination can also be performed by dual-energy X-ray absorptiometry (DXA), a low-dose radiation technique that allows the direct measurement of the various body compartments and at the moment it is considered the gold standard among all the available methods (50). Magnetic resonance imaging (MRI) and CT are able to quantify the fat mass and fat-free mass. That means fat distribution and hence estimation of skeletal muscle mass (SMM) is enabled (43). Both methods are most commonly used for research projects because MRI and CT are not easily available, expensive, and time consuming (51). To get an accurate estimation of SMM, imaging of the third lumbar vertebra is the method of choice (25).

1.5.2.2 Biochemical Measures

There is not one specific biochemical marker which can be used for assessment of the nutritional state of a patient or even for monitoring the therapy of a nutritional condition. However, in clinical practice when taking blood there are several different parameters measured, which may help to evaluate the patient's nutritional status (e.g. underlying cause of malnutrition, therapeutical success) (43,52).

Biochemical markers which are classically used to evaluate nutritional status may be altered due to inflammation. However, it is recommended to measure albumin, pre-albumin, and transferrin, as mortality predictors. Albumin and pre-albumin should be evaluated in a global context because of alterations which can be caused by the occurrence of other additional and common problems in patients with cancer. Liver diseases, infections, anasarca, renal diseases etc. are some examples. CRP can be measured as a marker of systemic inflammation (42,47). A decrease in albumin concentration is related to long periods of malnutrition, because albumin has a half-life of 20 days. There is a strong relationship between low albumin concentrations and poor outcome in cancer patients (53).

1.5.2.3 Functional Measures

More emphasis regarding nutritional assessment is put on functional measurements, which indeed influence QoL. If there is a deficiency of energy, muscle strength but also overall physical condition of the patient deteriorates (43). Hand dynamometry can be used as a nutritional marker, due to its proven correlation with the nutritional status (43). Surgical outcome, the hospitalization time and a decreased physical status can be predicted by hand dynamometry (43,54). It is an easy test to perform, the measurement is done very fast and it is a cheap method but its disadvantage is the dependence on the patient's will and ability to perform it (43). The overall physical condition of the patient can also be assessed by measuring the distance the patient can walk in a distinct time span (43,55). Muscle function tests display a high sensitivity in regard to patient's nutritional state and consequently to nutritional therapy (43). Assessment of QoL is getting more and more attention lately in regard to the evaluation of nutritional state. Symptoms as for example pain, physical deficiencies in regard to patient's mobility and strength, psychological factors as anxiety or depression and social issues (isolation) making up the domains of the patient's perception of wellbeing and all potentially having an effect on eating. QoL may be used as a follow-up measure for success or failure of nutritional intervention. There are many questionnaires available, but there is no established consensus on which optimally should be used (43).

Still there is no gold standard for nutritional evaluation and to achieve an accurate determination of the nutritional status it is not enough to just use one single above mentioned category. The use of a combination of the described parameters is essential for proper nutritional assessment results (25).

1.6 Treatment of Cancer-associated Malnutrition

1.6.1 Nutritional Support

Prevention or correction of nutritional deficiencies, improvement of immune system and maintenance or improvement of the QoL are the primary goals of nutritional therapy. Furthermore, the definite goals are the improvement of the response and tolerance to anticancer-treatment, prolonging survival, reduction of complications of malnutrition, and decrease of the length of hospital stay (3). Nutritional support, a patient who is at risk of malnutrition or who is already malnourished should get, is a step-by-step intervention (56). The form of medical nutrition care depends on the patient's medical history, appetite, type of cancer, stage of cancer, and his or her response to treatment (48). So the treatment should be adapted to individual needs (26) and the goal of nutritional support should be either prevention or treating malnutrition, in order to allow the successful completion of oncologic treatments, improve prognosis and preserve functional status and QoL (57,58).

The best way of treating cancer associated malnutrition would be obviously to cure the cancer, which would normalize the metabolic abnormalities induced by the tumor or the tumor/host interactions. When cure cannot be achieved, the next step would be to increase nutritional intake by dietary counseling and oral nutritional supplements (ONS) or by artificial nutrition (59). It is recommended to increase oral intake in cancer patients who are able to eat but are malnourished or at risk of malnutrition. Dietary advice, the treatment of symptoms and derangements impairing food intake, as well as offering ONS are included in the first step of nutritional intervention. Nutritional therapy should preferably be initiated when patients are not yet severely malnourished (60). Nutritional support can be also via tube feeding (nasogastric tube or direct gastric or jejunal route) or through parenteral nutrition (PN) when oral and enteral routes are, for any reason, unavailable (40). The decision which way of nutritional intervention is the best to choose is dependent on the patient’s current overall state. It is influenced by the patient’s diagnosis, onco-specific therapy, different nutritional parameters and the duration of application of the nutritional intervention (47).

1.6.1.1 Counseling and Oral Nutritional Supplements

The first goal of nutritional treatment is to preserve nutrition via oral route by minimizing food related discomfort and maximizing food enjoyment which is achieved through strategies including dietary counseling by a dietitian or other healthcare professionals and the offering of ONS (41,61,62). The initial step of nutritional therapy according to ESPEN guidelines is counseling, which has the purpose to manage food related complaints as for example appetite loss, nausea, constipation, dysphagia and others. Patients should be encouraged to eat and drink what is most tolerable for them. It is important to collect information about any kind of food allergies and intolerances, but also about recent dietary habits and sensational changes (smell, taste) to find the food which is preferred by the patients (37,63).

Numerous studies have shown the beneficial impacts of ONS on nutritional status and clinical outcomes (64-66). In addition to these beneficial effects, ONS treatment can lead to overall medical cost savings (67). For patients with maintained ability to eat, the best way of treating them would be a combination of ONS, rich in calories and proteins, with usual oral diet to meet nutritional demands. After ONS were administered to patients at nutritional risk, it has been shown that their immune system and their nutritional state improved (3,64).

As a fact, the compliance of patients with ONS is directly influenced by the physical state, smell, taste, and mouthfeel of the product (24). In a study of long-term compliance of patients, it was observed that 54% of cancer patients had stopped taking ONS due to unfavorable taste (68). It also has been shown that formula, if enriched with long-chain omega-3 fatty acids, eicosapentaenoic and docosahexaenoic acids, is an important nutrient in cancer patients in need for nutritional treatment (3). If patients are treated with radio-/chemotherapy, enriched formula is supposed to improve appetite and lean body mass (3,63). ONS are the easiest, most natural and least invasive method to increase nutrient intake in patients if they are unable to meet their energy requirements just with normal foods alone, despite dietary counseling (69). Suggested benefits of ONS include increased appetite and weight gain, decreased GI toxicity and improved performance status (70).

1.6.1.2 Enteral Nutrition via Tube

Cancer patients who are unable to eat, digest or absorb food, or if their intake is insufficient even if interventions have been offered, artificial nutrition may stabilize nutritional status. In patients with tumors that impair oral intake or food transport in the upper gastrointestinal (GI) tract, nutritional status can be stabilized by enteral nutrition (EN) either via nasogastric tube or percutaneous endoscopic gastrostomy, which is gold standard (71).

The method to choose is dependent on the expected duration of the feeding and the patient's general state (47). If the duration is estimated to be not longer than 6 weeks a nasogastric tube can be considered (62)**.**

The main indications to start with tube feeding are of different nature. Firstly, there are mechanical and functional problems which are caused by the tumor itself as for example difficulties in swallowing (pain, obstruction) or obstructions in the stomach. Secondarily, there are also unfavorable treatment-related effects (62,72). If it is known that a patient won't live longer than just few weeks or months and is not able to eat more than two thirds of his/her daily nutritional requirements, another way of support has to be found and a good strategy is an early GI access (62).

It is recommended to assume that cancer patients generally request the same amounts of calories as a healthy individual when no personalized measures have been performed (25–30 kcal/kg/day) (47). Awareness has to be drawn to the occurring overestimation in obese people and underestimation in very thin patients if this method is used (47).

The amounts of proteins should be between 1 (minimum) and 1.2–1.5 g/kg/day. Under specific circumstances the amount should be adjusted according to requirements e.g. because of protein wasting (increase) or renal failure (decrease) (33,47). In regard to the ideal lipid to carbohydrate ratio, the individual's clinical state has to be taken into account. It is recommended to increase the proportion of lipids if there is an insulin resistance, which may lead to increased weight loss (47,73).

1.6.1.3 Parenteral Nutrition

If ONS and/or EN are not sufficient for supply and there is no possibility of using patient's GI-tract for adequate feeding, PN, a method bypassing the GI-tract, is indicated (47,74-76). It is sometimes used in severely compromised patients, who would require EN, but the nutritional needs can't be met as a consequence of a not effectively working gut. Examples are patients with peritoneal carcinomatosis, radiation enteritis, patients with extensive bowel resections or chemotherapy-/radiation-induced diarrhea, nutrition impact symptoms or more simply because patients refuse the tube (40,62).

The most frequent indication für PN is given in patients with tumors of the GI-tract, i.e., gastric carcinoma, colorectal carcinoma, and pancreatic carcinoma, when patients display symptoms as nausea or vomiting (77). There are of course contraindications for PN. It is not recommended in hemodynamically unstable patients, with ascites, severe organ failure, or in the presence of severe glycemic instability and it is rarely appropriate in incurable cancer patients with life expectancy shorter than 3 months, Karnowfsky score ≤50 or Eastern Cooperative Oncology Group (ECOG) performance status ≥3 (58,78).

Home PN may be a consideration for patients who cannot be fed orally or enterally, and in situations where they are more likely to die of starvation rather than tumor progression (58). In incurable/palliative patients, the nutritional support should be performed when the expected benefit outweighs the potential risk. When the estimated survival is greater than 1–3 months, and in case of intestinal insufficiency, PN can be offered, if the oral/enteral route is insufficient and there are expectations of improvement in the patient's QoL and functionality (63).

1.6.2 Physical Activity

The ESPEN guidelines recommend cancer patients to maintain or even increase the level of physical activity in order to support muscle mass, physical function, and metabolic pattern. Even patients with advanced stages of the disease are often able and have the will to engage in physical activity. It is well-tolerated and safe at different stages of cancer (60).

1.6.3 Pharmacological Interventions

Corticosteroids are suggested to increase the appetite of anorectic cancer patients with advanced disease for a restricted period but side effects as for example muscle wasting, insulin resistance and infections have to be always kept in mind (60). However, as mentioned above the anti-anorectic effect of corticosteroids is just transient and disappears after a few weeks (79). As a consequence of the adverse effects, particularly with longer duration of use, corticosteroids may be more suitable for patients with a short life expectancy, especially if they have other symptoms that may be alleviated by this class of drugs such as pain or nausea (60). Progestins are suggested as well. They increase the appetite of anorectic cancer patients with advanced disease but as well as corticosteroids they have potentially serious side effects (e.g. thromboembolism) (80).

2. OBJECTIVES

2.1 Aims

The aim of this study was to determine and compare the prevalence of malnutrition in pancreatic and colorectal cancer patients attending the outpatient clinic presenting for diagnosis, therapy or follow-up. Additionally, the study investigated the benefit of nutritional intervention in the different cancer groups.

2.2 Hypotheses

1. The prevalence of malnutrition in pancreatic cancer patients is higher than in colorectal cancer patients.
2. Pancreatic cancer patients and colorectal cancer patients benefit from nutritional intervention.

3. SUBJECTS AND METHODS

3.1 Study Design

This retrospective study was conducted in the REGIOMED MVZ Coburg – Medical office for oncology and haemato-oncology. Anonymized medical data were collected by the ISYNET medical documentation program. For the current study all patients who are aged >18 years**,** diagnosed with PC or CRC and who received chemotherapy were eligible for inclusion in the study. The subjects presented different stages of cancer, from early diagnosis to advanced stage. 108 patients accounted for the whole study group comprising CRC (N = 57) and PC (N = 51) patients. The study was approved by the institutional review board of the Medical School REGIOMED according to the Declaration of Helsinki.

3.2 Data Collection

Demographic and clinical characteristics were collected including sex, age, height, weight, BMI defined as the ratio of weight (kg) to height (m^2), tumor entity, tumor stage (defined according to Union Internationale Contre le Cancer (UICC) classification), received treatment, course of disease and serum levels of albumin. Furthermore, BIA-measurement results as well as food intake related complaints (altered taste, nausea, vomiting, early satiety, diarrhea, constipation, GI-obstruction, malabsorption), appetite (poor, moderate, good), NRS results, food intake and nutritional support (ONS, PN) were documented.

3.3 Nutritional Evaluation

The nutritional consultation consists of a screening (performed by the nutritionist), which is followed by a complete assessment of nutritional status if the patient is at risk of malnutrition, before reaching a decision regarding the most appropriate treatment for the patient's requirements and characteristics. All PC and CRC patients who visit the medical office for diagnosis, therapy or follow-up have to fill out a questionnaire consisting of four questions and it is seen as the modified pre-screening usually incorporated in the NRS:

- unintentional weight loss during the past three months
- decreased food intake
- loss of appetite
- food intake related/GI-tract complaints (altered taste, nausea, vomiting, early satiety, diarrhea, constipation, GI-obstruction, malabsorption)

If any of these questions were positively answered, the patients were referred to the dietitian. Patients at nutritional risk were identified using a nutritional screening test (NRS) (43). The test verifies disturbances regarding nutritional status (loss of weight, decreased food intake, decreased BMI) and severity of disease/stress metabolism (mild stress metabolism: patient is mobile e.g. chronic disease with complications, moderate stress metabolism: patient can't leave the bed due to illness, severe stress metabolism: severe illness). For each of these two categories the resulting score can be 0-3. Older age (>70 years) is considered as an independent risk factor with one extra point. If the score was <3 the patient should be rescreened 8 weeks later. The 8 weeks in between the two screenings are adjusted to outpatient setting. The original NRS recommends a weekly rescreening if score is <3 (43). Patients were considered at nutritional risk or already malnourished when total score was ≥3 points and if this was the case, intensive assessment or even a nutritional intervention should have probably followed.

The assessment was done by a dietitian and by oncologists and consisted of measuring actual body weight and calculating weight loss during last 2 months prior to assessment, calculating actual BMI and perform a BIA measurement. Serum albumin levels were measured as well and were considered low if the value was below 33g/l. Patients were asked by the dietitian and also during their oncologist's appointment about present GI-related complaints (side effect of therapy) and about their character of appetite which could be either described as poor, moderate or good. All patients with a positive prescreening received nutritional counseling. If patients were malnourished or oncologists decided that it was indicated, patients got an intervention (ONS or PN), which was adjusted (amount, composition, route of administration) to their needs. At the end of the study patients' appetite, complaints as well as body weight were reassessed and compared to baseline. These three variables were used to evaluate the benefit of the intervention.

3.4 Outcome Measures

Malnutrition is defined by involuntary loss of weight >5% in 2 months, BMI <18.5 kg/m² in patients <70 years of age and BMI <22 kg/m² in patients ≥70 years of age (43), and reduced muscle mass measured via BIA. BIA measurements were performed, if patients were at risk of malnutrition or even already malnourished on the grounds of the NRS. If one of these three variables applied patients were considered malnourished.

Benefit evaluations were done for all patients who received an intervention, which meant either getting ONS or PN. Benefit was given if two of three following criteria applied: there was no reduction in weight of more than 0.5 kilograms compared to the weight pre-intervention, the appetite has not worsened compared to pre-intervention and there were no food intake related or GI-tract complaints. Appetite was classified as poor, moderate or good and not worsened meant that it was the same as before or got better. Dietitian and oncologists asked for all variables. The starting point was defined as the first meeting after a positive pre-screening and the point of time to compare with was the end of the study.

3.5 Statistical Analysis

The statistical analysis was conducted with SPSS version 26 software (SPSS Inc., Chicago, IL, USA). A descriptive analysis was performed using mean and standard deviation values for the quantitative variables, and the frequency distribution for qualitative variables. The data collected contain different variables, categorical and metric. In the case of categorical variables, a Chi-square test is applied. In the case of metric variables, t-test is applied. P-value <0.05 is considered statistically significant.

4. RESULTS

4.1 Patient Characteristics

Table 1. shows the two type-samples with respect to age, gender and UICC stage. In total, 108 patients with a mean age of 68±10 years took part in the study. PC patients had a mean age of 70±9 and CRC patients had a mean age of 67±10. In this study 48% participants were female and 52% were male. If we look at the PC group there were 57% men and just 43% women compared to 47% males and 53% females in the CRC group. The patients presented different stages of cancer, from early diagnosis to advanced stage. There is no significant difference in regard to the stage of disease between the two groups (P=0.637) but overall, there were 84% in stage III and VI which means in more advanced condition. There are also no significant differences with respect to age (P=0.130) and gender (P=0.324), so the samples are largely comparable.

Table 1. Patient characteristics

	All (N = 108)	**PC[a] (N = 51)**	**CRC[b] (N = 57)**	**N 1 / N2**	***P***
Age	68±10	70±9	67±10	51 / 57	0.130[†]
Gender				51 / 57	0.324*
Female	48 %	43 %	53 %		
Male	52 %	57 %	47 %		
UICC[c]				51 / 57	0.637*
Stage I	4 %	6 %	2 %		
Stage II	12 %	10 %	14 %		
Stage III	36 %	37 %	35 %		
Stage IV	48 %	47 %	49 %		

Data are presented as percentages or as mean±standard deviation

* Chi-square test

[†] t-test

[a] Pancreatic cancer group

[b] Colorectal cancer group

[c] Union Internationale Contre le Cancer

4.2 Nutritional Evaluation Measurements

Table 2. describes the measurements which were made to evaluate the nutritional status. Comparing the frequencies of hypoalbuminemia between the groups, patients with PC displayed a significant (P=0.002) higher rate of hypoalbuminemia compared to the CRC group. When looking at BMI at the beginning of the study the patients with PC had a BMI of 24±4 kg/m² and CRC patients a BMI of 28±6 kg/m² (P<0.001) and at the end the BMI for PC patients was 24±5 kg/m² and that for CRC patients 28±7 kg/m² which makes a significant difference (P<0.001) between the groups. Comparing weight from beginning of the study and end of study between the two groups there are significant differences displayed with P=0.002 and P=0.004, respectively. Overall, 45% of all patients experienced weight loss. PC patients demonstrated a frequency of 71% compared to 23% in the CRC group, which led to a significant result with P<0.001. A significant difference of P=0.009 was seen between the groups regarding the NRS results. Out of the CRC group 14 (47%) patients had a NRS result ≥3, and 37 (75%) patients out of the PC group.

Table 2. Description of nutritional evaluation measurements

	All	**PC[a]**	**CRC[b]**	**N 1 / N2**	***P***
Albumin[c]	10 %	20 %	2 %	50 / 56	**0.002***
BMI1[d] (kg/m²)	26±6	24±4	28±6	51 / 57	**<0.001†**
BMI2[e] (kg/m²)	26±6	24±5	28±7	49 / 57	**<0.001†**
LoW[f]	45 %	71 %	23 %	51 / 57	**<0.001***
NRS[g]	65 %	75 %	47 %	49 / 30	**0.009***
Weight1[h] (kg)	75±19	69±14	80±21	51 / 57	**0.002†**
Weight2[i] (kg)	75±20	69±15	80±22	49 / 57	**0.004†**

Data are presented as percentages or as mean±standard deviation
* Chi-square test
† t-test
[a] Pancreatic cancer group
[b] Colorectal cancer group
[c] Albumin level <33g/l
[d] BMI at the first screening
[e] BMI at the end of the study
[f] Loss of weight 3 months prior to screening
[g] Nutritional risk screening ≥3
[h] Weight at first screening
[i] Weight at end of study

4.3 Outcome Measures and Intervention

The main outcome measure was malnutrition and is shown in Table 3. In the two investigated groups there was a significant difference (P=0.029) between frequencies of low BMI (<18.5 kg/m² <70 years of age / <22 kg/m² ≥70 years of age). In regard to weight loss (>5%) there was a significant difference between the two groups (P<0.001) as well. With 43% of PC patients losing >5% of weight 2 months prior to the first screening and just 14% of CRC patients. However, comparison of reduced skeletal muscle mass displayed no significant difference between the groups (P=0.057). Overall, malnutrition of the patients, who were investigated, was 64%. With 67% in PC patients and 59% in CRC patients so there was no significant difference (p=0.593). 94 % of the malnourished patients had an NRS ≥3.

Table 3. Prevalence of malnutrition

	All	**PC[a]**	**CRC[b]**	**N 1 / N2**	***P****
Malnutrition	64 %	67 %	59 %	41 / 21	0.593
BMI[c]	14 %	22 %	7 %	51 / 57	**0.029**
LoW[d]	27 %	43 %	14 %	49 / 57	**<0.001**
SMM[e]	54 %	64 %	35 %	33 / 17	0.057

Data are presented as percentages
Malnutrition is given when one of the three variables was positive
* Chi-square test
[a] Pancreatic cancer group
[b] Colorectal cancer group
[c] BMI <18.5 kg/m² (<70 years) / BMI <22 kg/m² (≥70 years)
[d] Loss of weight >5% during last two months prior to screening
[e] Skeletal muscle mass reduced (BIA measurement)

Table 4. illustrates the distribution of nutritional interventions the groups received. 71% of PC patients receive either ONS and/or PN which is significantly (P<0.001) more compared to the CRC group (17%). Overall, 43% received an intervention. There are also significant differences between the groups (P<0.001) when looking at the interventions separately.

Table 4. Distribution of intervention

	All	**PC[a]**	**CRC[b]**	**N 1 / N2**	***P****
Intervention[c]	43%	71%	17%	51/57	**<0.001**
ONS[d]	34%	55%	16%	51/57	**<0.001**
PN[e]	20%	35%	5%	51/57	**<0.001**

Data are presented as percentages
* Chi-square test
[a] Pancreatic cancer group
[b] Colorectal cancer group
[c] ONS and/or PN
[d] Oral nutritional supplement
[e] Parenteral nutrition

The second outcome measure, which was investigated is benefit and is illustrated in Table 5. Benefit was assessed for all participants who received an intervention (Table 4.). However, if we look at the overall benefit (P=0.162) and the single variables contributing to it (appetite, complaints, weight) there is no significant difference between the groups. But there is a benefit of 37% for the whole group. 43% of the patients with PC experienced a benefit from the intervention compared to 14% in the CRC group.

Table 5. Distribution of benefit

	All	**PC[a]**	**CRC[b]**	**N 1 / N2**	***P****
Overall benefit	37 %	43 %	14 %	28 / 7	0.162
Benefit appetite	29 %	32 %	14 %	28 / 7	0.350
Benefit complaints	51 %	54 %	43 %	28 / 7	0.612
Benefit weight	31 %	37 %	10 %	35 / 10	0.102

Data are presented as percentages
Overall benefit is given in people with intervention if two out of the three variables apply
* Chi-square test
[a] Pancreatic cancer group
[b] Colorectal cancer group

5. DISCUSSION

In this study the prevalence of malnutrition was investigated, which is a commonly encountered problem in a majority of cancer patients. In accordance to other studies 64% of patients were malnourished. Overall, patients with GI cancers are at higher risk of developing malnutrition due to their tumor entity (18). PC is one of the leading tumor types associated with malnutrition, and compared to CRC, PC always displays higher frequencies according to the literature (15,21,81,82). In this study prevalence of malnutrition was about two-thirds in the PC group accompanied with a low BMI, high loss of weight during last two months and a relevant SMM reduction (Table 3.).

An interestingly high rate of malnutrition was found among the CRC patients, too, compared to other studies (81-83). The retrospective character of our study limits the interpretation of these observations. Only 21 CRC patients were finally included in the analysis of malnutrition in the CRC group. Especially, data for patients with a negative pre-screening, suggesting no risk of malnutrition, were incomplete. Just 17 patients out of the CRC group got their body composition measured via BIA. Reduction in SMM was the only variable defining malnutrition, which displayed no significant difference between the two groups (Table 3.). It is speculative, whether more BIA measurements would have revealed more details between PC and CRC patients. The fact that patients with PC had a significant higher frequency of NRS ≥ 3 ($P=0.009$), which displays a higher risk for malnutrition, may reinforce this assumption (21). Furthermore, albumin level, which reflects the nutritional status of cancer patients and has been identified as critical prognostic factor, was observed to be more often decreased to a level <33g/l in PC patients compared to CRC patients (Table 2.) (84).

Otherwise, selection bias could be another reason for the unexpected high prevalence of malnutrition found in patients with CRC (Table 3.) which is higher compared to recent results (82). Almost half of CRC patients included in our study suffered from an advanced stage of the disease, which generally displays a higher prevalence of malnutrition as compared to those in earlier stages (85).

The high prevalence of malnutrition in PC patients (67%) complied with previously published data (21,81,86) and underlines the aggressiveness of PC accompanied with a high risk of catabolic metabolism. This may be partially explained by distinct gene expression profiles found in PC, which makes patients more vulnerable for developing a wasting syndrome (87).

However, frequencies within the studies reveal a wide range of variability, because malnutrition is influenced by several different factors not just the tumor entity. In addition, the screening tool adopted to diagnose malnutrition may influence the prevalence rate (88), as well as the adoption of criteria that include the assessment of body composition to detect low muscle mass, CT, DXA, or BIA. This makes comparison of the prevalence quite challenging. There are several different approaches to identify malnutrition and no consensus about the definition (25).

Overall, almost half of all the patients in this study experienced unintentional weight loss. It is a recognized marker of malnutrition and is linked to a shorter overall survival, decreased response to chemotherapy, lower QoL, and declining performance status with higher morbidity and mortality rates (43,89). But if it is detected early and properly treated, it may be reversed and this may lead to better disease outcome (40), which makes it an important variable to screen for. The patients with PC were losing weight with a frequency of 71% which is consistent with findings in other studies and is partially caused by the pancreatic exocrine insufficiency (89,90). Almost half of the patients even lost >5% of their body weight. Some other studies, however, reported an increased frequency of weight loss in PC patients compared to this study, which may be due to the different time spans which were taken into account (91). The duration of assessment of general weight loss and weight loss >5% in our study accounted for two and three months, respectively. Whereas in other studies it was investigated for up to six months (91).

Significantly less patients in CRC group lost weight in general and also less patients lost >5% (Table 2.). There is one publication where losing weight in CRC patients is more pronounced as in our study and almost as high as loss of weight in PC patients. One reason may be ascribed to the fact that patients in that study were hospitalized cancer patients, which implies a more acute and sever stage of disease. Also, CRC group in our study was heterogenous when looking at the different states of disease (diagnosis, treatment, follow-up). Gilliland *et al.* stated that weight loss greater than 5% is associated with a greater risk of developing surgical site infections and hospital stay is prolonged as well (90).

A grading system based on BMI and weight loss was proposed by Martin *et al.*, comparing the impact on mortality of lower versus higher initial BMI and found highest risk category to be in patients with low initial BMI and high weight loss and the lowest risk was found in patients with ≤2.5% of weight loss, and a BMI of 28 kg/m² (92).

22% of PC patients had a very low BMI and together with the high weight loss it puts them at a higher risk of mortality. Whereas only 7% of CRC patients had a low BMI, their mean BMI was 28±6 kg/m² and the amount of lost weight wasn't as high as in the PC patients, which is according to Martin *et al.* the category with lowest risk of mortality (92).

Despite the fact that 45% of patients present with involuntary weight loss at the time of diagnosis, in the era of obesity, patients may not appear malnourished. PC patients and CRC patients displayed normal and even high BMI, respectively. Mean BMI in PC was 24±4 kg/m² (normal), mean BMI in CRC 28±6 kg/m² (obese). There was a significant difference between them (Table 2). Recent studies have reported that between 40-60% of patients with cancer are overweight or obese (BMI >25 kg/m²) even in the setting of metastatic disease (74,92-94). Measuring percentage weight loss or simple BMI does not capture abnormal body composition, including muscle mass (27).

The importance of determining body composition rather than just BMI in cancer patients is evident especially in the case of fluid overload and edemas but also in sarcopenic obesity, which is often an underdiagnosed challenge. This problem has to be identified and after that treated correctly to increase survival rate and to prevent complications of cancer therapy (25,94,95). Low muscle mass can be found in patients regardless of their BMI-result (25). Age as a contributing factor to reduction in SMM has to be kept in mind but in our study, there was no significant difference between age in the two groups (Table1.) so the difference in muscle reduction was not attributed to older age.

Recently, Caan *et al.* demonstrated the prognostic value of low muscle mass in CRC and stated that it was independently associated with a higher risk of overall mortality (96). The frequency of reduced SMM in CRC patients in this study (Table 3.) was higher compared to the findings in a recently performed systematic review (97). First reason for that could be the different approaches to measuring SMM. Second reason, as mentioned above, may be the small number of just 17 patients out of the CRC group who got their body composition measured via BIA. Third reason could be that patients in the systematic review were measured pretreatment, which could also explain lower values.

Studies of patients with cancer of pancreas or the biliary tract receiving a standard chemotherapy reported a muscle loss in almost 90% of publications (98). In this work 64% of PC cancer patients have been found to have reduced SMM, which is in line with results of a recent performed study (99).

Although no significant difference of reduced SMM was found between the two groups, tumor entity is known to contribute to the reduction (97), and with P=0.057 it is almost significant and according to Bozzetti *et al.* it appears that patients with cancer of the pancreas are affected the most with loss of muscle mass during chemotherapy (98).

In a recent systematic review of 24 studies using BIA for the identification of reduced SMM in cancer, BIA was an accurate method for detecting it and for evaluating associations with adverse outcomes (100).The primary drawback and barrier to the use of BIA in oncology is the lack of precision with fluctuations in hydration status and in the presence of edema. Nevertheless, if used carefully and in a standardized fashion, BIA represents an inexpensive and simple, noninvasive tool that does not require highly skilled personnel and results are immediately available. It is a viable alternative to CT, DXA, and MRI in oncology clinical practice (100).

PC is burdened with an aggressive tumor biology, no given cardinal symptoms, no screening test for early detection and is diagnosed most often in a metastasized stage (9,10). Compared to CRC where we have early successful screenings and only 20% presenting in metastatic state at diagnosis (8). This could probably explain the significant differences in the two groups. But overall, both types were found to have a high risk of malnutrition and should be evaluated carefully in regard of nutritional status.

Prevention or correction of nutritional deficiencies, improvement of immune system and maintenance or improvement of the QoL are the primary goals of nutritional therapy. Furthermore, the definite goals are the improvement of the response and tolerance to anticancer-treatment, prolonging survival, reduction of complications of malnutrition, and decrease of the length of hospital stay (3). Nearly every second patient (43%) of our studied population needed either oral (ONS) or parenteral (PN) nutritional support. A striking and significant difference between pancreatic and colorectal cancer patients was found. Two thirds (71%) from PC patients but only less than one fifth (17%) of CRC patients obtained ONS and/or PN which reflects the different nutritional states.

Overall, 37% of patients profited from an intervention irrespective of the tumor entity. Variables weight, appetite and GI-complaints were used to assess benefit. It is suggested that benefits of ONS include increased appetite and weight gain, decreased GI-toxicity and improved performance status and QoL (3,101,102). Also the improvement due to PN in regard to global QoL, subjective global assessment, and weight was reported (9). In another systematic review an overall positive effect of nutritional interventions during chemo(radio)therapy on body weight was found (30). We could confirm these findings although the lack of consistent assessment tools and different clinical endpoints make comparison difficult and challenging. Additionally, the lack of controlled allocation and the sample size did not allow more conclusions on the overall benefit.

12% of patients who were recommended to use ONS, did not take it because of the unfavorable taste. This problem regarding compliance was already mentioned in another study (68). This makes the group to investigate again even smaller. Another limitation of this observational study was the frequency of reexaminations. Merely 49 patients were examined a second time without a predefined procedure.

The high percentages of malnutrition in both studied groups in the outpatient setting was especially remarkable and worrisome when considering that patients able to attend an ambulatory consultation or therapy should represent a favorably selected segment of the cancer population. Since a NRS result ≥3 displays a nutritional risk and calls for further more deep nutritional assessment, it is noteworthy that this result was observed in 75% of patients with cancer of the pancreas and also in almost every second CRC patient (Table 2.). Previous studies have revealed that among the patients who had some degrees of malnutrition 5% to 25% die directly from malnutrition, and not by the tumor itself (16,17).

Even if oncologists do not always feel comfortable, confident or adequately prepared to provide nutritional counseling, such a remarkable prevalence of outpatients with high nutritional risk should alert them to face actively with this issue. One good reason to do so are the deleterious effects of malnutrition on the tolerance of oncologic therapies and response to treatment (15,60). Also, there is a growing experience that an early nutritional intervention when tumor burden is still limited is able to achieve a clinical benefit (60). In our study a benefit in more than one third of patients could be achieved (Table. 5). It was reported that when applying a periodic nutritional assessment, identify patients at risk for malnutrition and start early with nutritional support, clinical benefit would be the consequence (21).

According to the ESPEN guidelines, apart from BMI and weight loss, the loss of muscle mass is a hallmark of cancer-associated malnutrition and should be addressed (86). In future studies there should be a consensus about the definition of malnutrition to make comparison easier.

6. CONCLUSIONS

As we expected the prevalence of malnutrition is higher in patients with pancreatic cancer compared to patients with colorectal cancer and both groups benefit from intervention. Due to the high prevalence of malnutrition in certain cancer types, resulting from the physical and metabolic effects of cancer and from the influence of anticancer treatment, early nutritional risk screening and periodically reassessment is mandatory and should be performed in order to increase awareness and to facilitate early recognition and treatment to reverse mild malnutrition. Oncologists should be familiar with screening tools, indications for nutritional support and the best route of administration. All healthcare workers should be aware of the consequences caused by malnutrition as well as the importance of early interventions. Nutritional evaluation should be part of every cancer patient's treatment.

7. REFERENCES

1. Sung H, Ferlay J, Siegel RL, Laversanne M, Soerjomataram I, Jemal A, et al. Global cancer statistics 2020: GLOBOCAN Estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA Cancer J Clin. 2021;71:209-49.
2. Karimi P, Islami F, Anandasabapathy S, Freedman ND, Kamangar F. Gastric cancer: descriptive epidemiology, risk factors, screening, and prevention. Cancer Epidemiol Biomarkers Prev. 2014;23:700-13.
3. Garla P, Waitzberg DL, Tesser A. Nutritional therapy in gastrointestinal cancers. Gastroenterol Clin North Am. 2018;47:231-42.
4. Fidler MM, Soerjomataram I, Bray F. A global view on cancer incidence and national levels of the human development index. Int J Cancer. 2016;139:2436-46.
5. Bray F. Transitions in human development and the global cancer burden. In: Stewart BW, Wild CP, editor. World Cancer Report 2014. Lyon, France: International Agency for Research on Cancer; 2014. p. 42-55.
6. Siegel RL, Miller KD, Goding Sauer A, Fedewa SA, Butterly LF, Anderson JC, et al. Colorectal cancer statistics, 2020. CA Cancer J Clin. 2020;70:145-64.
7. Bibbins-Domingo K, Grossman DC, Curry SJ, Davidson KW, Epling JW, Jr., García FAR, et al. Screening for colorectal cancer: US preventive services task force recommendation statement. Jama. 2016;315:2564-75.
8. Thanikachalam K, Khan G. Colorectal cancer and nutrition. Nutrients. 2019;11(1).
9. Gärtner S, Krüger J, Aghdassi AA, Steveling A, Simon P, Lerch MM, et al. Nutrition in pancreatic cancer: A review. Gastrointest Tumors. 2016;2:195-202.
10. Loveday BPT, Lipton L, Thomson BN. Pancreatic cancer: An update on diagnosis and management. Aust J Gen Pract. 2019;48:826-31.
11. Tempero MA, Malafa MP, Al-Hawary M, Asbun H, Bain A, Behrman SW, et al. Pancreatic adenocarcinoma, Version 2.2017, NCCN Clinical Practice Guidelines in Oncology. J Natl Compr Canc Netw. 2017;15:1028-61.
12. Bockhorn M, Uzunoglu FG, Adham M, Imrie C, Milicevic M, Sandberg AA, et al. Borderline resectable pancreatic cancer: a consensus statement by the International Study Group of Pancreatic Surgery (ISGPS). Surgery. 2014;155:977-88.
13. Corral JE, Das A, Bruno MJ, Wallace MB. Cost-effectiveness of pancreatic cancer surveillance in high-risk individuals: An economic analysis. Pancreas. 2019;48:526-36.
14. Brand RE, Lerch MM, Rubinstein WS, Neoptolemos JP, Whitcomb DC, Hruban RH, et al. Advances in counselling and surveillance of patients at risk for pancreatic cancer. Gut. 2007;56:1460-9.

15. Álvaro Sanz E, Garrido Siles M, Rey Fernández L, Villatoro Roldán R, Rueda Domínguez A, Abilés J. Nutritional risk and malnutrition rates at diagnosis of cancer in patients treated in outpatient settings: Early intervention protocol. Nutrition. 2019;57:148-53.
16. Sagar RC, Kumar KVV, Ramachandra C, Arjunan R, Althaf S, Srinivas C. Perioperative artificial enteral nutrition in malnourished esophageal and stomach cancer patients and its impact on postoperative complications. Indian J Surg Oncol. 2019;10:460-4.
17. Bozzetti F, Gianotti L, Braga M, Di Carlo V, Mariani L. Postoperative complications in gastrointestinal cancer patients: the joint role of the nutritional status and the nutritional support. Clin Nutr. 2007;26:698-709.
18. Levonyak NS, Hodges MP, Haaf N, Brown TJ, Hardy S, Mhoon V, et al. Importance of addressing malnutrition in cancer and implementation of a quality improvement project in a gastrointestinal cancer clinic. Nutr Clin Pract. 2022;37:215-23.
19. Marshall KM, Loeliger J, Nolte L, Kelaart A, Kiss NK. Prevalence of malnutrition and impact on clinical outcomes in cancer services: A comparison of two time points. Clin Nutr. 2019;38:644-51.
20. Na BG, Han SS, Cho YA, Wie GA, Kim JY, Lee JM, et al. Nutritional status of patients with cancer: A prospective cohort study of 1,588 hospitalized patients. Nutr Cancer. 2018;70:1228-36.
21. Bozzetti F, Mariani L, Lo Vullo S, Amerio ML, Biffi R, Caccialanza G, et al. The nutritional risk in oncology: a study of 1,453 cancer outpatients. Support Care Cancer. 2012;20:1919-28.
22. Pressoir M, Desné S, Berchery D, Rossignol G, Poiree B, Meslier M, et al. Prevalence, risk factors and clinical implications of malnutrition in French Comprehensive Cancer Centres. Br J Cancer. 2010;102:966-71.
23. Argilés JM. Cancer-associated malnutrition. Eur J Oncol Nurs. 2005;9 Suppl 2:S39-50.
24. Wang Y, Zhang T, Liu R, Chang M, Wei W, Jin Q, et al. New perspective toward nutritional support for malnourished cancer patients: Role of lipids. Compr Rev Food Sci Food Saf. 2021;20:1381-421.
25. Bossi P, Delrio P, Mascheroni A, Zanetti M. The spectrum of malnutrition/cachexia/sarcopenia in oncology according to different cancer types and settings: A Narrative Review. Nutrients. 2021;13.

26. Arends J, Baracos V, Bertz H, Bozzetti F, Calder PC, Deutz NEP, et al. ESPEN expert group recommendations for action against cancer-related malnutrition. Clin Nutr. 2017;36:1187-96.
27. Tsoli M, Robertson G. Cancer cachexia: malignant inflammation, tumorkines, and metabolic mayhem. Trends Endocrinol Metab. 2013;24:174-83.
28. Vaupel P, Multhoff G. Revisiting the Warburg effect: historical dogma versus current understanding. J Physiol. 2021;599:1745-57.
29. Vaupel P, Schmidberger H, Mayer A. The Warburg effect: essential part of metabolic reprogramming and central contributor to cancer progression. Int J Radiat Biol. 2019;95:912-9.
30. de van der Schueren MAE, Laviano A, Blanchard H, Jourdan M, Arends J, Baracos VE. Systematic review and meta-analysis of the evidence for oral nutritional intervention on nutritional and clinical outcomes during chemo(radio)therapy: current evidence and guidance for design of future trials. Ann Oncol. 2018;29:1141-53.
31. Skipworth RJ, Fearon KC. The scientific rationale for optimizing nutritional support in cancer. Eur J Gastroenterol Hepatol. 2007;19:371-7.
32. Kang KS, Huh W, Bang Y, Choi HJ, Baek JY, Song JH, et al. Electroacupuncture for chemotherapy-induced anorexia through humoral appetite regulation: A preliminary experimental study. Exp Ther Med. 2019;17:2587-97.
33. Dewys WD, Begg C, Lavin PT, Band PR, Bennett JM, Bertino JR, et al. Prognostic effect of weight loss prior to chemotherapy in cancer patients. Eastern Cooperative Oncology Group. Am J Med. 1980;69:491-7.
34. Fukuda Y, Yamamoto K, Hirao M, Nishikawa K, Maeda S, Haraguchi N, et al. Prevalence of malnutrition among gastric cancer patients undergoing gastrectomy and optimal preoperative nutritional support for preventing surgical site infections. Ann Surg Oncol. 2015;22 Suppl 3:S778-85.
35. Barrera R. Nutritional support in cancer patients. JPEN J Parenter Enteral Nutr. 2002;26:S63-71.
36. Aaldriks AA, van der Geest LG, Giltay EJ, le Cessie S, Portielje JE, Tanis BC, et al. Frailty and malnutrition predictive of mortality risk in older patients with advanced colorectal cancer receiving chemotherapy. J Geriatr Oncol. 2013;4:218-26.
37. Day T. Managing the nutritional needs of palliative care patients. Br J Nurs. 2017;26:1151-9.

38. Correia M. Nutrition screening vs nutrition assessment: What's the difference? Nutr Clin Pract. 2018;33:62-72.
39. Mueller C, Compher C, Ellen DM. A.S.P.E.N. clinical guidelines: Nutrition screening, assessment, and intervention in adults. JPEN J Parenter Enteral Nutr. 2011;35:16-24.
40. Bozzetti F. Nutritional support of the oncology patient. Crit Rev Oncol Hematol. 2013;87:172-200.
41. Blackwood HA, Hall CC, Balstad TR, Solheim TS, Fallon M, Haraldsdottir E, et al. A systematic review examining nutrition support interventions in patients with incurable cancer. Support Care Cancer. 2020;28:1877-89.
42. Castillo-Martínez L, Castro-Eguiluz D, Copca-Mendoza ET, Pérez-Camargo DA, Reyes-Torres CA, Ávila EA, et al. Nutritional assessment tools for the identification of malnutrition and nutritional risk associated with cancer treatment. Rev Invest Clin. 2018;70:121-5.
43. Reber E, Gomes F, Vasiloglou MF, Schuetz P, Stanga Z. Nutritional risk screening and assessment. J Clin Med. 2019;8.
44. van Bokhorst-de van der Schueren MA, Guaitoli PR, Jansma EP, de Vet HC. Nutrition screening tools: does one size fit all? A systematic review of screening tools for the hospital setting. Clin Nutr. 2014;33:39-58.
45. Kondrup J, Rasmussen HH, Hamberg O, Stanga Z. Nutritional risk screening (NRS 2002): a new method based on an analysis of controlled clinical trials. Clin Nutr. 2003;22:321-36.
46. Charney P. Nutrition screening vs nutrition assessment: how do they differ? Nutr Clin Pract. 2008;23:366-72.
47. Virizuela JA, Camblor-Álvarez M, Luengo-Pérez LM, Grande E, Álvarez-Hernández J, Sendrós-Madroño MJ, et al. Nutritional support and parenteral nutrition in cancer patients: an expert consensus report. Clin Transl Oncol. 2018;20:619-29.
48. Fearon K, Strasser F, Anker SD, Bosaeus I, Bruera E, Fainsinger RL, et al. Definition and classification of cancer cachexia: an international consensus. Lancet Oncol. 2011;12:489-95.
49. Grundmann O, Yoon SL, Williams JJ. The value of bioelectrical impedance analysis and phase angle in the evaluation of malnutrition and quality of life in cancer patients--a comprehensive review. Eur J Clin Nutr. 2015;69:1290-7.

50. Kamarajah SK, Bundred J, Tan BHL. Body composition assessment and sarcopenia in patients with gastric cancer: a systematic review and meta-analysis. Gastric Cancer. 2019;22:10-22.
51. MacDonald AJ, Greig CA, Baracos V. The advantages and limitations of cross-sectional body composition analysis. Curr Opin Support Palliat Care. 2011;5:342-9.
52. Leuenberger MS, Joray ML, Kurmann S, Stanga Z. [How to assess the nutritional status of my patient]. Praxis (Bern 1994). 2012;101:307-15.
53. Nitenberg G, Raynard B. Nutritional support of the cancer patient: issues and dilemmas. Crit Rev Oncol Hematol. 2000;34:137-68.
54. Norman K, Stobäus N, Gonzalez MC, Schulzke JD, Pirlich M. Hand grip strength: outcome predictor and marker of nutritional status. Clin Nutr. 2011;30:135-42.
55. Studenski S, Perera S, Wallace D, Chandler JM, Duncan PW, Rooney E, et al. Physical performance measures in the clinical setting. J Am Geriatr Soc. 2003;51:314-22.
56. Caccialanza R, Pedrazzoli P, Cereda E, Gavazzi C, Pinto C, Paccagnella A, et al. Nutritional support in cancer patients: A position paper from the italian society of medical oncology (AIOM) and the italian society of artificial nutrition and metabolism (SINPE). J Cancer. 2016;7:131-5.
57. Paccagnella A, Morassutti I, Rosti G. Nutritional intervention for improving treatment tolerance in cancer patients. Curr Opin Oncol. 2011;23:322-30.
58. Bozzetti F, Arends J, Lundholm K, Micklewright A, Zurcher G, Muscaritoli M. ESPEN guidelines on parenteral nutrition: non-surgical oncology. Clin Nutr. 2009;28:445-54.
59. Bosaeus I. Nutritional support in multimodal therapy for cancer cachexia. Support Care Cancer. 2008;16:447-51.
60. Muscaritoli M, Arends J, Bachmann P, Baracos V, Barthelemy N, Bertz H, et al. ESPEN practical guideline: Clinical nutrition in cancer. Clin Nutr. 2021;40:2898-913.
61. Gillespie L, Raftery AM. Nutrition in palliative and end-of-life care. Br J Community Nurs. 2014;Suppl:S15-20.
62. Cotogni P, Stragliotto S, Ossola M, Collo A, Riso S, On behalf of the intersociety italian working group for nutritional support in c. The role of nutritional support for cancer patients in palliative care. Nutrients. 2021;13.
63. Arends J, Bachmann P, Baracos V, Barthelemy N, Bertz H, Bozzetti F, et al. ESPEN guidelines on nutrition in cancer patients. Clin Nutr. 2017;36:11-48.

64. Kim SH, Lee SM, Jeung HC, Lee IJ, Park JS, Song M, et al. The effect of nutrition intervention with oral nutritional supplements on pancreatic and bile duct cancer patients undergoing chemotherapy. Nutrients. 2019;11.
65. de van der Schueren MAE. Use and effects of oral nutritional supplements in patients with cancer. Nutrition. 2019;67-68:110550.
66. Burden ST, Gibson DJ, Lal S, Hill J, Pilling M, Soop M, et al. Pre-operative oral nutritional supplementation with dietary advice versus dietary advice alone in weight-losing patients with colorectal cancer: single-blind randomized controlled trial. J Cachexia Sarcopenia Muscle. 2017;8:437-46.
67. Elia M, Normand C, Laviano A, Norman K. A systematic review of the cost and cost effectiveness of using standard oral nutritional supplements in community and care home settings. Clin Nutr. 2016;35:125-37.
68. Rahemtulla Z, Baldwin C, Spiro A, McGough C, Norman AR, Frost G, et al. The palatability of milk-based and non-milk-based nutritional supplements in gastrointestinal cancer and the effect of chemotherapy. Clin Nutr. 2005;24:1029-37.
69. van Bokhorst-de van der Schueren MA. Nutritional support strategies for malnourished cancer patients. Eur J Oncol Nurs. 2005;9:74-83.
70. Barber MD, Ross JA, Preston T, Shenkin A, Fearon KC. Fish oil-enriched nutritional supplement attenuates progression of the acute-phase response in weight-losing patients with advanced pancreatic cancer. J Nutr. 1999;129:1120-5.
71. Wang J, Liu M, Liu C, Ye Y, Huang G. Percutaneous endoscopic gastrostomy versus nasogastric tube feeding for patients with head and neck cancer: a systematic review. J Radiat Res. 2014;55:559-67.
72. Cocks H, Ah-See K, Capel M, Taylor P. Palliative and supportive care in head and neck cancer: United kingdom national multidisciplinary guidelines. J Laryngol Otol. 2016;130:198-207.
73. Vaquerizo Alonso C, Grau Carmona T, Juan Díaz M. [Guidelines for specialized nutritional and metabolic support in the critically-ill patient. Update. Consensus of the spanish society of intensive care medicine and coronary units-spanish society of parenteral and enteral nutrition (SEMICYUC-SENPE): hyperglycemia and diabetes mellitus]. Med Intensiva. 2011;35:48-52.
74. Gioulbasanis I, Martin L, Baracos VE, Thézénas S, Koinis F, Senesse P. Nutritional assessment in overweight and obese patients with metastatic cancer: does it make sense? Ann Oncol. 2015;26:217-21.

75. Isenberg SR, Aslakson RA, Smith TJ. Implementing evidence-based palliative care programs and policy for cancer patients: Epidemiologic and policy implications of the 2016 american society of clinical oncology clinical practice guideline update. Epidemiol Rev. 2017;39:123-31.
76. Jordan K, Aapro M, Kaasa S, Ripamonti CI, Scotté F, Strasser F, et al. European society for medical oncology (ESMO) position paper on supportive and palliative care. Ann Oncol. 2018;29:36-43.
77. Chow R, Bruera E, Chiu L, Chow S, Chiu N, Lam H, et al. Enteral and parenteral nutrition in cancer patients: a systematic review and meta-analysis. Ann Palliat Med. 2016;5:30-41.
78. August DA, Huhmann MB. A.S.P.E.N. clinical guidelines: nutrition support therapy during adult anticancer treatment and in hematopoietic cell transplantation. JPEN J Parenter Enteral Nutr. 2009;33:472-500.
79. Moertel CG, Schutt AJ, Reitemeier RJ, Hahn RG. Corticosteroid therapy of preterminal gastrointestinal cancer. Cancer. 1974;33:1607-9.
80. Ruiz Garcia V, López-Briz E, Carbonell Sanchis R, Gonzalvez Perales JL, Bort-Marti S. Megestrol acetate for treatment of anorexia-cachexia syndrome. Cochrane Database Syst Rev. 2013;2013:Cd004310.
81. Hébuterne X, Lemarié E, Michallet M, de Montreuil CB, Schneider SM, Goldwasser F. Prevalence of malnutrition and current use of nutrition support in patients with cancer. JPEN J Parenter Enteral Nutr. 2014;38:196-204.
82. Muscaritoli M, Lucia S, Farcomeni A, Lorusso V, Saracino V, Barone C, et al. Prevalence of malnutrition in patients at first medical oncology visit: the PreMiO study. Oncotarget. 2017;8:79884-96.
83. Planas M, Álvarez-Hernández J, León-Sanz M, Celaya-Pérez S, Araujo K, García de Lorenzo A. Prevalence of hospital malnutrition in cancer patients: a sub-analysis of the PREDyCES® study. Support Care Cancer. 2016;24:429-35.
84. Lin JX, Chen XW, Chen ZH, Huang XY, Yang JJ, Xing YF, et al. A multidisciplinary team approach for nutritional interventions conducted by specialist nurses in patients with advanced colorectal cancer undergoing chemotherapy: A clinical trial. Medicine (Baltimore). 2017;96:e7373.
85. Muscaritoli M, Arends J, Aapro M. From guidelines to clinical practice: a roadmap for oncologists for nutrition therapy for cancer patients. Ther Adv Med Oncol. 2019;11:1758835919880084.

86. Li Z, Chen W, Li H, Zhao B. Nutrition support in hospitalized cancer patients with malnutrition in China. Asia Pac J Clin Nutr. 2018;27:1216-24.
87. Freire PP, Fernandez GJ, de Moraes D, Cury SS, Dal Pai-Silva M, Dos Reis PP, et al. The expression landscape of cachexia-inducing factors in human cancers. J Cachexia Sarcopenia Muscle. 2020;11:947-61.
88. Fiol-Martínez L, Calleja-Fernández A, Pintor de la Maza B, Vidal-Casariego A, Villar-Taibo R, Urioste-Fondo A, et al. Comparison of two nutritional screening tools to detect nutritional risk in hematologic inpatients. Nutrition. 2017;34:97-100.
89. Hendifar AE, Petzel MQB, Zimmers TA, Denlinger CS, Matrisian LM, Picozzi VJ, et al. Pancreas cancer-associated weight loss. Oncologist. 2019;24:691-701.
90. Gilliland TM, Villafane-Ferriol N, Shah KP, Shah RM, Tran Cao HS, Massarweh NN, et al. Nutritional and metabolic derangements in pancreatic cancer and pancreatic resection. Nutrients. 2017;9.
91. Hendifar AE, Chang JI, Huang BZ, Tuli R, Wu BU. Cachexia, and not obesity, prior to pancreatic cancer diagnosis worsens survival and is negated by chemotherapy. J Gastrointest Oncol. 2018;9:17-23.
92. Martin L, Senesse P, Gioulbasanis I, Antoun S, Bozzetti F, Deans C, et al. Diagnostic criteria for the classification of cancer-associated weight loss. J Clin Oncol. 2015;33:90-9.
93. Martin L, Birdsell L, Macdonald N, Reiman T, Clandinin MT, McCargar LJ, et al. Cancer cachexia in the age of obesity: skeletal muscle depletion is a powerful prognostic factor, independent of body mass index. J Clin Oncol. 2013;31:1539-47.
94. ÉB NB, Daly LE, Power DG, Cushen SJ, MacEneaney P, Ryan AM. Computed tomography diagnosed cachexia and sarcopenia in 725 oncology patients: is nutritional screening capturing hidden malnutrition? J Cachexia Sarcopenia Muscle. 2018;9:295-305.
95. Baracos VE, Arribas L. Sarcopenic obesity: hidden muscle wasting and its impact for survival and complications of cancer therapy. Ann Oncol. 2018;29:ii1-ii9.
96. Caan BJ, Meyerhardt JA, Kroenke CH, Alexeeff S, Xiao J, Weltzien E, et al. Explaining the obesity paradox: The association between body composition and colorectal cancer survival (C-SCANS Study). Cancer Epidemiol Biomarkers Prev. 2017;26:1008-15.
97. Pamoukdjian F, Bouillet T, Lévy V, Soussan M, Zelek L, Paillaud E. Prevalence and predictive value of pre-therapeutic sarcopenia in cancer patients: A systematic review. Clin Nutr. 2018;37:1101-13.

98. Bozzetti F. Chemotherapy-induced sarcopenia. Curr treat options Oncol. 2020;21:7.
99. Basile D, Parnofiello A, Vitale MG, Cortiula F, Gerratana L, Fanotto V, et al. The IMPACT study: early loss of skeletal muscle mass in advanced pancreatic cancer patients. J Cachexia Sarcopenia Muscle. 2019;10:368-77.
100. Aleixo GFP, Shachar SS, Nyrop KA, Muss HB, Battaglini CL, Williams GR. Bioelectrical impedance analysis for the assessment of sarcopenia in patients with cancer: A systematic review. Oncologist. 2020;25:170-82.
101. Barber MD, Fearon KC, Tisdale MJ, McMillan DC, Ross JA. Effect of a fish oil-enriched nutritional supplement on metabolic mediators in patients with pancreatic cancer cachexia. Nutr Cancer. 2001;40:118-24.
102. Baldwin C, Spiro A, Ahern R, Emery PW. Oral nutritional interventions in malnourished patients with cancer: a systematic review and meta-analysis. J Natl Cancer Inst. 2012;104:371-85.

8. SUMMARY

Objectives: The aim of this study was to determine and compare the prevalence of malnutrition in pancreatic and colorectal cancer patients attending the outpatient clinic presenting for diagnosis, therapy or follow-up. Additionally, the study investigated the benefit of nutritional intervention, which includes oral nutritional supplements (ONS) and parenteral nutrition (PN) in the pancreatic cancer (PC) group and the colorectal cancer (CRC) group.

Subjects and methods: 108 patients accounted for the whole study group comprising CRC (N = 57) and PC (N = 51) patients. All patients were pre-screened and if this was positive the main screening followed. This was performed by the dietitian with the NRS. Patients with a score <3 were rescreened 8 weeks later and patients with NRS ≥3 were assessed by the dietitian and the oncologists for malnutrition (BMI, weight loss, reduced skeletal muscle mass). 43% of the whole study group received an intervention (ONS or PN). 71% received ONS and/or PN in the PC group compared to just 17% in the CRC. At the end of the study patients' weight, complaints and appetite were compared to first screening. These three variables were used to evaluate the benefit of the intervention.

Results: From the overall 108 patients 71% were malnourished. In the PC group 67% were malnourished compared to 59% in the CRC group. There was no significant difference between the two groups (P=0.593). However, in regard of low BMI, which was one variable defining malnutrition, 22% of PC patients presented with a low BMI in comparison to 7% of CRC patients (P=0.029). Comparing the weight loss (>5%), also one criterion of the definition, there was a significant difference (P<0.001). 71% patients with PC and 17% of patients with CRC received an intervention (P<0.001). When looking at the outcome of benefit 43% of PC patients experienced a benefit after intervention compared to 14% in the CRC patients. Benefit was seen in both groups but there was no significant difference between them (P=0.162).

Conclusions: As expected prevalence of malnutrition is higher in patients with pancreatic cancer compared to patients with colorectal cancer. Both groups benefit from intervention. Due to the high prevalence of malnutrition in the studied groups, all healthcare workers should be aware of the consequences caused by malnutrition as well as the importance of early interventions. Nutritional evaluation should be part of every cancer patient's treatment.

9. CROATIAN SUMMARY

Naslov: Pothranjenost kod pacijenata s rakom debelog crijeva i rakom gušterače: Prevalencija i potrebe liječenja u jednogodišnjem razdoblju od kolovoza 2020 do kolovoza 2021.

Ciljevi: Cilj ove studije bio je utvrditi i usporediti prevalenciju pothranjenosti kod pacijenata s rakom gušterače i rakom debelog crijeva koji posjećuju ambulante radi utvrđivanja dijagnoze, liječenja ili kontrole. Dodatno, studija je istražila koristi od prehrambene intervencije, što uključuje oralne dodatke prehrani (ONS) i parenteralnu prehranu (PN) u skupini s rakom gušterače (PC)i skupini s rakom debelog crijeva (CRC).

Subjekti i metode: Cijela promatrana skupina sastojala se od 108 pacijenata, a sastojala se od pacijenata s CRC (N=57) i PC (N=51). Svi pacijenti bili su podvrgnuti predprobiru, a ako je ovaj bio pozitivan onda i glavnom probiru. Ovo je obavio nutricionist probirom prehrambenog rizika (NRS). Pacijenti s rezultatom 3 ponovo u probrani nakon 8 tjedana, a pacijente s NRS≥3 procijenili su nutricionist i onkolog u vezi pothranjenosti (indeks tjelesne mase (BMI), gubitak težine, smanjena koštano-mišićna masa). 43% cijele promatrane skupine primilo je neku intervenciju (ONS ili PN). 71% primilo je ONS i/ili PN u skupini PC, prema svega 17% u skupini CRC. Na kraju studije težina, pritužbe i apetit pacijenata uspoređeni su s prvim probirom. Pomoću ove tri varijable procijenjena je korist od intervencije.

Rezultati: Od sveukupnih 108 pacijenata 71% bili su pothranjeni. U skupini PC pothranjeno je bilo 67% pacijenata u usporedbi s 59% u skupini CRC. Nije bilo značajne razlike između ove dvije skupine (P=0,593). Međutim, u vezi niskog BMI, koji je bio jedna od varijabli koje određuju pothranjenost, 22% pacijenata s PC pokazalo je nizak BMI u usporedbi sa 7% pacijenata s CRC (P=0,029). U usporedbi gubitka težine, što je još jedan kriterij ovog određenja, postojala je značajna razlika (P<0,001). Intervenciju je primilo 71% pacijenata s PC i 17% pacijenata s CRC (P<0,001). Kada se promatra konačna korist, 43% pacijenata s PC imalo je korist od intervencije, uspoređeno s 14% pacijenata s CRC. Korist je uočena u obje skupine, ali među njima nije bilo značajne razlike (P=0,162).

Zaključci: Kao što se i očekivalo, prevalencija pothranjenosti veća je kod pacijenata s rakom gušterače nego u onih s rakom debelog crijeva. Obje skupine imale su korist od intervencije. Zbog visoke prevalencije pothranjenosti u promatranim skupinama, svi zdravstveni radnici moraju biti svjesni posljedica pothranjenosti, kao i važnosti rane intervencije. Procjena prehrane mora biti dio liječenja svakog onkološkog pacijenta.

10. CURRICULUM VITAE

PERSONAL DATA

Name	Judith Dorsch
Date and place of birth	7/13/1993, Haßfurt
Nationality	German

EDUCATION

10/2016 - today	Medical Studies University of Split – School of medicine
	Medical School REGIOMED, Coburg
09/2014 - 01/2015	Biochemistry Studies, University of Regensburg
09/2008 - 07/2012	Regiomontanus Gymnasium, Haßfurt
	Graduation: A Level
09/2004 - 07/2008	Friedrich-Rückert-Gymnasium, Ebern

WORK EXPERIENCE

10/2021 - 12/2021	Clinical traineeship, General practice, Coburg
8/2015 - 07/2016	Apprenticeship as surgical nurse
	clinical center 'Barmherzige Brüder', Regensburg
10/2013 - 01/2014	Nursing internship,
	clinical center 'Vivantes-Auguste-Viktoria-Klinikum',
	Berlin Tempelhof: gynecology & obstetrics
09/2012 - 08/2013	Federal volunteer service, 'Bavarian red cross', Haßfurt

OTHER ACTIVITIES

05/2015 - 07/2015	occupation at 'FTE automotive', Ebern
04/2014 - 05/2014	occupation at 'NESPOLI', Dinkelsbühl
05/2014 - 07/2014	Language study travel to Spain

ADDITIONAL SKILLS

Languages	German (native), English (C1), Latin (Latinum)
Computer literacy	Microsoft Office
Driver's license	license B (car), license C (truck)

PERSONAL INTERESTS

Hobbies	travelling, endurance sports