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Outpatient preoperative oral nutritional support for undernourished surgical patients: a systematic review

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Conflict of Interest Statement

The authors declare no conflict of interest.

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Abstract

Aims and objectives: To evaluate the effects of preoperative nutritional support using a regular diet for undernourished surgical patients at the outpatient clinic.

Background: Undernutrition (or malnutrition) in surgical patients has severe consequences i.e. more complications, longer hospital stay, and decreased quality of life. While systematic reviews show the effects of oral nutritional supplements (ONS), enteral and parenteral nutrition in surgical patients, the effects of normal foods and regular diets remain unclear.

Design: A systematic review.

Methods: PubMed, CINAHL, Web of Science, PsycInfo, Cochrane Library, and Embase were searched up to July 24th, 2017. Studies on undernourished patients receiving nutritional support using regular or therapeutic diet, performed preoperatively at the outpatient clinic, were considered eligible. Risk of bias was assessed using the Cochrane Risk of Bias tool. Two reviewers independently performed study selection, quality assessment, and data extraction.

Results: Six studies with moderate risk of bias were included. Interventions were preoperatively performed in mainly oncological outpatients by dieticians and aimed to reach nutrient requirements. Interventions included consults for counselling and advice, follow-up meetings and encouragements, and ONS. Nutritional status, nutrient intake, and quality of life improved in supported patients. Improvements were better in counselled patients compared to patients using supplements. Unsupported patients experienced worse outcomes.

Conclusion: Frequent consults with counselling and advice as nutritional support for undernourished patients before surgery result in improvements to nutritional status, intake, and quality of life. This statement is supported by weak evidence due to few studies and inadequate methods.

Relevance to clinical practise: Nutritional support should be provided to all undernourished surgical patients during preoperative course. Nurses are in key position to provide nutritional support during outpatient preoperative evaluations.

Keywords
Nutritional support, Preoperative Care, Undernutrition, Outpatients, Malnutrition, Surgery, Systematic review, Regular diets, Nutrition Therapy

WHAT DOES THIS PAPER CONTRIBUTE TO THE WIDER GLOBAL CLINICAL CUMMUNITY?

- Disease-related undernutrition is a worldwide problem which hampers health, and quality of life even in surgical patients in developed countries.
- This review shows that preoperative nutritional support using a regular or therapeutic diet for undernourished outpatients consists of consults, follow-up and additional provision of supplements and results in an improved nutritional status, nutritional intake and quality of life.
- Besides the lack of studies, the heterogeneity of interventions, settings and patient population, and the variety of definition of outcomes, undernourished surgical patients should receive nutritional support during their preoperative course.

INTRODUCTION

Undernutrition in surgical patients affects their postoperative recovery. Undernutrition is defined as 'a disorder of nutritional status resulting from reduced nutritional intake or impaired metabolism' and is often described as protein energy malnutrition (Cederholm *et al.* 2015). Treatment-related factors, such as required episodes of fasting before surgery, side effects of medication like vomiting or diarrhea, and surgery-induced inflammation and metabolic stress response, may contribute to undernutrition(Norman *et al.* 2008, Weimann *et al.* 2017). Surgical patients with undernutrition face longer hospital stays with subsequent increases in costs (Kruizenga *et al.* 2016, Kruizenga *et al.* 2005, Mosquera *et al.* 2016, Naber 2004, Pichard *et al.* 2004, Rypkema *et al.* 2004), more postoperative complications, i.e., infections, renal and cardiac complications, delayed recovery of gastrointestinal functions, and fistula or wound healing troubles (Huang *et al.* 2013, Lohsiriwat 2014, Schiesser *et al.* 2009). They also have a higher risk of mortality and morbidity (Barker *et al.* 2011, Kanda *et al.* 2011), and experience a decreased quality of life (Larsson *et al.* 1994). This long list of the consequences of undernutrition among surgical patients indicate the urgency for adequate nutritional support.

Timely recognition of undernutrition and initiation of nutritional support may lead to a nutritionally better starting position for surgery. Health status, including nutritional status, is evaluated during an outpatient preoperative evaluation by both anaesthesiologists and nurses before a planned surgery (Haverkort *et al.* 2012, Neelemaat *et al.* 2008, van Klei *et*

al. 2004). In the case of undernutrition identified during these evaluation sessions, nurses should provide nutritional support to decrease nutritional risk and prevent deterioration of nutritional status before hospitalization. Nutritional support, or nutritional therapy, is defined as the provision of nutrition either orally, including regular or therapeutic diet and oral nutritional supplements (ONS), enteral, or parenteral (EN/PN)(Weimann *et al.* 2017). Systematic reviews and meta-analyses on perioperative use of ONS, EN, and PN have been shown to positively impact postoperative recovery (Burden *et al.* 2012, Cerantola *et al.* 2011, Feinberg *et al.* 2017, Zhong *et al.* 2015). Complications were significantly reduced in patients nutritionally supported with EN or PN, and length of hospital stay was effectively shortened in these patients. Nutritional support using a regular or therapeutic diet are not addressed in these reviews but could be started early, e.g. during outpatient preoperative evaluation by nurses. Nurses should have an very important role in nutritional support because undernutrition is both a nursing sensitive outcome (Dubois *et al.* 2017) and a fundamental element of nursing (Huisman-de Waal *et al.* 2018, Jefferies *et al.* 2011, Kitson *et al.* 2010). However, the effects of nutritional support using a regular or therapeutic diet during preoperative courses remain unclear. Therefore, this review aims to evaluate the effects of early outpatient preoperative oral nutritional support using regular or therapeutic diet in undernourished surgical patients.

AIMS

METHDOS

This review was undertaken in accordance with the PRISMA guidelines (Moher *et al.* 2016) and the Cochrane Handbook (Higgins JPT 2011).

Search strategy

A comprehensive systematic search strategy was performed in PubMed, CINAHL, Web of Science, PsycInfo, Cochrane Library and EMBASE from the starting dates of the databases until July the 24th, 2017. The structure of the search strategy followed the well-known PICO scheme whereby only terms related to the population (e.g. preoperative care, outpatients), and intervention (e.g. nutritional support, nutrition therapy, nursing care, dietetics, nutritionists) were defined (Higgins JPT 2011). Outcomes were not defined in the search strategy since the effects of interest are wide and measured differently. The full search strategy is shown in appendix 1. Additionally, reference lists of included articles and related reviews were searched.

Eligibility criteria

Articles were eligible when they were primary research studies, included patients of at least 18 years of age, included at least 30% undernourished patients and were written in Dutch, German, or English. Studies of interest evaluated oral nutritional supportive interventions that used a regular or therapeutic diet, were performed in the outpatient setting, and took place before a planned hospital admission for surgery. Oral nutritional supplements as part of the intervention were accepted if these were part of an intervention or if these were compared with oral nutritional support without supplements. Studies should report on effects of an intervention. There were no limitations regarding methodological quality and publication date. Conference articles were not included.

Study screening process

Each database was searched separately, and search results were transported to Endnote X7.2. After duplicate removal, the selection process was performed in three phases by two reviewers (HN and GHdW) independently. First, they assessed the titles of the records. Secondly, abstracts of relevant titles were assessed. Finally, full-text articles were read. Additionally, reference lists of the selected full text articles and a review regarding preoperative nutritional support (Burden *et al.* 2012) were assessed during the three phases. After each phase, differences in assessment were discussed by the reviewers until a consensus was achieved. A third reviewer (HV) was available in case of discrepancies.

Quality appraisal

The risk of bias in randomised studies was assessed using the risk of bias tool of the Cochrane Collaboration (Higgins JPT 2011). The Newcastle-Ottawa Scale (NOS) for Assessing the Quality of Nonrandomized Studies was used for case-control studies (Wells G 2013). All assessments were independently performed by two reviewers (HN, MtM). A third reviewer was available for discussions and disagreements to reach a consensus (GHdW). The risk of bias was used for interpretation during the synthesis of the data.

Data extraction and synthesis

Data collection was facilitated by a structured data collection form. Two reviewers (HN, RE) undertook the process of data extraction, and any discrepancies were discussed with a third reviewer (GHdW). Data included the first author; year of publication; country; study design; time points of measurements; details of study participants, i.e., number of

participants, age, gender, diagnoses, nutritional status and type of assessment; details of the intervention, i.e., professionals involved, intervention period, study groups, and intervention components; and effectiveness with regard to the outcomes of nutritional intake, weight, nutritional status, quality of life, length of hospital stay, postoperative complications; patients' satisfaction with care; and cost effectiveness.

RESULTS

Description of the articles

The literature search resulted in 11.595 hits of which six articles finally met the inclusion criteria (see article flow in figure 1). The included studies were published between 1987 and 2015. Five articles describe a (pilot) randomised study design, and one describes a case-controlled study (Leistra *et al.* 2015) (see table 1). Of the articles on RCTs, one three-armed study is described in two articles, one on the short term effects (Ravasco *et al.* 2005) and one on the long term effects (Ravasco *et al.* 2012)). Data were collected in all studies at three points in time: the first visit to the outpatient clinic during or soon after diagnosis; the period before surgery, and, after surgery. The third point could be during hospitalisation (Le Cornu *et al.* 2000), at discharge (Flynn & Leightty 1987), or after discharge (Leistra *et al.* 2015, Ravasco *et al.* 2012, Ravasco *et al.* 2005, Silvers *et al.* 2014). Study outcomes include nutritional outcomes (nutritional intake (Le Cornu *et al.* 2000, Ravasco *et al.* 2012, Ravasco *et al.* 2005), nutritional status (Ravasco *et al.* 2012, Ravasco *et al.* 2005, Silvers *et al.* 2014), weight(Leistra *et al.* 2015, Silvers *et al.* 2014)), quality of life (Ravasco *et al.* 2012, Ravasco *et al.* 2005, Silvers *et al.* 2014), length of hospital stay and complications (Flynn & Leightty 1987, Le Cornu *et al.* 2000, Leistra *et al.* 2015), patient satisfaction (Silvers *et al.* 2014), and cost effectiveness (Flynn & Leightty 1987).

Quality

The overall quality of the studies appeared to be moderate (table 3). Of the five randomised studies, one study meets the criteria for a low risk of bias for five of seven items (Flynn & Leightty 1987), the other studies only meet these criteria for two or three of the items. One study did not perform blinding at all, resulting in two items at high risk of bias (Silvers *et al.* 2014). An unclear risk of bias was determined due to lack of clearly described procedures. The case-control study meets eight of the nine NOS -items.

Participants

Sample sizes ranged from 21 to 190 with a total of 327 patients in this review. Patients had been diagnosed with cancer in five of the six studies. The other study included patients with end-stage liver disease (ESLD) that were scheduled for orthotropic liver transplantation. Most of the patients were male (57-73%) and the mean age ranged from 51 to 68 years. To address nutritional status, the patient-generated subjective global assessment (PG-SGA) score, Short Nutritional Assessment Questionnaire (SNAQ), weight change, BMI, laboratory parameters, and mid-arm muscle circumference (MAMC) were used. Undernutrition rates were 100% (two studies), 90%, 55%, and 38% (two studies) (table 1).

Interventions

Five interventions are evaluated in the six studies (table 1). The intervention periods range from two to 18 weeks. All interventions were performed by dieticians and aimed to improve dietary intake (energy and protein) to meet patients' nutrient requirements using a regular or therapeutic diet. The interventions were consults consisting of counselling and advice, follow-up meetings, and oral nutritional supplements if indicated or provided separately.

Consults

Patients had consults with dieticians at an early time in their treatment period. During these consults, patients received counselling and were advised about their nutritional status and nutritional behaviour, i.e., eating patterns. Counselling was based on personal eating patterns and preferences (Leistra *et al.* 2015, Ravasco *et al.* 2012, Ravasco *et al.* 2005, Silvers *et al.* 2014). In two studies, guidelines and theoretical approaches were used. In other studies, patients received advice only.

One study followed the Dutch guidelines for nutritional care specified for patients with cancer (Leistra *et al.* 2015). Another study used the taxonomy of behaviour change techniques of Abraham and Michie (Abraham & Michie 2008) as a base for a tailored, symptom-directed treatment (Silvers *et al.* 2014). In this approach, behaviour change techniques were translated into treatment for undernutrition. During the treatment, information about consequences and causes of undernutrition was provided, barriers to adapt dietary modifications were identified, and nutritionally healthy behaviour was instructed and encouraged.

In the other studies, dieticians gave advice that was tailored to patients' medical conditions, symptoms, and their eating patterns (Flynn & Leightty 1987, Le Cornu *et al.* 2000, Ravasco *et al.* 2012, Ravasco *et al.* 2005). Based on their personal eating patterns and preferences, patients with cancer received a prescription for a therapeutic diet of regular foods. The prescription included the type of food, amount, and frequency of feeding, specified the required caloric and protein level, and included any restrictions (Ravasco *et al.* 2012, Ravasco *et al.* 2005).

Advice as a nutritional intervention was tailored to patients' underlying medical condition and symptoms and aimed to alter usual eating patterns to increase intake and achieve protein requirements (Flynn & Leightty 1987, Le Cornu *et al.* 2000). In one study, specific recommendations were to eat small, frequent meals and snacks and a late evening snack (Le Cornu *et al.* 2000). Another study provided suggestions to cope with eating problems, however, these suggestions and eating problems were not specified (Flynn & Leightty 1987).

Overall, consults aimed to reach nutrient requirements and were tailored to the condition and eating patterns of the individual patient. Counselling was based on theoretical frameworks, such as the taxonomy of behaviour change and guidelines for nutritional care.

Follow-up meetings

During follow-up meetings, dieticians encouraged patients by telephone or during face-to-face contact (Flynn & Leightty 1987, Leistra *et al.* 2015, Ravasco *et al.* 2012, Ravasco *et al.* 2005, Silvers *et al.* 2014). Contact was weekly or independently determined per patient by the dietician. Encouragements included positive feedback on weight, compliance with dietary modifications, the previous week's nutritional goals, trying one change at a time, and compliance with the study protocol. Patients were discouraged from following current healthy eating guidelines in one study however, healthy eating guidelines were not specified. Patients were instructed to record usual food intake once, it remains unclear whether this was an element of the intervention or an outcome measurement (Le Cornu *et al.* 2000).

Supplements

In all studies, oral nutritional supplements (ONS) were provided. Two intervention studies provided ONS systematically to patients in one intervention group separately or along with advice and counselling (Le Cornu *et al.* 2000, Ravasco *et al.* 2012, Ravasco *et al.* 2005). During the first consult, patients received instructions on the supplements, such as number per day and moment of consumption during mealtimes. Other studies provided ONS if needed to reach intake needs (Flynn & Leightty 1987, Leistra *et al.* 2015, Silvers *et al.* 2014), while patients received advice or counselling as well.

Effects on outcomes

The following outcomes were evaluated in the studies: nutritional intake (Le Cornu *et al.* 2000, Ravasco *et al.* 2012, Ravasco *et al.* 2005) and nutritional status in three of the studies (Ravasco *et al.* 2012, Ravasco *et al.* 2005, Silvers *et al.* 2014), length of hospital stay and complications in three (Flynn & Leightty 1987, Le Cornu *et al.* 2000, Leistra *et al.* 2015), quality of life (Ravasco *et al.* 2012, Ravasco *et al.* 2005, Silvers *et al.* 2014) and weight in two of the studies (Leistra *et al.* 2015, Silvers *et al.* 2014), and patient satisfaction (Silvers *et al.* 2014) and cost effectiveness (Flynn & Leightty 1987) in one study (see table 2).

Nutritional outcomes

Nutritional risk, indicating nutritional status, significantly decreased in supported patients while it increased in patients without this support ($p<0.001$) (Silvers *et al.* 2014). Nutritional status deteriorated more frequently in supplemented patients than in counselled patients ($p<0.001$). In addition, this deterioration was even more severe and more present in controlled patients ($p=0.008$) (Ravasco *et al.* 2012, Ravasco *et al.* 2005). At long-term follow-up, controlled patients were found to not even be able to maintain or improve nutritional status (Ravasco *et al.* 2012). However, results for weight were inconclusive. Patients who received counselling gained more weight compared to patients in control or supplemented groups (Ravasco *et al.* 2005). However, in another study concerning patients with head and neck cancer, both groups lost weight over the study period (Leistra *et al.* 2015).

Supported patients improved their nutrient intake. Energy and protein intake was similar for patients provided with supplements and counselling and patients provided with counselling only (Le Cornu *et al.* 2000). Patients who received counselling only ate more regular foods in comparison to patients, who received supplements, for whom supplements contributed 20-25% to their total nutrient intake (Le Cornu *et al.* 2000). Ravasco and colleagues (Ravasco *et al.* 2005) reported significant improvement of energy and protein intake before surgery compared with the study onset for both the counselled and the supplemented groups compared to the control group. Energy intake increased significantly more for the group that received counselling in comparison with the supplemented group while protein intake was lower. In conclusion, nutritional status and nutrient intake improved with nutritional support. Results suggest that supplements are not necessary to achieve the required nutrient intake when counselling is provided.

Quality of life

Patients who were supported reported improvements in their quality of life (QoL). Overall QoL scores were significantly higher in intervention groups compared with the control groups, both at mid-study follow-up and long-term follow-up (Ravasco *et al.* 2012, Ravasco *et al.* 2005, Silvers *et al.* 2014). One study reports that QoL-function scores even worsened in association with a deterioration of nutritional intake and nutritional status in unsupported patients (Ravasco *et al.* 2005).

Length of hospital stay and complications

No significant differences were found in length of hospital stay and complication rates. Head and neck cancer (HNC) patients who received counselling stayed 0.8 days shorter in the hospital. However, this result was not significantly different. The same applies to the results for the liver transplant group (Le Cornu *et al.* 2000, Leistra *et al.* 2015). Despite the three-day shortened hospital stay for supported cancer patients, no statistical test was performed (Flynn & Leightty 1987).

Effects of nutritional support on complications were not convincing. Complications occurred in 27% more patients receiving usual care than in patients on nutritional support, however, no statistical test was performed in this study (Flynn & Leightty 1987). In another study, severe rejection occurred in more control patients than supplemented patients (Δ12%, p=0.377) (Le Cornu *et al.* 2000). For surgical HNC patients, counselled patients had less overall complications (i.e. pneumonia, oral infection, fistula, other) than control patients

(p=0,04). In this group, major postoperative complications had a low prevalence (12% versus 18%) and were not significantly different for both groups (p=0.49) (Leistra *et al.* 2015). In conclusion, complications rates tended to be lower in nutritional supported patients, but, not statistically.

Other effects

Patients' satisfaction and cost effectiveness were almost not evaluated. Thematic analyses of experiences with nutritional counselling resulted in reassurance, improved knowledge, and understanding of the behaviour-to-health-outcome link. Furthermore, patients responded positively to the dietician and stated that the counselling was generally helpful (Silvers *et al.* 2014). Treatment cost decreased with $766 per patient per day shorter hospital stay (Flynn & Leightty 1987). However, this was calculated in a small sample, with no statistical analysis, and was studied decades ago. In conclusion, patients seems to demonstrate some positive experiences with nutritional counselling and no valid cost analysis was performed.

DISCUSSION

Summary of evidence

This systematic review evaluates the effects of preoperative oral nutritional interventions using regular or therapeutic diet in undernourished surgical patients. A comprehensive search through six databases resulted in five intervention studies reported in six articles of moderate quality. Interventions were performed in patients mostly facing cancer-induced surgery. Intervention elements include consults with counselling and advice, follow-up and encouragements, and supplements. In general, patients who received any kind of support had better outcomes than control patients. The interventions resulted in an improved or maintained nutritional status, an increased intake, and a better quality of life. Counselling and advice during consults showed equal or better outcomes than ONS. No clear effects were found with regard to length of hospital stay, complications, patient satisfaction, and costs.

Comparison with other studies

This review focuses on improving nutritional status at outpatient clinics in the period before hospitalisation. Due to differences in the period between diagnosis and hospital admission, times before surgery vary, and can be both short and prolonged in clinical practise. Elective surgical patients may benefit from very early interventions in primary care settings (Fernández-Barrés *et al.* 2017) . Additionally, preoperative nutritional support may also be provided during hospitalisation as is shown in a study in patients with hip fractures (Gunnarsson *et al.* 2009). Optimal setting of preoperative nutritional support should be further investigated.

In the study on patients with hip fractures (Gunnarsson *et al.* 2009), nutritional support included oral nutritional supplements as well. Other strategies on nutritional support using a regular diet during hospitalisation may include adequate fasting regimens (Khoyratty *et al.* 2010, Ljungqvist & Soreide 2003) during surgical procedures and optimal meal conditions after surgery. Strategies for optimal meal conditions include changes to the organisation of nutritional care and feeding environment, modifications to meals, supplementation of meals, and home-delivered meals (Kimber *et al.* 2015). These strategies also need development and adequate evaluation of their effects to achieve better nutritional support using a regular diet.

We focused on nutritional support to improve nutritional status before surgery. Prehabilitation, an approach that focuses on nutritional and physical improvements before surgery (Weimann *et al.* 2017, West *et al.* 2017), was not fully addressed in our systematic review. Prehabilitation of surgical patients however could be a solution to optimise physical status before surgery and diminish negative postoperative outcomes. Furthermore, we did not address undernutrition-related problems. Undernutrition-related problems are, for instance, taste and smell alterations and poor oral health(Hong *et al.* 2009, Van Lancker *et al.* 2012). Effective approaches to these problems may also benefit undernourished patients planned for surgery. A recent review showed the need for an effective approach to support patients with taste and smell alterations (Thorne *et al.* 2015). Oral hygiene to improve poor oral health may prevent oral-health-related pneumonia (Sjogren *et al.* 2008). However, oral health is not yet investigated in relation to undernutrition in surgical patients. Further studies should evaluate preoperative physical prehabilitation and these undernutrition-related problems to improve health statuses among surgical patients.

Limitations

A few considerations should be made with regard to the results. First, only five studies in six articles evaluated our predefined outcomes. Due to this small number of studies, the heterogeneity of patients, the diversity of interventions and measurements, and very few (maximal three) studies per outcome, our conclusions should be considered with caution.

Second, thanks to our comprehensive search strategy, initially, many hits were found. Six databases were searched after evaluating the search terms with a clinical expert (GH-dW) and a clinical librarian (OYC). The fact that our searches resulted in only six studies is in accordance with other reviews that did not identify studies on nutritional support in the outpatient setting before surgery (Richards *et al.* 2017) using a regular diet (Burden *et al.* 2012).

Third, we could not perform a meta-analysis because outcomes are differently defined thorough the studies included in this review. For example, nutritional status is defined as weight, weight change, intake or intake change, or PG-SGA scores, and complications are defined as intensity of rejection, overall complications, or major complications. For future research, a consensus is needed about a valid way to measure outcomes of nutritional support to enable analysis across studies.

Areas for further research

More and well-designed research is needed on nutritional support using a regular or therapeutic diet, since only a few articles are available. The use of supplements should be reconsidered in this research to define the effects of supplements versus consults. Additionally, research is needed in populations with types of surgery other than cancer-induced surgery, such as orthopaedic and cardiovascular surgery. Effects have not yet been evaluated in these patients, despite the prevalence of undernutrition in these populations (Leistra *et al.* 2009).

CONCLUSION

In conclusion, we found weak evidence that nutritional support using a regular or therapeutic diet reduces undernutrition and improves nutritional intake and quality of life in surgical patients. Since nutritional support without supplements in this review indicate the

same or better outcomes than nutritional support with supplements, we should reconsider the use of oral nutritional supplements. Nutritional support included consults with counselling and advice, follow-up meetings and encouragements, and additional use of oral nutritional supplements. No firm conclusion can be drawn for the effects on complications, length of hospital stay, patient satisfaction, and costs due to few studies and inadequate methods. Most research was performed on patients diagnosed with cancer; therefore, it is necessary to evaluate nutritional support in other surgical patient populations. Consensus is needed for comparable measurements of outcomes. Until these limitations are addressed, undernourished surgical patients should receive nutritional support during their preoperative course.

RELEVANCE TO CLINICAL PRACTISE

Nutritional support using a regular or therapeutic diet should start as early as possible. The small number of studies in this review show promising results for oral nutritional support using a regular or therapeutic diet as this subsequently may result in improved intake, nutritional status, and quality of life. Improvements were better in patients receiving consults than in patients receiving supplements. Despite the fact that the evidence in this review has a moderate quality, we argue that there is no reason to withhold undernourished patients' nutritional support preoperatively.

Undernutrition in surgical patients should be treated by the involved disciplines in a pathway (Awad & Lobo 2011). The interventions found in our review were performed by dieticians, however, we know that the patients are also seen by nurses, anaesthesiologists and surgeons (Haverkort *et al.* 2012, Karlsson *et al.* 2009, Neelemaat *et al.* 2008, van Klei *et al.* 2004, West *et al.* 2017). Surgeons determine the treatment plan and are therefore in key position to coordinate such a treatment pathway. They can underline that nutritional support is of paramount importance for their undernourished patient. Nurses, are in the key position during outpatient pre-operative evaluations (van Klei *et al.* 2004) to provide nutritional support besides consulting dieticians. Additionally, nutrition is a fundament element of basic nursing which is essential for patient outcomes (Dubois *et al.* 2017, Huisman-de Waal *et al.* 2018, Jefferies *et al.* 2011, Kitson *et al.* 2010). Activities in nutritional nursing care include nutritional screening and nutrition care planning (Jefferies *et al.* 2011). Screening has already improved in hospitals, however, interventions for undernourished patients remains less provided. Nurses can take their responsibility and have nutritional consults with their patients. A multidisciplinary path for undernourished surgical patients is not reported in the literature yet. The involved health care professionals should therefore collaborate to develop and evaluate such a path for nutritional prehabilitation.

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Tables

Table 1 – Summary of study characteristics and interventions regarding oral nutritional support using a regular diet

Author (year), Country	Design	Participants	Nutritional assessment	Intervention period (mean)	Study group	Intervention components
Flynn et al. (1987) United States of America	RCT	*Patients* (n=36) with squamous cancer of the upper aerodigestive tract scheduled for operative resection *Age* (mean): 64 years *Undernutrition*: 100%	Weight change, antropometric features and relevant laboratory parameters	10-21 days between outpatient visit and surgery	IG (n=19)	*Consults:* Nutritional counselling and suggestions to cope with eating problems; specific recommendations: to meet their individual nutrient requirements or a nutritional supplement to fulfil their intake needs *Follow up meetings*: contact determined independently by the dietician to determine nutritional status and encourage compliance to the protocol *Supplements*: if indicated to fulfil intake need
					CG (n=17)	Nutritional counselling and suggestions to cope with eating problems
Le Cornu et al., 2000, United Kingdom	RCT	*Patients* (N=81) with ESLD scheduled for orthotopic liver transplantation Age (median): 51 years *Male* (%): 73% *Undernutrition*: 100%	mid-arm muscle circumference (MAMC) <25 percentile	IG: median 77 (1–395) days CG: median 45 days (1-424) between initial assessment and surgery	IG (n=42, S: n=39)	*Consults:* Advice to adapt usual intake to increase intake and to achieve individual protein requirements, tailored to their underlying medical condition and symptoms; to eat small, frequent meals and snacks, late evening snack; discouraged from following guidelines of healthy eating, food diary 5 days before outpatient visit *Supplements*: 500ml supplements each day until surgery *Follow up meetings:* no contact in between
					CG (n=40, S: n=32)	*Consults:* as described above
Ravasco et al., 2005, Portugal	RCT	*Patients* (N=111) with colorectal cancer *Age* (mean):64 years *Male* (%): 59% *Undernutrition*: 38%	BMI and PG-SGA	6 wks	IG1 (n=37)	*Consults*: weekly individualized dietary counselling on the prescription of therapeutic diets using regular foods
					IG2 (n=37)	*Supplements*: consumption of 400ml high-protein supplements each day in addition to regular foods
					CG (n=37)	instruction to maintain and consumption ad libitum intake
Ravasco et al., 2012, Portugal	RCT, follow-up median 6.5 (range 4.9–8.1) years Ravasco et al., 2005	*Patients* (N=89) with colorectal cancer *Age* (mean):64 years *Male* (%): 54% *Undernutrition*: 38%	BMI and PG-SGA	6 wks	IG1 (n=34)	*Follow-up after consults*: weekly individualized dietary counselling on the prescription of therapeutic diets using regular foods before and during the hospital admission
					IG2 (n=29)	*Follow-up after supplements*: consumption of high-protein supplements each day in addition to their regular foods before and during the hospital admission
					CG (n=26)	*Follow-up after* instruction to maintain and consumption ad libitum intake
Silvers et al. (2014) Australia	Pilot RCT	*Patients* (N=21) with esophageal or stomach cancer *Age* (mean): 68 years *Male* (%): 57% *Undernutrition*: 90%	PG-SGA	18 wks with start immediately after diagnoses	IG (n=10)	*Consults*: Weekly 15-30 min telephone calls or face-to-face interviews with tailored, symptom-directed treatment approach based on the taxonomy of behaviour change techniques of Abraham and Michie *Supplements*: oral nutritional supplement samples if indicated
					CG (n=11)	*Consults:* assessment and intervention 6-10 weeks after diagnoses, if nursing or medical staff made a referral; intervention had a similar tailored, symptom-directed approach, and varied for amount and timing
Leistra et al. (2015), The Netherlands	Case- control study	*Patients* (n=190) with head and neck cancer planned for surgery (n=78), radio- (n=38) or chemoradiotherapy (n=84) *Age*(mean): 61years *Male* (%): 71% *Undernutrition*: 55%	SNAQ and BMI	Pretreatment period: 4 wks, start within 1 wk after first outpatient visit	IG (n=95, S: n=34)	*Consults*: Dietary assessment in the pretreatment period including current intake of energy, nutrients and alcohol, evaluation of oral symptoms using the FAACT A/CS12; counselling according to most recent Dutch guidelines; aimed to improve dietary patterns with normal food intake, protein and/or energy enrichment, modified texture for dysphagia patients, alleviation of oral pain or chewing problems *Follow-up meetings:* weekly by telephone or face to face during outpatients visit *Supplements:* oral nutritional supplements (ONS) or tube feeding were provided if patients did not meet their goals with normal food (n=11 of the surgical patients[#)]
					CG (n=95, S: n=34)	*Consults*: during pretreatment period only on referral by a physician *Supplements:* ONS (standard of 4 packages a day) prescribed by a nurse in case of SNAQ score ≥3 or severe swallowing problems

RCT: Randomized Controlled Trial; IG: intervention group; CG: control group; S: patients who received surgery; ESLD: End-stage Liver Disease; BMI: Body Mass Index; PG-SGA: patient-generated Subjective global assessment; wks: weeks; SNAQ: Short Nutritional Assessment

Questionnaire; FAACT A/CS12: Functional Assessment of Anorexia/Cachexia Therapy; #: this information is received out of personal communication with the author of this study, E. Leistra, PhD, RD.

Table 2 – Outcomes, measurements, and effects of oral nutritional support using a regelar diet

Author, year	Points of measurements	Outcomes	Measurement	Results (number (percentage), mean (SD – range) or main findings))	
Flynn et al., 1987	0) first outpatient office visit (10-21 days before surgery) 1) hospital admission 2) hospital discharge	Complications	*n.s.*	IG CG	n=6 (32%) n=10 (59%)
		Length of hospital stay	Days	IG CG	18 days 21 days
		Cost effectiveness	$766 per patient per day	For the group (n=19) $43.662	
Le Cornu et al., 2000	0) outpatient setting 1) at outpatient clinic before transplantation 2) 9 days after transplantation	Nutritional intake (t=1)	Energy (kcal per day)	IG CG	2419 (157; 1093-4944) 2234 (194; 863-4669) (p>0.05)
			Protein (g per day mean)	IG CG	79.8 (5.99;35.2-183.1) 86.5 (6.22; 11.61-132.5) (p>0.05)
		Length of hospital stay	*n.s.*	no significant differences between groups	
		Complications	Mild acute rejection	IG CG	14 (36%) 10 (31%) (P=0.623)
			Severe rejection	IG CG	15 (38%) 16 (50%) (P=0.377)
Ravasco et al., 2005	0) every week during the 6 weeks of RT (day 7, 14, 21, 28, 35, 42) 1) after surgery and CT 2) every 3 month until 2y	Nutritional intake (onset - day 42)	Energy change (kcal per day)	IG1 IG2 CG	+555 (398-758) (P=0.002) +296 (286-401) (P=0.04) -285 (201-398) (P=0.01)
			Protein change (g per day)	IG1 IG2 CG	+27 (20-35) (P=0.007) +30 (20-40) (P=0.001) -10 (7-15) (P=0.01)
		Nutritional status	Nutritional deterioration at day 42/3 month	-higher in G2 and in G3 relative to G1; (P<0.001) -more severe and incident in G3 relative to G1 and G2 (P=0.008)	
			PG-SGA	IG1 IG2 CG	9 of 15 malnourished patients improved their nutritional status no patients improved their nutritional status no patients improved their nutritional status
		Quality of Life	EORTC QLQ-C30	IG1	all QoL function scores improved; (P=0.002) pain worsened in association with -anorexia, P<0.05 -nausea or vomiting, P<0.04 -diarrhea; P<0.03
				IG2	physical, role, and emotional scores improved (P<0.05), and these were proportional to the increase in protein intake (P=0.04)
				CG	all QoL function scores worsened in association with deterioration of -nutritional intake (P<0.0001) -nutritional status (P<0.002)
Ravasco et al., 2012	3)every 6 mo until 5y 4)every year once Mean follow up time 6.5y	Nutritional intake (at long term follow up)	Energy intake (median) (kcal per day)	IG1 IG2 CG	2482 (95%CI: 2210-2685) 1335 (95%CI: 1150-1569) 1332 (95%CI: 1098-1426)
			Protein intake (median) (g per day)	IG1 IG2 CG	74 (95%CI: 69-77) 42 (95%CI: 39-44) 40 (95%CI: 38-42.5)
		Nutritional status (at long term follow up)	Nutritional deterioration (PG-SGA)		CG and IG2>IG1 (p<0.001)
				IG1 IG2 CG	n=3 (9%) n=27 (93%) n=26 (100%)
		Quality of life (at long term follow up)	EORTC QLQ-C30		CG and IG2 had lower QoL scores than IG1 (p<0.002) IG2 worsened all functional scales significantly
Silvers et al., 2014	0) Baseline assessment/near time of diagnoses 1) midstudy follow-up/preoperatively 2) final follow-up after 26 wks	Weight (kg)		T=0: 80 (18) (CG) versus 73 (20) (IG) T=1: 71 (20) (CG) versus 78 (18) (IG) T=2: 61 (20) (CG) versus 81 (14) (IG) Preoperatively: similar between groups 26-weeks follow-up: on average 6 kg greater for IG vs CG (p<0.001)	
		Nutritional status	PG-SGA	T=1 IG: six points lower nutritional risk than the CG (p=0.008) T=2 IG: 10 points lower than CG (p<0.001)	
		Health-related QoL	EORTC QLQ-C30	T=1 IG>CG (p<0.001) T=2 IG>CG (p<0.01)	
			EQ-5D	T=1 IG>CG (p=0.003) T=2 IG>CG (p=0.001)	
			EQ-5D VAS	T=1 IG>CG (p=0.003) T=2 IG>CG (p<0.001)	
Leistra et al., 2015	0) At first outpatient visit 1) start of primary treatment	Weight change[&]	between T=0 and T=1	IG CG	-0.7% (5,5) -0.2% (5,5) (p=0.53)
			Between T=0 and T=2	IG CG	-6.0%(6.9) -5.4 (5.7) (p=0.83)

	2) end of primary treatment	Complications	Overall complications*	IC CG	15 (44%) 21 (70%) (p=0.04)
			Major complications#	IC CG	4 (12%) 6 (18%) (p=0.49)
		Length of hospital stay	Mean (SD)	IC CG	18.5 (11.2) 19.3 (11.2) (p=0.79)

SD: standard deviation; kcal: kilocalories; g: grams; PG-SGA: Patient-Generated- Subjective global assessment; QoL: Quality of Life; vs.: versus; EORTC QLQ-C30: European Organisation for Research and Treatment of Cancer Quality of Life Questionnaire version 3.0 ; EQ-5D: European Quality of Life Instrument; EQ-5D VAS: European Quality of Life Instrument visual analogue scale; n.s.: not specified in the article; IG: intervention group; CG: control group; &: for this outcome, 112 patients treated with (chemo)radiotherapy were included as well; *:pneumonia, oral infection, fistula, other; #: reoperation, readmission <4wk, ICU admission, in hospital mortality;

Table 3 – Quality assessment of the included studies

Cochrane Risk of Bias tool	Random sequence generation (selection bias)	Allocation concealment (selection bias)	Blinding of participants and personnel (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data (attrition bias)	Selective reporting (reporting bias)	Other bias	Total items at low risk
Flynn et al., 1987	-	-	-	-	-	/	/	5/7
Le Cornu et al., 2000	-	-	+	/	-	/	/	3/7
Ravasco et al., 2005	-	-	/	/	-	/	/	3/7
Ravasco et al., 2012	-	-	+	/	-	/	/	3/7
Silvers et al., 2014	-	-	+	+	/	/	/	2/7

Newcastle-Ottawa Scale (NOS)	Selection	Comparability	Exposure	Total stars
Leistra et al., 2015	✷✷✷✷	✷✷	✷✷✷	8/9

-=low risk of bias; += high risk of bias; /=unclear risk of bias; ✷=each star indicate a high quality choices for the items per domain of the Newcastle-Ottawa Scale

1. Figure

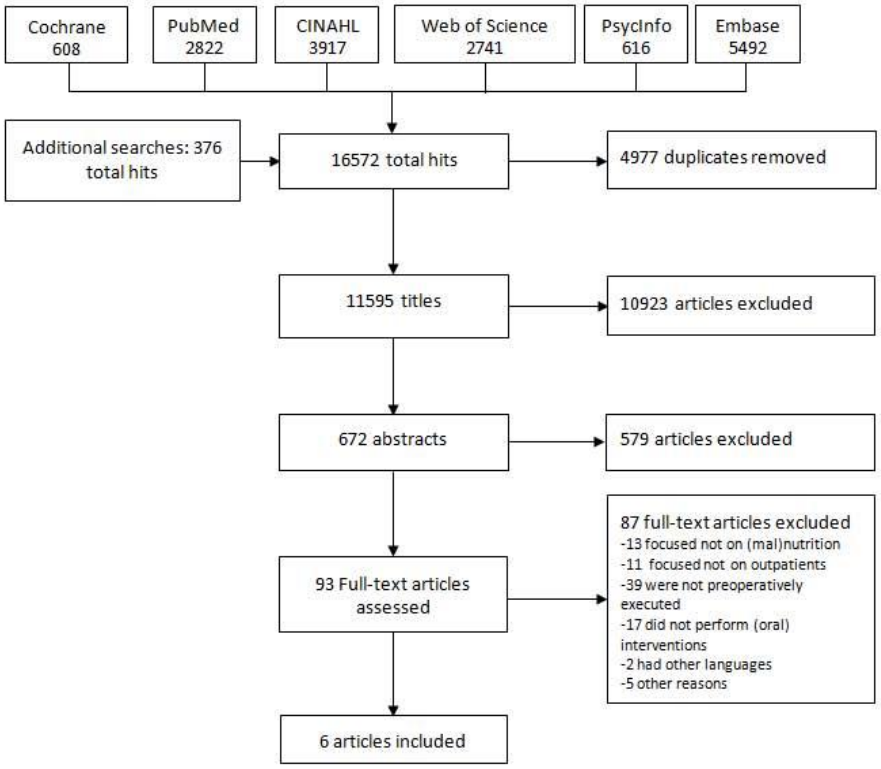

Figure 1 – Artide flow during the selection process of the studies