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Oral nutritional supplement adherence and barriers among adult oncology patients: A cross-sectional study

Suukaudse täisväärtusliku ravijoogi kasutamissoovituse järgimine ja takistused täiskasvanud onkoloogiliste patsientide seas: ristlõike uuring

Master's thesis

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Abstract

Title: Oral nutritional supplement adherence and barriers among adult oncology patients: A cross-sectional study

Aim: The aim of this study was to assess adherence to prescribed oral nutritional supplements and to identify barriers influencing their use among adult oncology patients.

Background: Oral nutritional supplements (ONS) are commonly prescribed to oncology patients to support nutritional status and improve clinical outcomes. However, adherence to ONS is often suboptimal, limiting their effectiveness. Understanding the factors influencing adherence, including patient-reported barriers and symptoms, is essential for optimising nutritional care in this population.

Methods: A cross-sectional observational study was conducted among adult oncology inpatients at the Haematology-Oncology Clinic of Tartu University Hospital. Data were collected using a self-developed questionnaire assessing adherence to ONS, perceived barriers, and patient-reported symptoms. Adherence was defined as consumption of $\geq 75\%$ of the prescribed ONS. Descriptive statistics were used to summarise the data.

Results: A total of 22 patients were included in the study. The mean age was 65.9 ± 12.9 years. Ten patients (45.5%) were female and twelve (54.5%) were male. The mean body mass index (BMI) was 24.0 ± 5.4 kg/m², and 23% of patients were underweight (BMI < 18.5 kg/m²). All of the participants were identified as malnourished or at high risk of malnutrition. Overall, 59.1% of patients were classified as adherent. The mean adherence was 69.5% (SD 33.9%), while the median adherence was 82.5% (IQR 50–100%), indicating substantial variability. The most frequently reported barrier was unpleasant taste (50.0%), followed by lack of access and nausea or vomiting after use (both 27.3%). Barriers were more commonly reported among non-adherent patients, particularly unpleasant taste (77.8% vs. 30.8%), swallowing difficulties (44.4% vs. 0.0%), and lack of appetite (44.4% vs. 7.7%). Patient-reported symptoms were broadly similar between groups, although dysphagia was more frequent among non-adherent patients (66.7% vs. 30.8%). A higher proportion of adherent patients reported receiving information about ONS compared to non-adherent patients (61.5% vs. 33.3%).

Conclusion: Adherence to ONS among adult oncology patients was moderate and characterised by considerable variability. Non-adherence was primarily associated with perceived unpleasant taste of ONS, swallowing difficulties, lack of appetite and not receiving information. These findings highlight the importance of addressing sensory characteristics of ONS and improving patient education to enhance adherence.

Keywords: oral nutritional supplements; adherence; oncology; barriers; malnutrition; patient-reported outcomes

(CERCS B470)

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1. Introduction

Malnutrition is a common and clinically significant problem among patients with cancer. A considerable proportion of oncology patients experience malnutrition or are at high risk of malnutrition during the course of the disease, with reported prevalence varying widely depending on patient population, cancer type, and assessment methods [1-4]. Malnutrition in cancer is multifactorial and may result from tumour-related metabolic changes, treatment-related side effects, and reduced dietary intake. Common contributing factors include nausea, vomiting, dysphagia, pain, and loss of appetite, all of which can impair food intake [1,3,5,6]. Malnutrition has significant adverse consequences including increased mortality and treatment-related complications, longer hospital stays, and reduced quality of life. Therefore, early identification and effective management of malnutrition are essential components of oncology care [7-9].

Oral nutritional supplements (ONS) are an important component of nutritional management for patients who are unable to meet their nutritional needs through regular food intake alone but retain gastrointestinal function. ONS are energy-, protein-, and nutrient-dense products designed to supplement dietary intake and are commonly available as ready-to-drink liquids. They are widely used in oncology care and have been shown to improve nutritional intake, support weight maintenance, and enhance clinical outcomes. ONS are considered a relatively simple and cost-effective intervention in the management of disease-related malnutrition. [10-12]

Despite the benefits of ONS, their effectiveness is highly dependent on patient adherence. Adherence to ONS can be defined as the extent to which patients consume the supplements according to prescribed or recommended intake. Maintaining adequate adherence is essential to achieve the intended nutritional intake and clinical benefits. However, adherence to ONS remains a significant challenge in clinical practice. Previous studies have reported considerable variability in adherence rates among cancer patients, with some studies demonstrating very low adherence levels. This variability may reflect differences in patient populations, disease characteristics, treatment phases, and methods used to assess adherence. [13,14]

A wide range of factors may influence adherence to ONS, including treatment-related and product-related barriers. Gastrointestinal symptoms and treatment side effects are the most consistently reported barriers. Sensory characteristics have also been frequently identified as important determinants of ONS acceptability, with unpleasant taste and texture leading to reduced intake. Beyond treatment- and product-related factors, healthcare-related and system-level factors may also play a role. These include the provision of adequate information and support from healthcare professionals, as well as the availability and cost of ONS. Patient education has been shown to influence adherence, as understanding the purpose and benefits of ONS may improve motivation and engagement with nutritional interventions. [14-16]

Although several studies have investigated adherence to ONS and associated barriers, there is currently no published data on ONS adherence among oncology patients in Estonia. The present study aims to provide insights based on data collected at Tartu University Hospital.

2. Scientific background to the research

2.1 Disease related malnutrition

Disease-related malnutrition (DRM) refers to a distinct form of malnutrition caused by underlying disease and is defined as a state where inadequate intake or uptake of nutrients leads to altered body composition, specifically decreased fat-free mass and body cell mass. This condition results in diminished physical and mental function and negatively impacts clinical outcomes. DRM is divided into two primary categories based on the presence or absence of systemic inflammation. DRM with inflammation is a catabolic condition, including chronic forms like cachexia and acute forms related to major injury or surgery. Conversely, DRM without inflammation (non-cachectic DRM) occurs when the deficit is caused by other disease-triggered mechanisms such as physical obstructions or neurological disorders. Diagnosis requires that patients are first identified as being at nutritional risk before meeting specific criteria for reduced body mass index (BMI) or significant weight loss. [10]

2.2 Disease related malnutrition in cancer patients

The causes of malnutrition in cancer patients are multifactorial and include tumour-related, treatment-related, and patient-related factors. Tumour characteristics, including type and anatomical location, are one of the major contributors [1,5]. Advanced cancer stage also significantly increases malnutrition risk, with stage IV cancer patients demonstrating significantly higher odds of malnutrition compared to those with earlier stages [6]. Cancer treatments, particularly chemotherapy and radiotherapy, further contribute to nutritional decline through side effects that impair food intake [3]. Gastrointestinal symptoms such as nausea, vomiting, diarrhoea, and loss of appetite are also common and play a significant role in the development of malnutrition [5,6].

The clinical consequences of malnutrition are significant and affect multiple aspects of patient outcomes. Malnutrition is associated with increased all-cause mortality and a higher likelihood of chemotherapy-related complications, including decreased response to chemotherapy and aggravated chemotherapy-induced toxicity. It is also linked to impaired immune function, longer hospital stays, increased healthcare costs, and impaired quality of

life. [7-9]. A 2025 meta-analysis and systematic review of over 30,000 cancer patients found that malnutrition was associated with approximately a twofold higher all-cause mortality, with graded risk for moderate and severe malnutrition, as well as a significantly elevated risk of postoperative complications [1]. Similarly, a large prospective cohort study reported three-year overall survival of 69.8% in well-nourished patients and only 37.2% in malnourished patients, with adjusted mortality hazard ratios of 1.79 and 2.74 for at-risk and malnourished groups respectively [17]. Kufeldt et al. found that malnutrition was a significant independent risk factor for both prolonged hospital stay and complication occurrence [9].

2.3 Prevalence of malnutrition in cancer patients

Malnutrition is a common and clinically significant problem among patients with cancer. Current diagnostic approaches, such as the Global Leadership Initiative on Malnutrition (GLIM) criteria, define malnutrition based on a combination of phenotypic factors, including weight loss, low body mass index, reduced muscle mass, and etiologic factors, including reduced food intake or disease-related inflammation [18]. The reported prevalence of clinical malnutrition varies widely depending on the patient population and assessment methods used. In some studies, malnutrition has been defined using criteria such as BMI < 18.5 kg/m² or serum albumin levels < 3.5 g/dL. However, these definitions differ from current consensus diagnostic criteria. Reported prevalence rates range from approximately 12% to 41% among adult cancer patients undergoing active treatment. A recent meta-analysis of 65 studies reported 41% overall malnutrition prevalence [1]. A large Chinese study of 36,635 hospitalized cancer patients found that 12.0% with BMI < 18.5 kg/m² and 20.6% with serum albumin < 3.5 g/dL had clinical malnutrition [2]. In European cohorts, studies involving 1,903 and 2,197 patients reported malnutrition prevalence rates of approximately 39%, when assessed using combined BMI and weight loss criteria [3,4].

2.4 Nutritional Management in Oncology

Nutritional management in oncology is recognised as an essential component of cancer care, integrated across the full treatment continuum. The European Society for Clinical Nutrition and Metabolism (ESPEN) guidelines, the most widely adopted international framework, recommends systematic nutritional screening for all patients with cancer at diagnosis and

throughout treatment, regardless of body weight or BMI. In all patients, except those in end-of-life care, energy and protein requirements should be met through a stepwise escalation: dietary counselling first, then oral nutritional supplements, then enteral nutrition, and finally parenteral nutrition if needed [19,20].

2.5 Oral Nutritional Supplements

Oral nutritional supplements (ONS) are a form of oral nutrition therapy classified as foods for special medical purposes (FSMPs). They are energy-, protein-, and nutrient-dense products designed to support dietary intake in individuals who are unable to meet their nutritional requirements through regular food alone but retain gastrointestinal function. ONS are available in various forms, including ready-to-drink liquids, creams, and powders that can be prepared as beverages or added to foods. Liquid ONSs are often referred to as “sip feeds”. ONS are a relatively simple and well-accepted intervention and have been shown to improve nutritional status, health outcomes, and quality of life, while also offering economic benefits in the management of disease-related malnutrition. [10,11,12]

Oral feeding is the preferred first-line approach for meeting patients’ nutritional needs. The use of oral nutritional supplements should be considered when usual oral intake is insufficient to meet macro- or micronutrient requirements. The use of ONS depends on the patient’s ability to safely swallow and the absence of oesophageal or gastric obstruction. ONS may be used to meet total nutritional requirements or, more commonly, to supplement the diet when patients are unable or unwilling to consume sufficient amounts of regular food. They are widely used to improve nutritional intake in older adults and in patients with various health conditions that affect eating. [12]

Oral nutritional supplements can be broadly classified into two types: nutritionally complete and nutritionally incomplete.

Nutritionally complete oral nutritional supplements provide a balanced supply of macronutrients and micronutrients in line with dietary recommendations. They are suitable for use as the sole source of nutrition over prolonged periods, but are more often used to

supplement inadequate dietary intake. In certain situations, they may constitute the patient's only source of energy, protein and nutrients. [10]

Nutritionally incomplete oral nutritional supplements cannot be used as the sole source of nutrition, as they are formulated to provide specific nutrients in higher amounts while other nutrients may be insufficient or lacking. Disease-specific ONS are designed to meet the particular nutritional and metabolic needs associated with certain conditions, and may be either nutritionally complete or incomplete. [10]

A wide variety of ONS are available, allowing selection to be tailored to individual patient needs where reimbursement permits. ONS differ in composition and form and may be high in protein or energy, available as clear or milk-style products, and suitable for consumption either cold or warm, including savoury or coffee-flavoured options. They are also available in different consistencies, ranging from liquid to thickened formulations, and may include products similar to desserts or sweet foods. In hospital settings, offering a variety of products and flavours is beneficial to support patient preference and adherence. In home settings, patients may further adapt ONS by incorporating them into shakes, ice creams, soups, or desserts. [12]

2.6 Adherence to ONS

Adherence to ONS can be defined as the extent to which individuals consume oral nutritional supplements according to a recommendation or prescription. Maintaining high adherence is essential for achieving optimal treatment outcomes and is linked to increased nutritional intake, improved nutritional status, and a lower risk of hospitalisation. However, adherence to therapy remains a significant challenge, particularly in the context of ONS use. [13]

Reported adherence rates to ONS among cancer patients vary widely. A systematic review by Wang et al. (2022), including 18 studies and 1,267 cancer patients, reported adherence rates ranging from 6.0% to 96.9%. That wide range reflects differences in cancer type, treatment phase, setting, and how adherence was measured [14]. Lower adherence rates have been observed in patients with gastrointestinal (GI) cancers. A systematic review focusing on this

population reported postoperative adherence rates ranging from 26.2% to 71.1%, while patients receiving chemotherapy demonstrated higher adherence, with an average of approximately 90.2% [21]. Similarly, Lidoriki et al. (2020) found that only 35.9% of patients undergoing upper GI cancer surgery consumed all prescribed supplements one month after discharge [22]. This pattern is further supported by Qin et al. (2021), who reported a median adherence of 50% among 111 GI cancer patients prescribed ONS [15].

2.7 Barriers to ONS Use

2.7.1 Treatment-related barriers

Gastrointestinal symptoms and treatment-related side effects are the most consistently reported barriers across the literature. A 2022 systematic review covering 18 studies identified gastrointestinal intolerance and taste aversion as the most common barriers [14]. A 2025 mixed-methods systematic review of 14 studies in gastrointestinal neoplasm patients similarly ranked adverse reactions as the top barrier [23]. The most commonly described symptoms are bloating, early satiety, diarrhoea, and nausea. Lidoriki et al. (2020) found that bloating (58% of non-adherent vs. 17.9% of adherent patients) and early satiety (52% vs. 25%) were all significantly more common among non-adherent patients undergoing upper GI surgery [22]. Treatment-induced symptoms like mucositis, dysphagia and taste alterations from chemo- and radiotherapy further exacerbate these problems [21,24,25].

2.7.2 Product-related barriers

Product-related factors are also frequently described as barriers to ONS use. Taste, texture, and smell dissatisfaction are found to contribute to non-adherence [13,26]. Flavour or texture dislike was reported in 34% of non-compliant patients following upper gastrointestinal cancer surgery, compared to just 7% of compliant patients, underscoring the direct impact of sensory acceptability on adherence behaviour [22]. Cancer patients have also been shown to be more sensitive to sensory characteristics than healthy individuals, making them more likely to reject products they find disagreeable [27]. The palatability of ONS can also shift across the treatment trajectory. A study by IJpma et al. found that palatability changed during and after

chemotherapy, suggesting that as treatment progresses a patient may become averse to a supplement that was previously well tolerated [28].

2.7.3 Patient-related barriers

Patient-related barriers to ONS adherence include individual cognitive and psychological factors. A key barrier is low perceived need and insufficient understanding of the purpose of ONS. Patients who do not recognise clear benefits of supplementation, or who believe their regular diet is sufficient, demonstrate lower adherence [15]. A 2025 qualitative study by Liu et al., using a social cognitive theory framework identified misconceptions about ONS and insufficient self-efficacy as core personal-level barriers, alongside fluctuating adherence behaviours that shifted across different phases of illness and treatment [16].

The literature identifies several facilitators that can meaningfully improve ONS adherence. The most consistently supported is active healthcare professional involvement, specifically regular monitoring, follow-up, and personalised guidance. A systematic review by Wang et al. concluded that ONS management strategy, encompassing monitoring, guidance, and incentive structures, was among the most important facilitators of adherence [9]. A large systematic mixed-studies review covering 171 studies similarly identified well-functioning healthcare routines and support as key facilitators, alongside patients' motivation and product satisfaction [13]. Improving patients' understanding, attitudes, and perceived benefits of ONS through structured nutritional education has also been shown to support adherence. Patients who have a clear understanding of how ONS supports their treatment and recovery, and who receive a clearly communicated daily intake target, show better adherence [23,29].

2.7.4 Financial and systemic barriers

Financial and system-level barriers to ONS use are less frequently investigated but may contribute to adherence. Previous research has identified financial burden and inadequate reimbursement policies as potential barriers. Furthermore, insufficient training of healthcare professionals, lack of standardized nutritional care protocols, and limited follow-up after hospital discharge may hinder the effective integration of ONS into patient care. [30,16]

3. Aim and Hypothesis

The objective of this project was to investigate adherence to prescribed oral nutritional supplements and to identify barriers and explore factors influencing non-adherence in adult oncology patients in Estonia. The study sought to provide insights to support the optimisation of nutritional interventions and improve adherence to ONS among oncology patients.

It was expected that adherence to prescribed oral nutritional supplements among adult oncology patients would be suboptimal and that patient-reported barriers and treatment-related symptoms may contribute to non-adherence.

4. Methodology

4.1. Overall study design

A cross-sectional observational study was designed. Inpatients of the Haematology-Oncology Clinic of Tartu University Hospital who had a diagnosis of an oncological disease, had been recommended or prescribed the use of oral nutritional supplements, were older than 18 years old and able to understand and sign the informed consent form, were included in the study. Patients who were unable to complete the study questionnaire or who did not understand the content of the informed consent form were excluded.

Data collection started on December 20th 2025 after receiving ethics approval and was completed on March 31th 2026. Participants were recruited from the Haematology-Oncology inpatient clinic at Tartu University Hospital. Convenience sampling was used to recruit study participants.

4.2 Approval of the Ethics Committee

This study was approved by the Research Ethics Committee of the University of Tartu (405T-23). All participants provided written informed consent and participated voluntarily.

Ethics application form (in Estonian), patient consent forms and the questionnaire (in Estonian and Russian), the approval of the clinical research centre and curriculum vitae of researchers were submitted to get the approval of the University of Tartu ethics committee. The application form included the general project details, funding information, a description of the study population and research methods, ethical considerations, and a description of prior similar research. The first ethics application was submitted in October 2025, and the ethics committee's approval was received in December 2025.

4.3 Approaching the patients

Eligible patients were identified by members of the patients' care-giving teams and were approached in the inpatient clinic. The researcher informed patients about the purpose of the study, introduced the questionnaire that would be given, and how their data would be used.

Each patient received an informed consent form, which the researcher explained, to ensure the patient fully understood its contents. Patients were given the opportunity to ask questions before deciding whether to participate. Signing the informed consent form confirmed the patient's participation. Patients also signed a copy of the informed consent form, which remains with them. If the patient agreed to participate in the study, the questionnaire was given to them. Both the consent form and questionnaire were available to the patient in Estonian and Russian.

4.4 Data collection

For the main data collection, a structured questionnaire was provided to the patient (see Appendices 1 and 2). A self-developed questionnaire was used to assess adherence to ONS, perceived barriers, and patient-reported symptoms. The questionnaire was designed specifically for this study to capture clinically relevant and context-specific information not available in existing validated instruments. It consisted of 13 multiple-choice questions.

If the patient was unable to complete the questionnaire independently, the researcher read the questions and response options aloud and recorded the answers.

Demographic data was recorded from the electronic health record system (eHL) of Tartu University Hospital. Collected variables included sex, age, weight, height, cancer type (general category) and stage, current anticancer treatment (chemotherapy / radiotherapy / immunotherapy / none), prescribed oral nutritional supplement, presence of malnutrition, relevant comorbidities.

4.5 Data Analysis

Data were analysed using Microsoft Excel. Descriptive statistics were used to summarise patient characteristics, adherence to ONS, reported barriers, and symptoms. Continuous variables are presented as mean $\pm$ standard deviation (SD) or median with interquartile range (IQR). Categorical variables are presented as frequencies and percentages. Free-text responses were analysed using thematic content analysis with manual coding.

Cancer diagnoses recorded as free text were categorised according to primary anatomical site for descriptive purposes. Pancreatic cancer was presented as a separate category due to its substantial representation in the cohort and its distinct biological and prognostic characteristics [31]. Other gastrointestinal cancers were grouped together.

Given the small sample size and exploratory nature of the study, no formal inferential statistical analyses were performed.

4.5.1 Assessment of adherence to ONS

Adherence to ONS was assessed based on patient self-reported intake using predefined categories (<25%, 25%, 50%, 75%, 90%, and 100%), representing approximate intake levels of prescribed proportion. Adherence to ONS was defined as consumption of at least 75 % of the prescribed amount during the study period. This is consistent with previous studies that have used comparable thresholds, although no universal standard exists [32].

For quantitative analysis, the <25% category was approximated as 12.5% (midpoint of the category), while the remaining categories were treated as their stated values, as they represented approximate intake levels reported by patients. Comparisons between adherent and non-adherent groups were performed descriptively using frequencies and percentages. An exploratory analysis was performed to assess adherence to ONS according to BMI category. Patients were classified as underweight, normal weight, or overweight based on BMI, and adherence values were plotted to visually assess potential patterns between BMI category and adherence.

Reported barriers and symptoms were summarised using frequency tables, and their distribution between adherent and non-adherent patients was described. In addition, selected data were visualised using a grouped bar chart.

5. Results

5.1 Baseline characteristics of the patients

Data were collected from 22 patients. Ten (45.5%) were female and 12 (54.5%) were male. The mean age was 65.9 ± 12.9 years, with a mean age of 61.4 ± 15.2 years in females and 69.6 ± 9.8 years in males. The mean body mass index of the patients was 24.0 ± 5.4 kg/m², and 23% of patients were underweight (BMI <18.5 kg/m²). Malnutrition was documented in 19 patients (86.4%), while 3 patients (13.6%) were classified as being at high risk of malnutrition.

The primary diagnoses included head and neck, gastrointestinal, pancreatic, lung, haematologic, and breast cancers. All patients were inpatients. Patient characteristics are shown in Table 1.

Table 1. Patient characteristics.

N=22

Age, years	65.9 ±12.9
Gender, n (%)	
Female	10 (45.5)
Male	12 (54.5)
Main diagnoses, n (%)	
Head and neck cancer	8 (36.4)
Gastrointestinal cancer	5 (22.7)
Pancreatic cancer	4 (18.2)
Lung cancer	3 (13.6)
Haematologic cancer	1 (4.5)
Breast cancer	1 (4.5)

Table 1. Patient characteristics.**N=22**

BMI (kg/m²), mean $\pm$ SD	24.0 $\pm$ 5.4
Underweight (<18.5)	5 (22.7)
Normal weight (18.5-24.9)	8 (36.4)
Overweight (25-29.9)	7 (31.8)
Obese ($\geq$ 30)	2 (9.0)
Malnutrition status, n (%)	
Present	19 (86.4)
High risk	3 (13.6)

5.2 Adherence to ONS

The mean adherence to oral nutritional supplements was $69.5 \pm 33.9\%$ while the median adherence was 82.5% (IQR 50–100%), indicating a skewed distribution with substantial variability. Using a predefined cutoff of $\geq 75\%$, 13 patients (59.1%) were classified as adherent, while 9 patients (40.9%) were classified as non-adherent. Adherence levels showed considerable variability among patients.

Adherence to oral nutritional supplements according to BMI category is presented in Figure 1. No clear differences in adherence were observed between BMI groups. Both high and low adherence values were present across all BMI categories, indicating no consistent relationship between BMI and adherence in this sample.

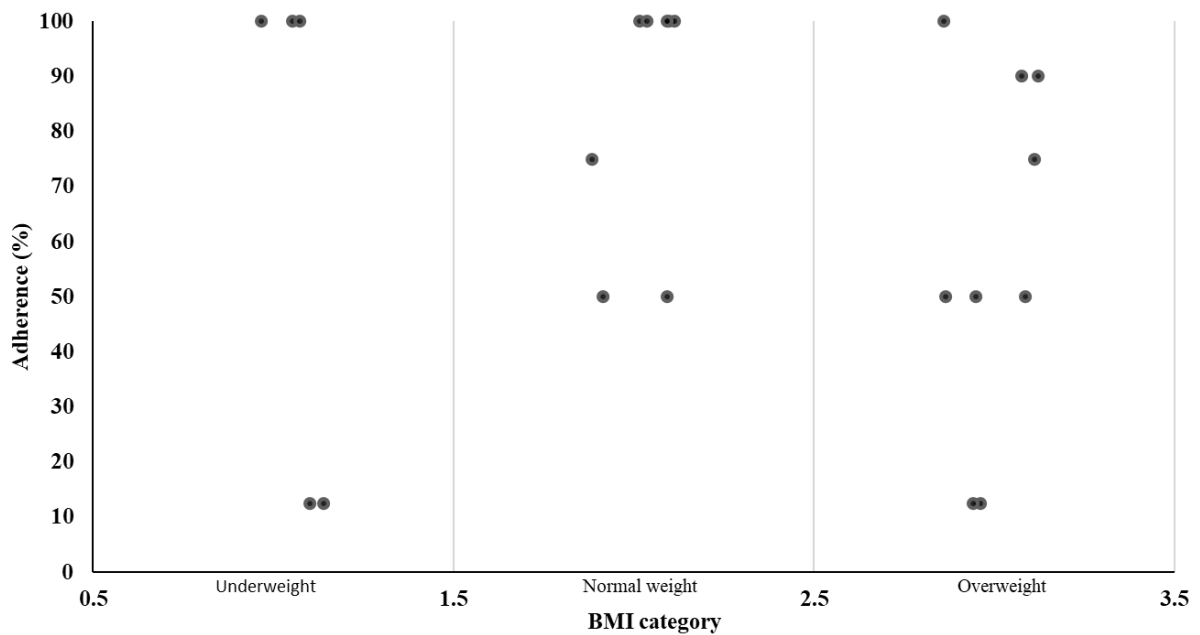


Figure 1. Adherence to oral nutritional supplements according to BMI category. Each point represents an individual patient. BMI categories were defined as underweight ($<18.5 \text{ kg/m}^2$), normal weight ($18.5\text{--}24.9 \text{ kg/m}^2$), and overweight ($\geq 25 \text{ kg/m}^2$).

5.3 Barriers to oral nutritional supplement intake

The most frequently reported barrier to oral nutritional supplement intake was unpleasant taste, reported by 11 patients (50.0%). Other commonly reported barriers included lack of access and nausea or vomiting after use (both 27.3%), as well as lack of appetite (22.7%). Lack of access to ONS was reported by six patients. Free-text responses further indicated that three patients had previously used ONS at home but reported that these were not offered immediately upon hospital admission. Swallowing difficulties were reported by 13.6% of patients. Other barriers, including unpleasant smell, texture, diarrhoea after use, cost, forgetting to take the supplement, and insufficient information, were reported less frequently.

Table 2. Reported barriers to oral nutritional supplement intake.**N=22**

Barrier, n (%)	
Unpleasant taste	11 (50.0)
Lack of access	6 (27.3)
Nausea/vomiting after use	6 (27.3)
Lack of appetite	5 (22.7)
Swallowing difficulties	3 (13.6)
Insufficient information	2 (9.1)
Unpleasant smell	1 (4.5)
Unpleasant texture	1 (4.5)
Diarrhoea after use	1 (4.5)
Too expensive	1 (4.5)
Forgot	1 (4.5)

5.4 Barriers according to adherence status

Barriers to oral nutritional supplement intake were more frequently reported among non-adherent patients. Unpleasant taste was reported by 77.8% of non-adherent patients compared to 30.8% of adherent patients. Lack of appetite, and nausea or vomiting after use were also more commonly reported among non-adherent patients (44.4% vs. 7.7%, and 44.4% vs. 15.4%, respectively). Swallowing difficulties and insufficient information was reported only among non-adherent patients 44.4% and 22.2% respectively. Overall, several barriers appeared to be more prevalent among non-adherent patients.

Table 3. Reported barriers according to adherence status

Barrier, n (%)	Adherent (n=13)	Non-adherent (n=9)
Unpleasant taste	4 (30.8)	7 (77.8)
Lack of access	4 (30.8)	2 (22.2)
Nausea/vomiting after use	2 (15.4)	4 (44.4)
Lack of appetite	1 (7.7)	4 (44.4)
Swallowing difficulties	0 (0.0)	4 (44.4)
Other barriers*	1 (7.7)	6 (66.7)

*Other barriers include unpleasant smell, unpleasant texture, diarrhoea, cost, forgetting to take supplements, and insufficient information.

5.5 Patient reported symptoms

Overall, the most commonly reported symptoms were nausea (59.1%), dysphagia (45.5%), taste and smell changes (40.9%). Taste and smell changes were reported by 40.9% and oral pain by 36.4%. The distribution of symptoms was broadly similar between adherent and non-adherent patients. Dysphagia was more frequently reported among non-adherent patients (66.7% vs. 30.8%). Nausea was reported at comparable rates in both groups (55.6% vs. 61.5%). Other symptoms, including taste and smell changes, oral pain, mucosal ulcers, vomiting, and constipation, showed no clear differences between groups. Reported symptoms according to adherence status are presented in Figure 2.

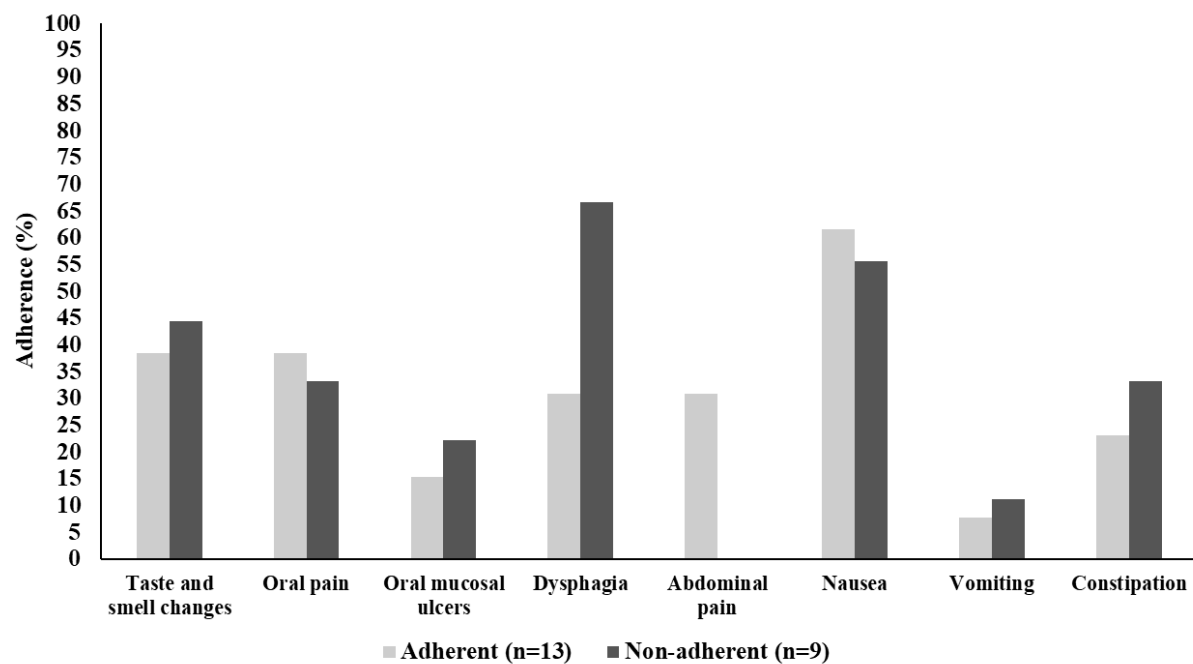


Figure 2. Reported symptoms according to adherence status. The figure presents the percentage of patients reporting each symptom among adherent (n=13) and non-adherent (n=9) groups.

5.6 Provision of information about ONS

11 patients (50%) out of 22 said they had received information about oral nutritional supplements. Receiving information was more frequently reported among adherent patients (61.5%) than non-adherent patients (33.3%), suggesting a possible association between information provision and adherence.

6. Discussion

This study evaluated adherence to oral nutritional supplements among hospitalised patients in Tartu University Hospital and explored barriers and factors associated with non-adherence. Overall, adherence was moderate, with 59.1% of patients managing at least 75% of their prescribed ONS and thus classified as adherent. While the mean adherence was 69.5%, the median adherence was higher (82.5%), indicating a skewed distribution with substantial variability between patients. This suggests that although many patients were highly adherent, a subgroup showed low adherence. Such variability may reflect the heterogeneous nature of this patient population, including differences in symptom burden, tolerance to ONS, and individual barriers to intake. This variability may also reflect differences in underlying diagnoses and disease severity, which were not specifically analysed in this study, but may influence symptom burden and tolerance to ONS.

No clear association between BMI and adherence was observed in the present study. This analysis was included to explore whether patients with different nutritional status demonstrated different adherence patterns. Evidence on the relationship between BMI and ONS adherence in oncology is limited and inconsistent. Some studies suggest that lower BMI may be associated with higher adherence. For example, Qin et al. reported that patients with gastrointestinal cancer and lower body weight demonstrated significantly higher adherence to ONS compared to those with normal weight or overweight status [15].

Several barriers to ONS intake were identified, with unpleasant taste being the most frequently reported barrier particularly among non-adherent patients. Taste-related issues were reported by 77.8% of non-adherent patients, highlighting the importance of sensory characteristics in ONS use. This finding aligns with previous research, which has identified both treatment-related symptoms and product-related factors as barriers to ONS adherence, although sensory characteristics appear to play a more prominent role in the present study.

Patients should have a variety of flavours to choose from, ideally having the opportunity to test different flavours beforehand. Darmon et al. demonstrated that acceptability varied significantly between flavour categories, with milky texture supplements preferred over

fruit-juice types. Within the milky texture category, vanilla, coffee, and strawberry performed comparably while chocolate was less chosen and neutral flavour almost never selected. Their study concluded that flavour variations must be considered to improve compliance [33]. Similarly, Lester et al. reported that sensory characteristics, including flavour profile, are key product-level determinants of palatability and intake [26].

To further support adherence, healthcare professionals should provide patients with guidance on optimal methods of ONS consumption. Changing the serving temperature could be one strategy to reduce the perceived sweetness. Lower temperature suppresses flavour release and can have a mild numbing effect on the palate, blunting the sweetness and odour that many patients find off-putting. Methven et al. demonstrated that chilled and frozen ONS were perceived as less sweet and were preferred compared to room-temperature formulations [34,13]. Prescribers should also inform patients that ONS can be mixed with other ingredients to alter or enhance the flavour. Additionally, the choice of container can impact consumption. While some patients prefer drinking from a glass, others find it better to drink from the bottle. Practical consumption strategies such as using a straw may improve acceptability as well [35,13].

Although specific ONS products, flavour preferences and serving methods were not assessed in the present study, these factors may play an important role in adherence. Offering a variety of flavours and providing practical guidance on consumption strategies may therefore be beneficial in clinical practice.

Swallowing difficulties, lack of appetite, and nausea or vomiting after use were also more commonly reported among non-adherent patients. One strategy to help to reduce nausea and vomiting after ONS use could be to consume the supplement slowly over time rather than drinking it quickly. It is recommended in clinical nutrition practice on the basis that rapid ingestion of a calorie-dense liquid can overwhelm gastric capacity and trigger nausea. However, direct evidence from randomized controlled trials specifically evaluating this strategy remains limited. Ideally, ONS should be energy-, protein- and nutrient-dense while provided in small volumes, so they do not induce early satiety or reduce appetite at

subsequent meals. Providing smaller-volume, energy-dense ONS between meals may therefore help increase overall nutritional intake in malnourished patients. [12]

Lack of access to ONS was reported by six patients. Notably, analysis of free-text responses indicated that three patients had previously used ONS at home, but reported that these were not offered immediately upon hospital admission. This finding suggests that improved continuity of nutritional care and routine assessment of nutritional support needs may be important to ensure timely provision of ONS.

Interestingly, symptoms alone did not seem to explain adherence patterns well. While dysphagia was more frequently reported among non-adherent patients, most other symptoms, including nausea, taste and smell changes, oral pain, mucosal ulcers and vomiting were reported at comparable rates between adherent and non-adherent groups. This suggests that the presence of symptoms may not be sufficient to predict adherence, and that other factors, such as patient perception and palatability of ONS, may play a more important role. These results are not entirely consistent with previous research, which has often emphasised treatment-related symptoms as key determinants of adherence [14,23].

The provision of information about ONS appeared to be associated with better adherence. A higher proportion of adherent patients reported receiving information compared to non-adherent patients, suggesting that information provision may influence adherence. This is consistent with previous studies demonstrating that improving patients' understanding, attitudes, and perceived benefits of ONS through nutritional education can support adherence [23,15]. The association is clinically relevant, as it represents a potentially modifiable factor that could be addressed through improved patient education and counselling by healthcare professionals.

Overall, the findings of this study suggest that non-adherence to ONS is multifactorial. Addressing sensory characteristics, providing individualised guidance on ONS use, managing clinical symptoms, and improving patient education may contribute to improved adherence and, consequently, better nutritional outcomes in this patient population.

6.1 Strengths

The study provides a detailed and clinically relevant assessment of adherence to oral nutritional supplements in a real-world inpatient setting. The use of patient-reported data allowed identification of specific and practical barriers to ONS intake, offering insight into factors that may not be captured through routine clinical records alone. The study explored multiple dimensions influencing adherence, including barriers, symptoms and the provision of information, allowing for a more comprehensive understanding of the issue. The identification of modifiable barriers, such as taste and insufficient information, provides actionable insights that may inform clinical practice and the development of targeted strategies to improve adherence.

6.2 Limitations

This study has several limitations. The sample size was small (n=22), which limits the statistical power of the study and the generalisability of the results. The small number of patients within subgroups (adherent vs. non-adherent) resulted in low cell counts for several variables, which limits the reliability of comparisons. Due to the small sample size, inferential statistical analyses, including the calculation of p-values and multivariable analysis, were not performed, as these would likely lead to unstable or misleading results. As a result, the findings are descriptive and exploratory in nature, and no conclusions regarding statistical significance or independent associations can be drawn.

Adherence and barriers were self-reported, which may be subject to recall or reporting bias. In addition, the cross-sectional design limits the ability to draw conclusions about causality. Further research with larger sample sizes is needed to confirm these findings and to evaluate strategies to improve adherence to ONS in patients with cancer.

7. Conclusions

This study examined adherence to oral nutritional supplements among hospitalised adult oncology patients and explored barriers influencing their use. The findings demonstrate that adherence to ONS in this population is moderate and characterised by considerable variability. While a substantial proportion of patients achieved high adherence, a notable subgroup exhibited low adherence.

The results indicate that non-adherence to ONS is multifactorial and cannot be explained by a single factor. Among the identified barriers, sensory characteristics, particularly perceived unpleasant taste, emerged as the most important factor associated with non-adherence. This finding aligns with existing literature emphasising the importance of palatability in ONS use. Swallowing difficulties, lack of appetite, and nausea or vomiting after use were also more commonly reported among non-adherent patients. In contrast, clinical symptoms alone did not fully explain adherence patterns, suggesting that patient perception, acceptability, and individual experience with ONS may play a more significant role than symptom burden alone.

Importantly, the provision of information about ONS appeared to be associated with improved adherence. Patients who reported receiving information were more likely to adhere to the prescribed intake, highlighting the role of patient education.

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Use of artificial intelligence tools

Artificial intelligence (AI) tool (ChatGPT-5.3) was used to assist with language editing, grammar correction, and improvement of clarity in writing. All scientific content, data analysis, and interpretation were performed independently by the author.

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Appendix 1

Küsimustik

Nimi: _____

Kuupäev: _____

Palun vastake järgnevatele küsimustele märkides "X" kõikidesse kastidesse, mis kehtivad Teie kohta. Palun vastake küsimustele ausalt.

1. Kas Teile on määratud ja/või soovitatud tarbida suukaudset täisväärtusliku ravijooki?

- ☐ Jah
- ☐ Ei
- ☐ Ma ei tea

2. Kes soovitas Teil tarbida suukaudset täisväärtusliku ravijooki?

- ☐ Arst
- ☐ Õde
- ☐ Toitumisravi spetsialist
- ☐ Perekond
- ☐ Tuttavad
- ☐ Mitte keegi
- ☐ Muu

Soovi korral kirjutage vabas vormis :

3. Kas Teil on olnud toitumisravi konsultatsioon?

- ☐ Jah
- ☐ Ei

☐ Ma ei tea

4. Kas Teile on määratud Tervisekassa soodustus suukaudsete toitmisravi preparaatide ostmiseks?

☐ Jah

☐ Ei

☐ Ma ei tea

5. Kas Te olete saanud informatsiooni suukaudsete ravijookide kohta?

☐ Jah

☐ Ei

☐ Ma ei tea

6. Kui olete saanud informatsiooni suukaudsete ravijookide kohta, siis kellelt või millistest allikatest?

☐ Arstilt

☐ Õelt

☐ Toitmisravi spetsialistilt

☐ Apteekrilt

☐ Perekonnalt

☐ Tuttavatelt

☐ Internetist

☐ Ei ole saanud informatsiooni

☐ Muu

Soovi korral kirjutage vabas vormis :

7. Milline kogus on Teile määratud / soovitatud tarbida suukaudseid täisväärtuslike ravijooke?

- ☐ 1 pudel päevas
- ☐ 2 pudelit päevas
- ☐ Rohkem kui 2 pudelit päevas
- ☐ Ma ei tea

8. Palun hinnake, kui suure osa Teile soovitatud päevasest kogusest olete tavaliselt tarvitanud.

- ☐ 100%
- ☐ 90%
- ☐ 75%
- ☐ 50%
- ☐ 25%
- ☐ Vähem kui 25%

9. Möödunud 7 päeva jooksul, mitmel päeval tarbisite suukaudset täisväärtusliku ravijooki vastavalt Teile antud soovitusele?

- ☐ 0 päeval
- ☐ 1 päeval
- ☐ 2 päeval
- ☐ 3 päeval
- ☐ 4 päeval
- ☐ 5 päeval
- ☐ 6 päeval
- ☐ 7 päeval

10. Möödunud kuu jooksul, kui sageli Te enda hinnangul tarbisite suukaudset täisväärtusliku ravijooki vastavalt Teile antud soovitusetele?

- ☐ Alati
- ☐ Sageli
- ☐ Mõnikord
- ☐ Harva
- ☐ Mitte kunagi

11. Kas olete jätnud suukaudse ravijoogi tarbimist vahele või pooleli?

- ☐ Jah
- ☐ Ei

12. Kui Te olete jätnud tarbimist vahele või pooleli, siis palun märkige põhjused (palun märkige kõik sobivad põhjused).

- ☐ Ebasobiv maitse
- ☐ Ebameeldiv lõhn
- ☐ Ebameeldiv tekstuur
- ☐ Iiveldus / oksendamine pärast tarvitamist
- ☐ Kõhulahtisus peale tarvitamist
- ☐ Kõhukinnisus peale tarvitamist
- ☐ Raskustunne peale tarvitamist
- ☐ Puhitustunne peale tarvitamist
- ☐ Neelamisraskused
- ☐ Pole isu
- ☐ Liiga kallis
- ☐ Puudub ligipääs / ei ole apteegis saadaval
- ☐ Olen saanud liiga vähe informatsiooni selle kohta

- ☐ Ei usu, et see aitab
- ☐ Lähedased ei soovita tarbida
- ☐ Unustasin tarbida
- ☐ Muu

Soovi korral kirjutage vabas vormis :

13. Kas Teil esineb järgnevaid sümptomeid?

Palun tehke märges "X" alltoodud sümptomite juurde vastavasse kasti, mis kõige paremini kirjeldab Teie seisundit. Kui Teil ei esine konkreetset sümptomit, siis tehke märges kasti "puudub".

	Puudub	Kerge	Mõõdukas	Tugev
Maitse- ja lõhna muutused				
Valu suupiirkonnas				
Haavandid suu limaskestal				
Neelamishäired (düsfaagia)				
Kõhuvalu				
Iiveldus				
Oksendamine				
Kõhukinnisus				
Väsimus				
Muud: Soovi korral kirjutage vabas vormis:				

Täname Teid küsimustikule vastamast!

Appendix 2

Анкета

Фамилия и имя: _____

Дата: _____

Пожалуйста, ответьте на следующие вопросы, отметив знаком “X” все варианты, которые относятся к вам. Просим отвечать честно.

1. Вам было назначено и/или рекомендовано употреблять пероральный полноценный лечебный напиток?

- ☐ Да
- ☐ Нет
- ☐ Не знаю

2. Кто рекомендовал вам употреблять пероральный полноценный лечебный напиток?

- ☐ Врач
- ☐ Медсестра
- ☐ Специалист по клиническому питанию
- ☐ Члены семьи
- ☐ Знакомые
- ☐ Никто
- ☐ Другое

При желании напишите в свободной форме:

3. Проходили ли вы консультацию по лечебному питанию?

- ☐ Да
- ☐ Нет

☐ Не знаю

4. Вам была назначена льгота Здравкассы (Tervisekassa) на покупку пероральных лечебных питательных средств?

☐ Да

☐ Нет

☐ Не знаю

5. Получали ли вы информацию о пероральных лечебных напитках?

☐ Да

☐ Нет

☐ Не знаю

6. Если вы получали информацию о пероральных лечебных напитках, то от кого или из каких источников?

☐ От врача

☐ От медсестры

☐ От специалиста по клиническому питанию

☐ От фармацевта

☐ От членов семьи

☐ От знакомых

☐ Из интернета

☐ Не получал(а) информацию

☐ Другое

При желании напишите в свободной форме:

7. Какое количество пероральных лечебных напитков вам было назначено / рекомендовано употреблять?

- ☐ 1 бутылка в день
- ☐ 2 бутылки в день
- ☐ Более 2 бутылок в день
- ☐ Не знаю

8. Пожалуйста, оцените, какую долю от рекомендованного вам суточного количества вы обычно употребляете.

- ☐ 100%
- ☐ 90%
- ☐ 75%
- ☐ 50%
- ☐ 25%
- ☐ Менее 25%

9. За последние 7 дней, в сколькие дни вы употребляли пероральный полноценный лечебный напиток в соответствии с рекомендацией?

- ☐ 0 дней
- ☐ 1 день
- ☐ 2 дня
- ☐ 3 дня
- ☐ 4 дня
- ☐ 5 дней
- ☐ 6 дней
- ☐ 7 дней

10. За последний месяц, как часто, по вашему мнению, вы употребляли пероральный лечебный напиток в соответствии с рекомендацией?

- ☐ Всегда
- ☐ Часто
- ☐ Иногда
- ☐ Редко
- ☐ Никогда

11. Пропускали ли вы употребление лечебного напитка или прекращали его приём?

- ☐ Да
- ☐ Нет

12. Если вы пропускали или прекращали приём, пожалуйста, отметьте причины (отметьте все подходящие варианты).

- ☐ Неподходящий вкус
- ☐ Неприятный запах
- ☐ Неприятная консистенция
- ☐ Тошнота / рвота после употребления
- ☐ Диарея после употребления
- ☐ Запор после употребления
- ☐ Ощущение тяжести после употребления
- ☐ Вздутие живота после употребления
- ☐ Затруднение при глотании
- ☐ Отсутствие аппетита
- ☐ Слишком дорого
- ☐ Нет доступа / нет в аптеке
- ☐ Недостаточно информации
- ☐ Не верю, что это помогает

- ☐ Родственники не рекомендуют употреблять
- ☐ Забыл(а) принять
- ☐ Другое

При желании напишите в свободной форме:

13. Испытываете ли вы следующие симптомы?

Пожалуйста, отметьте “X” в соответствующей графе, которая наиболее точно описывает ваше состояние. Если симптом отсутствует, отметьте «Отсутствует».

	Отсутствует	Лёгкая	Умеренная	Тяжёлая
Изменения вкуса и запаха				
Боль в области рта				
Язвы слизистой оболочки рта				
Затруднённое глотание (дисфагия)				
Боль в животе				
Тошнота				
Рвота				
Запор				
Утомляемость				
Другое (уточните):				

Благодарим вас за участие в анкетировании!