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Research Article

Nutrition Profile of Women with Functional Upper Gastrointestinal Disorders

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Abstract

The dietary profile is considered an important trigger causing symptoms of the functional upper gastrointestinal disorders,thus, the optimization of food intake is an important element in the treatment of non-erosive gastroesophageal reflux disease (NERD) and functional dyspepsia(FD).The cohort of 164 patients (mean age 31.4 ± 7.7 years) with NERD (84 patients, 51.2%) and FD (80 patients, 48.8%) was studded to evaluatethe possible links between dietary patterns and upper gastrointestinal functional disorders. The data obtained from one-month nutritional history questionnaires were used to quantify the usual intake of essential nutrients, including dietary fiber, which make up the energy balance. The gained data were reviewed by age of patients and forms of the disease. Comparisons were made between subgroups of patients, and regression models were analyzed. In the entire group of patients involved in the study, as well as ingroups divided by age and symptoms of functional gastrointestinal disorder, an absolute deficiency of intake of dietary fiber was revealed. Dietary fiber was significantly less consumed among patients aged <35 years compared to those aged ≥35 years (19.6 ± 9.3 g/day vs. 27.8 ± 7.9 g/day, $p < 0.0001$). The results of the regression analysis of the nutrients consumed revealed that in all study groups carbohydrate intake was a significant predictor of dietary fiber intake (coefficient of probability from 6.60 ± 1.27 to 9.65 ± 0.58). Conversely, the predictability of fiber consumption in relation to carbohydrates is very low (coefficient of probability - from 0.06 ± 0.01 to 0.08 ± 0.01). This relationship indicates that fiber is consumed from food forms that are high in simple carbohydrates and low in complex carbohydrates, including fiber. Deficiency of energy obtained from food was detected in 24.4% of patients, excess energy intake - in 43.3%, and recommended intake - in 32.3%. Assessment of consumption of macronutrientsin groups with different energy profiles revealed a relative deficiency of carbohydrate and protein intake and a relative excess of fat intake. In patients with NERD and FD intake of total fiber, as well as fiber from bread and wheat products, is significantly insufficient and it is consumed mainly from products with low fiber content.

Keywords: Non-erosive Gastroesophageal Reflux Disease; Functional Dyspepsia; Nutrients; Carbohydrates; Protein; Fat; Dietary Fiber; Energy Balance

Abbreviations

NERD: Non-Erosive Gastroesophageal Reflux Disease; FD: Functional Dyspepsia; FGID: Functional Gastrointestinal Disorders; IBS: Irritable Bowel Syndrome

Introduction

Direct and indirect expenses of morbidity from non-erosive gastroesophageal reflux disease (NERD) and functional dyspepsia (FD) account for an important part of the global burden of

gastrointestinal dysfunction [1,2]. According to the results of a large-scale, questionnaire-based internet survey, the prevalence of symptoms of functional gastrointestinal disorders (FGID) in adults is 35%, symptoms of functional bowel disorders were observed in 28.1% of cases, those of gastroduodenal disorders - in 10.6%, and of esophageal disorders – in 7%. In 36% of cases, an overlap of symptoms of different FGIDs was detected; for example, symptoms of irritable bowel syndrome (IBS) and FD were observed simultaneously in 4.2-9.6% of the cases [2]. Regarding the Rome IV criteria, 20.7% of adults had symptoms of at least one of the 22 functional GI disorders [3], among which 2.0% fulfilled criteria for NERD and 4.8% fulfilled criteria for FD. Symptoms of functional and non-functional diseases of the esophagus in most cases appeared simultaneously. In 12.4% of cases of FD, patients had symptoms of both postprandial distress and epigastric pain. Among the functional gastrointestinal disorders, the most common were functional disorders of the colon and FD, which occurred in 16.0% of the population with at least one Rome IV criteria [1]. These conditions were significantly more common in women and much rare in people over 50 years old.

The overlap of upper FGIDsymptoms is confirmed by the data ofa number of studies [4] and indicates the same pathogenesis of these diseases. According to the Rome IV process, the development of upper FGID may involve such mechanisms as motility disorders, mucosal and immune system dysfunction, visceral hypersensitivity, changes in gut microbiota, and incorrect processing of visceral impulses in or from the central nervous system [5]. Symptoms of upper FGID are often associated with the intake of various foods, however, the role of nutrition in the pathogenesis of these disease has not been fully evaluated and is a new area of evidence search [6]. It is also important to determine the relationship between dietary patterns and other pathogenic mechanisms.

FGID is characterized by a chronic course and requires long-term treatment and monitoring. Traditional treatment with proton pump inhibitors or histamine receptor blockers is often ineffective, and the partial improvement in symptoms obtained with these drugs is not sustainable. The use of antacids, bismuth and sucralfate is also ineffective, while treatment with antidepressants to modulate disorders of the gut-brain axis does not give the desired results. Long-term use of prokinetics and 5-HT4 receptor agonists for the treatment of gastric motility disorder and impaired gastric accommodation, despite their relative efficacy, is associated with significant adverse effects. These facts make it urgent to search for new approaches to treatment [7].

In patients with upper FGID, the intake of certain foods often triggers the symptoms, therefore, diet optimizationis considered an important element in the treatment of gastroesophageal reflux disease and FD.Studies conducted so far cannot determine the relationship between different nutrients and symptoms, and there is insufficient data on the role of diet as a therapeutic approach [8-10].

In recent years, the effect of dietary fiber on bowel motility and intestinal microbiota has been widely studied. A large amount of scientific data confirms the positive effect of dietary fiber in functional bowel disorders. In addition to the abovementioned beneficial effects on lower GI function, dietary fiber has a positive effect on the motility of the upper gastrointestinal tract and its secretion [11,12]. These effects are largely determined by the physiological and chemical characteristics of the nutrients that can be altered as a result of food processing and digestion in the upper gastrointestinal tract [13].

It is generally recognized that the severity and progression of upper FGID are largely determined by the diet of patients. Thus, the aim of the study was to show the effect of fiber-rich foods on NERD and FD and to develop recommendations for optimizing the balance of energy and nutrients in the diet of patients [14].

The research was carried out to explore the possible links between dietary disorders and FGID, in particular we evaluated relationship between consumption of macronutrients, including dietary fiber, as well as energy obtained with food and severity of NERD and FD.

Materials and Methods

The study included 164 female patients with NERD and FDsymptoms at the time of outpatient referral. Their average age was 31.4 ± 7.7 years. In all cases, at least 6 months have passed since the first appearance of symptoms of the disease.In order to review and analyze the study results, the patients were grouped according to disease variants and age.

The age of the majority of patients, i.e. 71.9% (118/164), was less than 35 years, and only 28.1% (46/164) was older (Figure 1A). 80 (48.8%) out of theexamined patients were diagnosed with FD, and 84 (51.2%) with NERD (Figure1B). 66 (82.5%) of patients with FGID belonged to the age group <35-years, and only 14 (17.5%) to the age group ≥35-years (Figure 1C). The age of 52 (61.9%) patents with FD was <35 years and of 32 (39.1%) - ≥35 years (Figure 1D).

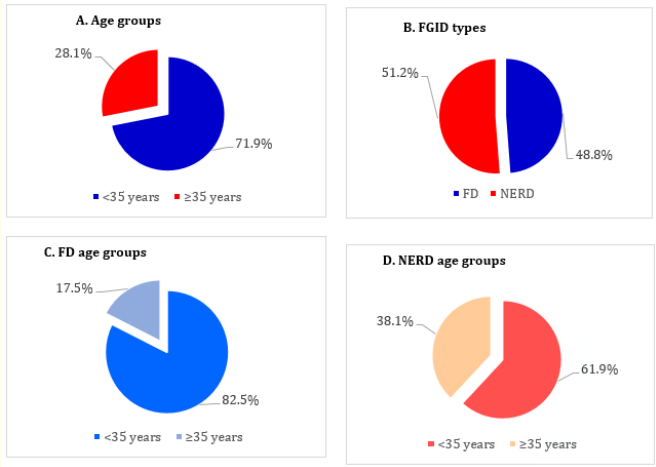

Figure 1: Distribution of patients in study groups.

After receiving informed consent, the study included patients who, according to Rome IV criteria [6,15], had functional disorders of the upper gastrointestinal tract, in particular, any of the symptoms characteristic of NERD or FD: A2 functional heartburn, A3 reflux hypersensitivity, B1 functional dyspepsia manifested by B1a postprandial distress, or B1b functional epigastric pain. The patients with identified exclusioncriteria at the time of involvement in the study, were not included (Table 1). In particular, the exclusion criteria were: the presence of "red flag" symptoms, clinically significant chronic disease with failure of organ function, malignancy, inflammatory or obstructive intestinal disease, gastrointestinalsurgery performed, pregnancy, breastfeeding, as well as the use of drugs affecting the secretory and motility function of the gastrointestinal tract in the last 4 weeks, other factors that prevent or make it impossible to provide medical care.

To estimate the daily intake of dietary fiber and energy-providing nutrients by one patient, we used the original, 127-item

Red flag symptoms
Ongoing, severe or acute dyspepsia; Previously established, untreated, or complicated or subsequently unmanageable peptic ulcer; Chronic erosive gastritis; Clinical symptoms/signs of bleeding from the gastrointestinal tract; Moderate and severe anemia; Difficulty swallowing or symptoms that indicate diseases of the esophagus; Acute vomiting; Acute pain in the stomach or chest; Excessive sputum or night sweats; Unexplained loss of body mass;
Clinically significant diseases/conditions
Established malignant tumor, with any localization; Liver disease; Chronic kidney disease; Symptomatic heart failure or cardiovascular disease; Shortness of breath; Endocrine diseases; Uncontrolled diabetes; Underweight (bmi<16 kg/m^2) Diseases and conditions that limit endoscopy; Pregnancy, progressing or expected; Breastfeeding; Surgery performed during the previous 6 months; Colectomy; Diseases with intestinal obstruction; Inflammatory bowel disease;
Drug treatment
Antibiotics for the last 4 weeks; Antisecretory medications within 1 week prior to inclusion in the study; pre/probiotics for the last 4 weeks; 5-HT1A receptor agonists, selective serotonin reuptake inhibitors (SSRIs), tricyclic antidepressants within 2 weeks prior to inclusion in the study; 5-HT3 receptor antagonists, 5-HT4 receptor agonists and other drugs with prokinetic effect for 2 weeks prior to inclusion in the study; Laxatives within 1 week prior to inclusion in the study;
Personal factors
Factors related to the patient or physician that may interfere with or make it impossible to provide medical care

Table 1: Exclusion criteria from the study.

dietary history questionnaire developed based on the methodology of the US National Cancer Institute [16] and the Dietary Instrument for Nutrition Education (DINE) [17]. The questionnaire allows collecting information on nutrient intake from 270 products, taking into account their commodity form and cooking method. These foods are the most common source of nutrients in the urban population of Georgia [18]. Using the questionnaire, it is possible to estimate the average frequency, proportion and size of individual food product/form intake during the past month. These semi-quantitative indicators are encoded in quantitative data with specific conversion coefficients [19]. Thus, with the help of the aforementioned questionnaire, we evaluated the amount of individual food products/forms consumed on average per day by one unique patient. Using the data from the nutritional value table [12,20], we calculated the average daily intake of the essential nutrients - carbohydrates, dietary fiber, proteins, fats, water and energy, both for individual food products/forms and in total.

For each patient, we calculated the quantitative characteristics of daily intake of all macronutrients: energy consumed from food (kcal/day), total dietary fiber and bread fiber (g/day), as well as the intake of total carbohydrates (g/day), protein (g/day) and fat (g/day).

Indicatorsof energy and carbohydrate consumption were calculated per unit (1 gram) of dietary fiber: energy intake per 1g of food (kcal/g), energy derived per 1g of dietary fiber (kcal/g), energy derived per 1g of bread/wheatfiber (kcal/g), carbohydrates obtained per 1g of dietary fiber (g/g) and the amount of carbohydrates (g/g) consumed to obtain 1g of bread/wheat fiber.

In the course of the study, the energy value of nutrients in the food consumed was determined, namely, the share of energy obtained from carbohydrates, proteins and fats (E%) of the total energy consumed daily. We used the recommendations of the Food Council of the US Medical Institute (IoM 2005) as a standard for assessing the proportion of macronutrients in the energy balance and identifying patients with excessive, recommended and insufficient energy consumption. In particular, the accepted target values for carbohydrates, proteins and fats in the daily energy balance are 50 ± 5E%, 25 ± 5E% and 25 ± 5E%, respectively [21,22].

Differences between indicators of the consumption profiles of main nutrients were assessed by comparative analysis of similar variables between the study groups. The logical assessment model was based on an observational, cross-sectional study and provided an opportunity for a comparative analysis of absolute nutrient intake, nutrient energy balanceand consumption of 1 g of fiber according to data from different research groups. For statistical analysis of quantitative variables, we used analysis of variance (ANOVA). Multiple regression models were used to analyze the relationship between various variables and assess the predictability of their characteristics. Differences between comparable data were considered significant with a 95% confidence interval when $p < 0.05$.

Study Results

Intake of energy and essential macronutrients

The average level of energy consumption in the group of all patients was 2638.8 ± 990.3 kcal. This indicator was significantly higher among patients aged ≥35 years (3038.9 ± 1049.8 kcal vs. 2482.8 ± 924.7 kcal, p = 0.001), but was not significantly different between the groups of patients with FD and NERD, p = 0.192 (Table 2).

Amount	Overall group	<35 yrs. of age	≥35 yrs. of age	p	FD	NERD	p
Average age (year)	31.4 ± 7.7	27.7 ± 4.0	41.0 ± 6.8	<0.0001	30.7 ± 6.9	32.1 ± 8.4	= 0.242
Energy (kcal)	2638.8 ± 990.3	2482.8 ± 924.7	3038.9 ± 1049.8	= 0.001	2535.1 ± 887.9	2737.5 ± 1074.9	= 0.192
Total fiber (g/day)	21.9 ± 9.6	19.6 ± 9.3	27.8 ± 7.9	<0.0001	19.6 ± 8.4	24.0 ± 10.3	= 0.004
Bread/wheat fiber (g/day)	4.9 ± 4.3	4.6 ± 4.3	5.5 ± 4.4	= 0.24	3.9 ± 2.9	5.8 ± 5.2	= 0.004
Carbohydrates (g/day)	276.0 ± 151.9	230.2 ± 127.0	393.6 ± 148.1	<0.0001	234.7 ± 118.5	315.5 ± 169.4	= 0.001
Protein (g/day)	101.0 ± 53.8	88.5 ± 41.1	133.0 ± 68.0	<0.0001	91.5 ± 40.3	109.9 ± 62.9	= 0.028
Fat (g/day)	88.4 ± 53.3	76.8 ± 42.3	118.3 ± 66.3	<0.0001	82.6 ± 42.4	93.9 ± 61.7	= 0.174

Table 2: Intake of energy and essential macronutrients, indicators of consumption of energy and carbohydrates per unit of fiber.

In the whole group of patients involved in the study, as well as in groups separated by age and FGID symptoms, an absolute deficiency of dietary fiber intake was revealed (Table 2). Dietary fiber was significantly less consumed among patients aged <35 years compared to those aged ≥35 years (19.6 ± 9.3 g/day vs. 27.8 ± 7.9 g/day, p < 0.0001). Indicators of dietary fiber intake, such as the amount of fiber consumed from bread, were not significantly different between age groups of patients (4.6 ± 4.3 g/day vs. 5.5 ± 4.4 g/day, p = 0.24), but were significantly lower among patients with FD compared to NERD cases (3.9 ± 2.9 g/day vs. 5.8 ± 5.2 g/day, p = 0.004).

Fiber consumption in the whole group was on average 18.1 ± 9.5 g/day less than the recommended 40 g/day (Table 2), and the amount of fiber consumed from bread was also deficient - on average -7.1 ± 4.0 g/day (recommended 12 g/day). Dietary fiber deficiency was significantly dramatic among patients <35 years of age compared to the older age group (-19.9 ± 9.4 g/day vs. -13.6 ± 8.1 g/day, p < 0.0001) and also among patients with FD versus NERD cases (-20.2 ± 8.3 g/day vs. -16.1 ± 10.1 g/day, p = 0.005). Deficiency of fiber intake from bread was also significantly high in the group of patients aged <35 years (-7.7 ± 3.8 g/day vs. -5.6 ± 4.3 g/day, p = 0.002) and among patients with FD compared to NERD cases (-8.1 ± 2.9 g/day vs. -6.2 ± 5.2 g/day, p = 0.004).

In contrast to the data on dietary fiber intake, the assessment of the consumption of other major macronutrients in the study groups did not reveal an absolute deficiency of carbohydrates, fats or proteins. However, a significant difference was found in the groups marked by both age and forms of functional disorders of the upper gastrointestinal tract (Table 2).

Patients ≥35 years of age consume significantly more carbohydrates than in the younger group (393.6 ± 148.1 g/day vs. 230.2 ± 127.0 g/day, p < 0.0001).Patients of the same age group also consume more protein (133.0 ± 68.0 g/day vs. 88.5 ± 41.1 g/day, p < 0.0001) and fat (118.3 ± 66.3 g/day vs. 76.8 ± 42.3 g/day, p < 0.0001). Consumption of carbohydrates (315.5 ± 169.4 g/day vs. 234.7 ± 118.5, p = 0.001) and protein (109.9 ± 62.9 g/day vs. 91.5 ± 40.3 g/day, p = 0.028) is significantly higher in patients with NERD than in the group of patients with FD. Fat consumption is also higher in the group of patients with NERD (93.9 ± 61.7 g/day vs. 82.6 ± 42.4 g/day, p = 0.174), although the difference was not statistically significant (Table 2).

Share of essential macronutrients in the energy balance

The assessment of the energy balance indicators showed a relative deficit of carbohydrate and protein intake compared to the recommended values in energy equivalents (E%) (by -15.3 ± 15.2E% and -27.4 ± 11.9E%, respectively) and a relative excess of fat intake (+29.7 ± 26.3E%) with) in the whole study group of patients (Table 3).

Amount/Index	Overall group	<35 yrs. of age	≥35 yrs. of age	p	FD	NERD	p
Energy intake by 1g of food (kcal/g)	1.5 ± 0.7	1.5 ± 0.8	1.3 ± 0.4	= 0.024	1.6 ± 0.7	1.4 ± 0.6	= 0.002
Energy derived per 1g of total fiber (kcal/g)	135.8 ± 68.9	143.4 ± 72.8	116.3 ± 53.8	= 0.023	144.6 ± 71.2	127.4 ± 66.1	= 0.038
Energy derived per 1g of bread/wheat fiber (kcal/g)	94.3 ± 30.8	89.5 ± 32.6	106.5 ± 21.4	= 0.023	87.7 ± 29.6	100.6 ± 30.7	= 0.007
Carbohydrates per 1g of total fiber (g/g)	12.6 ± 5.0	14.8 ± 7.2	11.7 ± 3.5	<0.0001	11.8 ± 3.5	13.3 ± 6.0	= 0.055
Carbohydrates per 1g of bread/wheat fiber (g/g)	17.2 ± 5.6	16.3 ± 5.7	19.7 ± 4.4	<0.0001	18.4 ± 5.5	15.9 ± 5.3	= 0.004

Table 3: Indicators of consumption of energy and carbohydrates per unit of fiber.

The analysis of the energy balance of patients aged <35 years showed a significantly deficient carbohydrate intake than in patients aged ≥35 years (-17.2 ± 13.9E% vs. -10.6 ± 17.4E%, p = 0.012) (Table 3). This indicator is significantly lower in cases of FD compared to NERD (-18.1 ± 13.4E% vs. -12.7 ± 16.4E%, p = 0.024).

The share of protein consumption in the energy balance is noticeably lower by -27.4 ± 11.9E% in the overall study group, although a significant difference was found between age groups (-26.8 ± 11.5E% vs. -29.0 ± 12.8E%, p = 0.279) and between groups of disease forms (-26.4 ± 11.1E% vs. -28.4 ± 12.6E%, p = 0.294) (Table 3).

The consumption of fats in the energy balance was represented by a significant excess in all groupsand amounted to 29.7 ± 26.3E% more than recommended in the whole study group (Table 3). There was no statistically significant difference in the share of excess fat in energy balance between the age groups (28.3 ± 27.1E% vs. 33.6 ± 23.8E%, p = 0.246) as well as between the groups of patients with FD and NERD (32.6 ± 24.6E % vs. 27.0 ± 27.7E%, p = 0.171).

Profiles of energy and macronutrients consumption

In the general group of patients, the essential nutrient consumption profile is represented by a relative deficiency of carbohydrates and protein, an absolute deficiency of dietary fiber and bread/wheat fiber intake, and a relative excess of fat intake. At the same time, energy deficiency was detected in 24.4% of patients, excess energy intake - in 43.3%, and recommended intake - in 32.3%.

Absolute deficiencyof energy (28.8% vs. 13.1%) and dietary fiber (93.2% vs. 86.9%) is more common in the nutritional profile of patients aged <35 years, although the difference compared to the older age group is statistically insignificant. In both age groups, bread/wheat fiber is deficient and appears with almost the same frequency (93.2% vs. 95.7%). In younger patients, relative carbohydrate and protein deficiency is more common (88.1% vs. 82.6% and 96.6% vs. 91.3%, respectively) in contrast to patients older than 35 years.

In patients aged ≥35 years, compared with the younger age group, recommended and excessive energy intakes are more common (39.1% vs. 30.5% and 47.8% vs. 40.7%, respectively), and recommended indicators of dietary fiber intake are also more common (13.1% vs. 6.8%). However, the recommended level of fiber intake from bread is less common (4.3% vs. 6.8%). In this age group no cases of carbohydrate consumption in recommended energy equivalents have been recorded, although excess consumption is relatively high (17.4% vs. 6.2%). In the group of patients aged ≥35 years, there was no relative fat deficiency, which was rarely found among patients aged <35 years (in 5.1%). Recommended intake of fat was also noted more often among younger patients (11.9% vs. 8.7%). Relative excess fat intake is more common in patients aged ≥35 years (91.3% vs. 83.0%).

In the group of patients with FD, in contrast to the cases of NERD, absolute energy deficiency is more often observed (30.0% vs. 19.0%). The frequency of excess energy intakedid not differ significantly between the groups of patients with FD and NERD (42.5% vs. 42.9%). Of particular interest was the absolute deficiency of the total amount of dietary fiber, which was more evident in patients with FD than with NERD(95.0% vs. 88.1%).The fiber consumed from bread and wheat products was absolutely insufficient in all cases(100%). In the FD group, a relative deficiency of carbohydrates (90.0% vs. 83.3%) and protein (97.5% vs. 92.9%) intake and a relative excess of fat intake (87.5% vs. 83.3%) are also observed.

Consumption of fiber from the diet

Energy consumption per 1 g of food was determined in all patients and amounted to 1.5 ± 0.7 kcal/g (Table 3). Among the patients younger than 35 years, the measured data were significantly higher compared to the older group of patients (1.5 ± 0.8 kcal/g versus 1.3 ± 0.4kcal/g, p = 0.024). Data analysis in patients with various upper FGIDs revealed significantly higher energy consumption from food in the FD group compared to patients with NERD (1.6 ± 0.7 kcal/g vs. 1.4 ± 0.6kcal/g, p = 0.002).

In the total group of patients, energy consumption per 1 g of fiber is 135.8 ± 68.9 kcal/g (Table 3). This indicator is higher among patients younger than 35 years compared with the group ≥35 years (143.4 ± 72.8 kcal/g vs. 116.3 ± 53.8 kcal/g, p = 0.023), as well as in patients with FD compared with patients with NERD (144.6 ± 71.2 kcal/g vs. 127.4 ± 66.1 kcal/gg, p = 0.038). The deficiency is detected in the energy consumption per 1 g of fiber obtained from

bread and is in average 94.3 ± 30.8 kcal/g. The deficiency is more noticeable in the group of patients older than 35 years than in the group aged <35 years (106.5 ± 21.4 kcal/g vs. 89.5 ± 32.6 kcal/g, p = 0.023) and in patients with NERD compared with FD patients (100.6 ± 30.7kcal/g vs. 87.7 ± 29.6 kcal/g, p = 0.023).g, = 0.007).

The consumption of carbohydrates per 1g of dietary fiber in the whole group is in average 12.6 ± 5.0g/g (Table 3). The total carbohydrate intake for 1 gram of fiber is higher among patients younger than 35 years (14.8 ± 7.2g/g vs. 11.7 ± 3.5g/g, p < 0.0001) and in the group of NERD patients (13.3 ± 6.0g/g vs. 11.8 ± 3.5g/g, p = 0.055). The intake of carbohydrates per 1 g bread derived dietary fiber is 17.2 ± 5.6g/g and the an index is significantly higher among patients ≥35 years(19.7 ± 4.4 g/g vs. 16.3 ± 5.7 g/g, p < 0.0001) and in patients with FD (18.4 ± 5.5g/g vs. 15.9 ± 5.3g/g, p = 0.004).

Discussion

Analysis of the energy and nutrient status of thepatients participating in the study revealed a significantly lower intake of total and bread fiber. The consumptionof 1g of total fiber and bread fiber corresponded to significantly higher energy and carbohydrate intake, indicating intake of fiber from food forms with its low content. A quantitative data assessment does not show either a deficit or an excess of carbohydrate, protein and fat intake; however, an analysis of the proportion of various nutrients in the energy value of food revealed a relative lack of carbohydrates and protein intake, as well as a relative excess of fat intake, which indicates a predominant consumption of food forms with high fat content. Such a nutrient intake profile is seen in all three groups of energy intake - excessive, recommended and deficient intake groups.

Several systematic reviews describe the relationshipbetween the consumption of basic nutrients and individual food forms with the development of upper FGID [9,11,23]. Evidence supports a significant cause-and-effect relationship between fiber consumption and upper FGID [7,11,13]. According to recent studies, the induction of such a functional disorder is associated with the intake of a certain food forms and is confirmed by the effect of food-based dietary interventions in the management of this clinical condition [9,24,25]. The relationship between the fat intake and high-energy foods with the development of functional dyspepsia was also described [26-28].

When considering the energy and nutrient intake profiles obtained by us, several age-related characteristics of the study cohorts should be taken into account. Among all patients, the proportion of patients aged <35 years was approximately 2.5 times higher than those aged ≥35 years. Thus, the fiber intake profile observed in the general group of patients is is largely characteristic of a younger group – consumption of significantly less total and bread fiber compared to patients aged ≥35 years. However, the proportion of patients with both total and bread fiber deficiency was equal in both age groups, and corresponds to the frequency of patients with fiber deficiency in the overall group.

The contribution of protein and fat to total energy intake does not significantly differ in various age groups. The profile of nutrient intake is also almost the same and similar to the data of the general group, i.e. it is characterized by a relative deficitof carbohydrate and protein intake and an excess of fat in both age groups. This macronutrient profile in patients aged <35 years is due to consumption of high-energy foodsin relatively small portions, a shortage of complex carbohydrates containing fiber and the main sources of protein, as well as a relative excess of fat intake. In patients over 35 years of age, excessive energy intake is due to the consumption of large portions of low energy content. However, even such a model cannot provide the recommended amount of fiber. The validity of such considerations is indicated by the fact that the intake of 1g of total fiber in the young age group is achieved with significantly more energy and carbohydrates. In patients aged ≥35 years, the consumption of fiber from bread sources is relatively high, which leads to a significant increase in the consumption of energy and carbohydrates from bread per 1 g of fiber.

Age-specific profiles of energy and macronutrient intake associated with functional disorders of the upper gastrointestinal tract have not been sufficiently studied. Since significant associations were found between energy consumption, macronutrients and age, discussion of nutrition profiles among patients with various forms of FGID required additional evaluation depending on age. Although these groups are similar in number and average age, approximately 4.7 times more patients with FD are<35 years, so the energy and nutrient intake profile typical of this age group dominants in the FD group. Although, there are 2.2 times more patients under the age of 35 in the NERD group than patients aged ≥35 years, patients

with this diagnosis mainly have energy and nutrient consumption profiles characteristic of the older age group.Consequently,in the presented study, the age related heterogeneity of the groups divided according to the forms of functional disorders does not allow us to determine the characteristics of specific nutrient profiles in different forms of upper FGID,regardless of age, which is a limitation of the study.

Existing data on specific profiles of energy and nutrient consumption in patients with various forms of upper FGID mainly reflect disorders caused by a single food form or nutrient. While the profile of food intake in FD has been studied more, there is fewer data on patients with functional esophageal symptoms [23-31].

The regression analysis used in the study allows to create sensitive (r2(adj)> 60%) and significant ($p < 0.05$) correlation models of the consumption of essential nutrients for all the studied garoups (Table 4). Only in the age group ≥35 years, it was found that the regression model of associations between dietary fiber intake and other nutrients has a low probability (r2(adj) = 45.5%). The intake of macronutrients with high energy value is positively associated with the consumption of fiber. The regression model is significant, but has relatively lower probability (r2(adj) – from 67.6% to 82.4%). The relationship of intake of other macronutrients was revealed by high probability and significance of regression (r2(adj) - from 82.3% to 93.9%, $p < 0.0001$) in all research groups.

These results can be explained by the relationships between the consumption of carbohydrate, proteins, and fats in an entire energy balance, as well as the consumption of carbohydrates and fiber from the same food sources. If carbohydrates are consumed in large quantities from food forms containing a small amount of fiber, and at the same time proteins are taken from foods rich in fats with a high energy, the correlation between fiber and high energy nutrients is weak. This pattern characterizes intake ofmacronutrient in the age group ≥ 35 years.

The results of the regression analysis of nutrient intake revealed that in all study groups carbohydrate intake was a strong and significant predictor of dietary fiber intake (coefficient ofprediction from 6.60 ± 1.27 to 9.65 ± 0.58). Conversely, the predictability of fiber consumption for carbohydrate consumption is much weaker (coefficient of prediction- from 0.06 ± 0.01 to 0.08 ± 0.01). Such a relationship indicates that fiber is consumed from food forms high in simple carbohydrates and low in complex carbohydrates.

In all the study groups, with the exception of the group aged <35 years, the results of the regression analysis showed the predictability of carbohydrate consumption in relation to fat consumption (coefficient of prediction - 1.11 ± 0.24 to 1.43 ± 0.23) (Table 4). However, the coefficient of prediction of carbohydrates for fat consumption in the age group <35 years is only 0.76 ± 0.56, whilethis indicator was not statistically significant. This relationship between the consumption ofcarbohydrates and fats indicates the consumption of combined forms of food, in which the content of simple carbohydrates and fats is high.

The relationship between protein and fat with other nutrients is characterized by low predictability and statistically lower significance of the corresponding coefficients.

Based on the analysis of the study results, it can be assumed that the nutritional profile of patients with upper FGIDis characterized by a lower than recommended fiber content and an excess of fat in all models- energy deficient, recommended and excess intake. Such a model of nutrient intake should be due to the intake of food forms with a high content of simple carbohydrates. Food reach with simple carbohydrates do not function as a source of fiber and cannot ensure its intake in sufficient. Food rich in simple carbohydrates and fats, even if taken in small portions, have a high energy value. In the same way, we can explain the relative lack of protein intake in the energy balance,which is associated with the predominant consumption of food forms in which protein is combined with fat. The intake of such food leads to a relative deficit of the total amount of carbohydrates and proteins and an excess of fats in the energy balance.

This nutrient and energy consumption profilecorresponds to a diet rich in fermentable oligo-, di- and monosaccharides and saturated fatty acids (FODMAPs). The role of such a nutritional profile in the occurrence ofupper FGID is now widely discussed [23,25,27,28]. In addition, the results of a systematic analysis of studies conducted up to date indicate that limiting the consumptionof fermentable oligo-, di- and monosaccharides and saturated fatty acids alleviates the symptoms of functional disorders of the upper gastrointestinal tract [25,29-31].

The study revealed probable nutritional and energy disturbances that predispose to the development of upper FGID and may represent an important target for dietary modifications and pharmacotherapeutic intervention.

Further research is needed to investigate both the possible mechanisms for the development of upper FGID and the effects of tailored dietary interventions.

Group	Nutrient	Predictability				Regression constant	r^2(adj)
		Carbohydrates	Protein	Fat	Fiber		
Overall	Carbohydrates	-	0.59 ± 0.24 (p = 0.016)	1.11 ± 0.24 (p < 0.0001)	7.91 ± 0.50 (p < 0.0001)	-55.04 ± 11.58 (p < 0.0001)	86.8%
	Protein	0.06 ± 0.02 (p < 0.0001)	-	0.83 ± 0.05 (p < 0.016)	-0.20 ± 0.26 (p = 0.439)	15.53 ± 3.76 (p < 0.0001)	89.2%
	Fat	0.11 ± 0.02 (p < 0.0001)	0.76 ± 0.05 (p < 0.0001)	-	-0.77 ± 0.24 (p = 0.002)	-0.34 ± 3.79 (p = 0.928)	90.0%
	Fiber	0.08 ± 0.01 (p < 0.0001)	-0.02 ± 0.02 (p = 0.439)	-0.08 ± 0.02 (p = 0.002)	-	9.62 ± 0.95 (p < 0.0001)	68.3%
<35 yrs. of age	Carbohydrates	-	-0.37 ± 0.26 (p = 0.156)	1.43 ± 0.23 (p < 0.0001)	9.65 ± 0.58 (p = 0.0001)	-35.21 ± 10.59 (p = 0.001)	87.7%
	Protein	-0.05 ± 0.03 (p = 0.156)	-	0.83 ± 0.06 (p < 0.0001)	1.35 ± 0.36 (p < 0.0001)	9.30 ± 3.84 (p = 0.017)	85.2%
	Fat	0.17 ± 0.03 (p < 0.0001)	0.80 ± 0.05 (p < 0.0001)	-	-1.89 ± 0.33 (p < 0.0001)	3.23 ± 3.85 (p = 0.404)	86.5%
	Fiber	0.07 ± 0.01 (p < 0.0001)	0.08 ± 0.02 (p < 0.0001)	-0.12 ± 0.02 (p < 0.0001)	-	4.53 ± 0.87 (p < 0.0001)	82.4%
≥35 yrs. of age	Carbohydrates	-	1.13 ± 0.55 (p = 0.045)	0.76 ± 0.56 (p = 0.183)	6.60 ± 1.27 (p < 0.0001)	-29.74 ± 43.38 (p = 0.497)	82.3%
	Protein	0.08 ± 0.04 (p = 0.450)	-	0.84 ± 0.08 (p < 0.0001)	-1.40 ± 0.38 (p = 0.001)	40.43 ± 9.95 (p < 0.0001)	93.9%
	Fat	0.06 ± 0.04 (p = 0.183)	0.84 ± 0.08 (p < 0.0001)	-	0.51 ± 0.43 (p = 0.243)	-29.73 ± 10.84 (p = 0.009)	93.6%
	Fiber	0.06 ± 0.01 (p < 0.0001)	-0.17 ± 0.05 (p = 0.001)	0.06 ± 0.05 (p = 0.243)	-	20.04 ± 2.73 (p < 0.0001)	45.5%
FD	Carbohydrates	-	-0.05 ± 0.32 (p = 0.867)	1.21 ± 0.30 (p < 0.0001)	8.53 ± 0.82 (p < 0.0001)	-28.05 ± 14.78 (p = 0.061)	84.1%
	Protein	-0.01 ± 0.04 (p = 0.867)	-	0.81 ± 0.08 (p < 0.0001)	0.57 ± 0.46 (p = 0.219)	15.34 ± 5.17 (p = 0.004)	82.2%
	Fat	0.15 ± 0.04 (p < 0.0001)	0.75 ± 0.07 (p < 0.0001)	-	-0.90 ± 0.43 (p = 0.041)	-2.49 ± 5.24 (p = 0.636)	85.1%
	Fiber	0.07 ± 0.01 (p < 0.0001)	0.04 ± 0.03 (p = 0.219)	-0.06 ± 0.03 (p = 0.041)	-	5.24 ± 1.22 (p < 0.0001)	74.5%
NERD	Carbohydrates	-	0.61 ± 0.36 (p = 0.088)	1.24 ± 0.36 (p = 0.001)	7.79 ± 0.65 (p < 0.0001)	-55.08 ± 17.36 (p = 0.002)	88.7%
	Protein	0.06 ± 0.03 (p = 0.088)	-	0.86 ± 0.07 (p < 0.0001)	-0.28 ± 0.33 (p = 0.411)	17.18 ± 5.36 (p = 0.002)	92.2%
	Fat	0.10 ± 0.03 (p = 0.001)	0.76 ± 0.06 (p < 0.0001)	-	-0.81 ± 0.30 (p < 0.009)	-2.59 ± 5.33 (p = 0.628)	92.9%
	Fiber	0.08 ± 0.01 (p < 0.0001)	-0.04 ± 0.04 (p < 0.411)	-0.10 ± 0.04 (p = 0.009)	-	10.88 ± 1.46 (p < 0.0001)	67.6%

Table 4: Predictability of nutrientconsumption by the results of regression analysis.

Conclusions

In patients with non-erosive gastroesophageal reflux disease and functional dyspepsia, the total intake of dietary fiber, as well as its consumption from bread and wheat products is significantly insufficient.

The assessment of micronutrient consumption in groups with different energy profiles revealed a relative deficit of carbohydrate and protein intake and a relative excess of fat intake.

Young patients with upper FGID are characterized by eating patterns with relatively small but high-calorie portions, while in the older age group excessive energy consumption is due to the intake of large portions with lower energy content.

Patients with FGID consume fiber from foods rich in simple, but poor in complex carbohydrates, including dietary fiber.

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Bibliography

1. Sperber AD., *et al*. "Worldwide Prevalence and Burden of Functional Gastrointestinal Disorders, Results of Rome Foundation Global Study". *Gastroenterology* 160.1 (2021): 99-114.e3.

2. Aziz I., *et al*. "Epidemiology, clinical characteristics, and associations for symptom-based Rome IV functional dyspepsia in adults in the USA, Canada, and the UK: a cross-sectional population-based study". *Lancet Gastroenterology and Hepatology* 3 (2018): 252-262.

3. Palsson OS., *et al*. "Rome IV diagnostic questionnaires and tables for investigators and clinicians". *Gastroenterology* 150.6 (2016): 1481-1491.

4. Palsson OS., *et al*. "Prevalence of Rome IV functional bowel disorders among adults in the United States, Canada, and the United Kingdom". *Gastroenterology* 158 (2020): 1262-1273. e3.

5. Drossman DA., *et al*. "Neuromodulators for Functional Gastrointestinal Disorders (Disorders of Gut-Brain Interaction): A Rome Foundation Working Team Report". *Gastroenterology* 154.4 (2018): 1140-1171.e1.

6. Chirila I., *et al*. "The role of diet in the overlap between gastroesophageal reflux disease and functional dyspepsia". *Turkish Journal of Gastroenterology* 27 (2016): 73-80.

7. Slavin JL. "Position of the American Dietetic Association: Health implications of dietary fiber". *Journal of the American Dietetic Association* 108 (2008): 1716-1731.

8. Duboc H., *et al*. "The Role of Diet in Functional Dyspepsia Management". *Frontiers in Psychiatry* 11 (2020): 23.

9. Popa SL., *et al*. "Exclusion Diets in Functional Dyspepsia". *Nutrients* 14.10 (2022): 2057.

10. Talley NJ Ford AC. "Functional dyspepsia". *The New England Journal of Medicine* 373 (2015): 1853-1863.

11. Brownlee I. "The impact of dietary fibre intake on the physiology and health of the stomach and upper gastrointestinal tract". *Bioactive Carbohydrates and Dietary Fibre* 4 (2014): 155-169.

12. Sulaberidze G., *et al*. "Impact of food enriched with dietary fiber on patients with constipation-predominant irritable bowel syndrome". *Georgian Medical News* 264.3 (2017): 132-135.

13. Capuano E. "The behavior of dietary fiber in the gastrointestinal tract determines its physiological effect, critical reviews". *Food Science and Nutrition* 57.16 (2017): 3543-3564.

14. Suzuki H., *et al*. "Effect of lansoprazole on the epigastric symptoms of functional dyspepsia (ELF study): A multicentre, prospective, randomized, double-blind, placebo-controlled clinical trial". *United European Gastroenterology Journal* 1.6 (2013): 445-452.

15. Suzuki H. "The Application of the Rome IV Criteria to Functional Esophagogastroduodenal Disorders in Asia". *Journal of Neurogastroenterology and Motility* 23.2 (2017)325-333.

16. Diet History Questionnaire II, National Cancer Institute.

17. Roe L., *et al*. "Dietary intervention in primary care: Validity of the DINE method for diet assessment". *Family Practice* 11 (1994): 375-381.

18. Sulaberidze G., *et al*. "Frequency of Consumption of Different Food Groups among Adult Population of Tbilisi". Collection of Scientific Works of the Tbilisi State Medical University 49 (2015): 104-106.

19. Coding Manual for the 2010 NCI Diet History Questionnaire II One-Month with Serving Sizes Version. Diet History Questionnaire, Version 2.0. National Institutes of Health, Epidemiology and Genomics Research Program, National Cancer Institute (2010).

20. Gebhardt Susan E and Robin G Thomas. "Nutritive Value of Foods". U.S. Department of Agriculture, Agricultural Research Service, Home and Garden Bulletin 72 (2002).

21. Stephen A., *et al*. "Dietary fibre in Europe: current state of knowledge on definitions, sources, recommendations, intakes and relationships to health". *Nutrition Research Reviews* 30 (2017): 149-190.

22. Manore MM. "Exercise and the institute of medicine recommendations for nutrition". *Current Sports Medicine Reports* 4.4 (2005): 193-198.

23. Pesce M., *et al*. "Diet and functional dyspepsia: Clinical correlates and therapeutic perspectives". *World Journal of Gastroenterology* 26 (2020): 456-465.

24. Duncanson K., *et al*. "Mechanisms of Food-Induced Symptom Induction and Dietary Management in Functional Dyspepsia". *Nutrients* 13 (2021): 1109.

25. Goyal O., *et al*. "Low fermentable oligosaccharides, disaccharides, monosaccharides, and polyols diet versus traditional dietary advice for functional dyspepsia: A randomized controlled trial". *Journal of Gastroenterology and Hepatology* 37 (2021): 301-309.

26. Futagami S., *et al*. "Comparison of clinical characteristics, eating behaviors, and clinical symptoms following fat intake in functional dyspepsia with functional dyspepsia with pancreatic enzyme abnormalities between Singapore and Japan". *Journal of Gastroenterology and Hepatology* 37.8 (2022): 1525-1533.

27. Khodarahmi M and Azadbakht L. "Dietary fat intake and functional dyspepsia". *Advanced Biomedical Research* 5 (2016): 76.

28. Duncanson KR., *et al*. "Food and functional dyspepsia: a systematic review". *Journal of Human Nutrition and Dietetics* 31.3 (2018): 390-407.

29. Jessica R., *et al*. "Low FODMAP diet beyond IBS: Evidence for use in other conditions". *Current Opinion in Pharmacology* 64 (2022): 102208.

30. Tack J., *et al*. "Evidence-Based and Emerging Dietary Approaches to Upper Disorders of Gut-Brain Interaction". *American Journal of Gastroenterology* 117.6 (2021): 965-972.

31. Tan VP. "The low-FODMAP diet in the management of functional dyspepsia in East and Southeast Asia". *Journal of Gastroenterology and Hepatology* 32 (2017): 46-52.