ARTÍCULO ORIGINAL

Gac Méd Caracas 2022;130(2):266-275
DOI: 10.47307/GMC.2022.130.2.6

Macronutrient and micronutrient intake in dietary habits contributed to dyspeptic symptoms in Indonesia

La ingesta de macronutrientes y micronutrientes en los hábitos dietéticos contribuye a los síntomas de dispepsia en Indonesia

Muhammad Miftahussurur[1a,b,c§*], Ricky Indra Alfaray[2b,c§], Yudith Annisa Ayu Rezkitha[3b,d§], Kartika Afrida Fauzia[4b,c], Hasan Maulahela[5e], Virly Nanda Muzellina[6e], Luciana Sophie Mariana Rotty[7f], Yoma Sari Namara[8g], Azzaki Abubakar[9h], Syifa Mustika[10i], Neneng Ratnasari[11j], Agus Yudho Santosa[12k], Marselino Richardo[13l], I Dewa Nyoman Wibawa[14m], I Ketut Adnyana[15n], Purnawati Hustina Rachman[16o], Brian Eka Rachman[17p], Dalla Doohan[18b], Langgeng Agung Waskito[19b], Yoshio Yamaoka[20a,c], Ali Khomsan[21o]

DOI: 10.47307/GMC.2022.130.2.6

ORCID ID: https://orcid.org/0000-0003-1415-6033[1]
ORCID ID: https://orcid.org/0000-0001-7721-9455[2]
ORCID ID: https://orcid.org/0000-0001-7600-9114[3]
ORCID ID: https://orcid.org/0000-0001-6901-3270[4]
ORCID ID: https://orcid.org/0000-0002-0396-4433[5]
ORCID ID: https://orcid.org/0000-0003-4949-7145[6]
ORCID ID: https://orcid.org/0000-0001-5637-742X[7]
ORCID ID: https://orcid.org/0000-0001-9852-0984[8]
ORCID ID: https://orcid.org/0000-0001-6837-5288[9]
ORCID ID: https://orcid.org/0000-0003-4831-2719[10]
ORCID ID: https://orcid.org/0000-0003-1323-2233[11]
ORCID ID: https://orcid.org/0000-0003-2359-0325[12]
ORCID ID: https://orcid.org/0000-0002-5738-9753[13]
ORCID ID: https://orcid.org/0000-0001-5190-3072[14]
ORCID ID: https://orcid.org/0000-0001-5217-2312[15]
ORCID ID: https://orcid.org/0000-0002-6574-484X[16]
ORCID ID: https://orcid.org/0000-0002-6574-484X[17]
ORCID ID: https://orcid.org/0000-0003-3076-571X[18]
ORCID ID: https://orcid.org/0000-0002-9400-1973[19]
ORCID ID: https://orcid.org/0000-0002-1222-5819[20]
ORCID ID: https://orcid.org/0000-0001-6101-3583[21]

[a] Division of Gastroentero-Hepatology, Department of Internal Medicine, Faculty of Medicine-Dr. Soetomo Teaching Hospital, Universitas Airlangga, Surabaya, East Java, 60286, Indonesia. Helicobacter pylori and Microbiota Study Group, Institute Tropical Disease. Universitas Ailangga, Surabaya, Esat Java, 60115, Indonesia

[b] Institute Tropical Disease, Universitas Airlangga, Surabaya, East Java, 60115, Indonesia.

[c] Department of Environmental and Preventive Medicine, Oita University Faculty of Medicine, Yufu, 879-5593, Japan.

[d] Faculty of Medicine, Muhammadiyah University of Surabaya, Surabaya, East Java, 60113, Indonesia.

[e] Division of Gastroenterology, Department of Internal Medicine, Cipto Mangunkusumo National General Hospital, Faculty of Medicine, Universitas Indonesia, Jakarta 10430, Indonesia.

[f] Division of Gastroentero-Hepatology, Department of Internal Medicine, Prof. Dr. RD Kandou Province General Hospital, Faculty of Medicine, Universitas Sam Ratulangi, Manado, North Sulawesi 95163, Indonesia.

[g] Department of Internal Medicine, Anutapura General Hospital, Palu, Central Sulawesi, 94221, Indonesia.

[h] Division of Gastroentero-Hepatology, Department of Internal Medicine, dr. Zainoel Abidin Teaching Hospital, Faculty of Medicine, Universitas Syiah Kuala, Banda Aceh 24415, Indonesia.

[i] Division of Gastroentero-Hepatology, Department of Internal Medicine, Faculty of Medicine, Universitas Brawijaya, Malang, East Java 65112, Indonesia.

[j] Division of Gastroentero-Hepatology, Department of Internal Medicine, Faculty of Medicine, Universitas Gajah Mada, Yogyakarta, 55284, Indonesia.

[k] Balung Region Hospital, Jember, East Java 68161, Indonesia.

[l] Merauke Region Hospital, Merauke, Papua 99613, Indonesia.

[m] Division of Gastroentero-Hepatology, Department of Internal Medicine, Sanglah General Hospital, Faculty of Medicine, Udayana University, Bali 80114, Indonesia.

[n] Department of Pharmacology & Clinical Pharmacy, School of Pharmacy, Institute of Technology Bandung, Bandung, West Java 40132, Indonesia.

[o] Department of Community Nutrition, Faculty of Human Ecology, IPB University, Bogor, West Java 16680, Indonesia.

[p] Division of Tropical and Infectious Disease, Department of Internal Medicine, Faculty of Medicine-Dr. Soetomo Teaching Hospital, Universitas Airlangga, Surabaya, East Java 60286, Indonesia

Recibido: 22 de diciembre 2021
Aceptado: 30 de marzo 2022

SUMMARY

Background: *Dyspepsia is a highly prevalent gastrointestinal disorder and assessing the nutrient correlation is important to improve the patient's dyspepsia. We analyzed the association of the macronutrients and micronutrients with dyspepsia also its correlation to the severity of dyspepsia.* **Methods:** *We analyzed 378 questionnaires from individuals with dyspepsia symptoms in 15 centers across Indonesia, including sites located on the three largest islands (Java, Sumatra, and Sulawesi) were collected. This research uses the 24-Hour Recall Questionnaire and Semi-Quantitative Food Frequency Questionnaire (S-FFQ) to determine the foods (nutrients) eaten that become a risk factor for dyspepsia. The symptoms of dyspepsia were assessed using the Gastrointestinal Symptom score (GIS).* **Results:** *The result revealed that 90.5 % of respondents (342/378) had dyspeptic symptoms. Dyspepsia was likely associated with the senile age group 50-59 (p=0.022) and GIS score was associated with the region (p=0.001; r=0.173). Macronutrients and micronutrients that correlated with dyspepsia are low consumption of fat (p=0.032) and magnesium (p=0.025). Macro and micronutrients intake were varied in each region and each bivariate analysis showed that almost all micro and macronutrient intakes were significantly different from each dyspepsia symptom.* **Conclusion:** *Macronutrients and micronutrients intake were associated with dyspepsia diagnosis and severity, especially consumption of fat and magnesium. The age, culture, and geographical region of the nutrient intake should also be considered in dyspepsia patient management.*

Keywords: *Indonesia, dyspepsia, macronutrient, micronutrient, nutritional Status.*

RESUMEN

Antecedentes: *La dispepsia es un trastorno gastrointestinal de alta prevalencia, por lo que es importante evaluar la correlación de los nutrientes para mejorar la dispepsia del paciente. Analizamos la asociación de los macronutrientes y micronutrientes con la dispepsia y su correlación con la gravedad de esta.* **Métodos:** *Se analizaron 378 cuestionarios de personas con síntomas de dispepsia en 15 centros de Indonesia, incluidos los sitios ubicados en las tres islas más grandes (Java, Sumatra y Sulawesi). Esta investigación utiliza el Cuestionario de recordatorio de 24 horas y el Cuestionario semicuantitativo de frecuencia de alimentos (S-FFQ) para determinar los alimentos (nutrientes) ingeridos que se convierten en un factor de riesgo de dispepsia. Los síntomas de dispepsia se evaluaron mediante la puntuación de síntomas gastrointestinales (GIS).* **Resultados:** *El resultado reveló que el 90,5 % de los encuestados (342/378) tenían síntomas dispépticos. La dispepsia probablemente se asoció con el grupo de edad senil 50-59 (p = 0,022) y la puntuación GIS se asoció con la región (p = 0,001; r = 0,173). Los macronutrientes y micronutrientes que se correlacionaron con la dispepsia son el bajo consumo de grasas (p = 0,032) y magnesio (p = 0,025). La ingesta de macro y micronutrientes varió en cada región y cada análisis bivariado mostró que casi toda la ingesta de micro y macronutrientes fue significativamente diferente de cada uno de los síntomas de dispepsia.* **Conclusión:** *La ingesta de macronutrientes y micronutrientes se asoció con el diagnóstico y la gravedad de la dispepsia, especialmente el consumo de grasas y magnesio. La edad, la cultura y la región geográfica de la ingesta de nutrientes también deben tenerse en cuenta en el manejo del paciente con dispepsia.*

Palabras clave*: Indonesia, dispepsia, macronutriente, micronutrientes, estado nutricional.*

INTRODUCTION

Dyspepsia is commonly defined as retrosternal pain or upper abdominal discomfort referable to as the proximal digestive tract (1). Dyspepsia is a highly prevalent health issue involving a substantial and increasing health-cost burden worldwide. The prevalence of dyspepsia was reported to reach as high as 30 % in the general population (2,3). The previous study revealed that 43 % to 79.5 % of patients with dyspepsia in East Asian and Southeast Asian countries were functional dyspepsia (4,5). In Indonesia, dyspepsia cases became the number sixth and fifth of the top 10 most prevalent inpatient and outpatient diseases, respectively (6).

Several factors had been reported to have important roles in dyspepsias such as abnormalities of electrical control activity, gastric acid secretion disorder, gastric motility disturbance, abnormalities of perception, psychological disturbances, environmental factors, *Helicobacter pylori* infection, and dietary habits (7). The gastric motility abnormality includes the impaired gastric accommodation reflex in the corpus that resulted

in the early satiety; the important dyspepsia symptoms (8). Delayed gastric emptying also leads to a distended stomach and triggers a visceral hypersensitivity which can be shown as bloating and epigastric pain symptoms (9). Dyspepsia may not induce life-threatening situations but the negligence of these symptoms can give complications such as a decreased quality of life (10). The control of nutrient intake was proposed as part of dyspepsia management, although there were no clear guidelines. The over-restriction of the food intake of the patient could be harmful.

The type of nutrition was reported to affect gastrointestinal sensory and motor (11). The nutrient that was proposed to be related to dyspepsia were: macronutrients which consisted of carbohydrate, proteins, and fats; micronutrients which consisted of vitamins and minerals; and fiber (12,13). Despite this information, the relation of nutrition to dyspepsia remains unclear. While a study reported that carbohydrate affects dyspepsia symptoms (14), another study reported a non-significant association (15). Association study on protein intake was also scarce (10). Moreover, nutrient intake was also related to eating preference which is influenced by the culture (16). Hence a study that records the data on the common daily dietary intake from the community is necessary to understand which nutrient is associated with dyspepsia.

Indonesia is an archipelago that has around 633 ethnicities with their own cultures that spread in cities and islands. The influence of culture contributed to specific eating habits hence may be related to macronutrients and micronutrients intake. This study was conducted to assess the association between dyspepsia with the micronutrients and macronutrients in the dietary pattern habits in Indonesia. Dyspepsia symptom severity was also assessed carefully by interview using the Gastro-Intestinal Symptoms (GIS) score. Macronutrients ad micronutrients intake was measured using the Semi-quantitative Food Frequency Questionnaire (SFFQ), a questionnaire for collecting information on dietary intake. Indonesia has a different culture and different dietary pattern habits; therefore, this study also compares the nutritional intake dietary pattern habits between the Western and Eastern regions.

METHODS

Patients Sampling and Diagnosis of Dyspepsia

From January to August 2019, we collected 378 respondents who came to the hospital in 8 cities (Banda Aceh in Sumatra Island; Jakarta, Yogyakarta, Surabaya, Malang, Jember in Java Island; and Palu, Manado in Sulawesi Island). Sumatra Island and Java Island were categorized as a Western region of Indonesia and Sulawesi Island was included as the Eastern region due to the quite big gap in culture. Prior performed the survey, we collected informed consent from each participant, detailed medical and medication history regarding dyspepsia symptoms from the local community hospital, previous medical records, and their clinical consultants. Respondents that had a history of dyspepsia or were diagnosed with dyspepsia were included as a subject group and the dyspepsia symptoms description including its severity was assessed using the GIS questionnaire (17), whilst the patients that do not have a history of dyspepsia before were included as the control group. A respondent with a history of *H. pylori* infection with or without eradication therapy and with a history of partial or total gastrectomy was excluded. The study design and protocol were approved by the Ethics Committee of Dr. Cipto Mangunkusumo Teaching Hospital, Jakarta, Indonesia (No. KET-650/UN2.F1/ETIK/PPM.00.02/2019), Siti Khodijah Hospital, Surabaya-Sidoarjo, Indonesia (No. 008/KET-KEPK/4-2020) and Dr. Soetomo General Hospital, Surabaya, Indonesia (No. 1643/200/ix/2019).

Dietary Habits Survey

Dietary habits were measured based on the nutrients consumed by respondents with complaints of dyspepsia. Trained hospital nutritionist performed face-to-face interviews to obtain nutritional information. Nutrition referred to in this study is the food content and eating patterns that cause dyspepsia symptoms appeared. Dietary habits were measured based on the modified Semi-Quantitative Food Frequency Questionnaire (S-FFQ).

Modified S-FFQ that contained 24 hours of food recall was used in the patient`s interview (18). This questionnaire is suitable for large surveys and has a low burden for respondents. In the interview, participants were asked to describe the foods and drinks they had consumed in the previous 24 hours, including the type of food listed in the questionnaire. The open-ended interview is intended to help produce the most detailed description of foods and drinks consumed. Details information included how many meals per day, source of food, and portion size of food. The questionnaires are typically completed in 20-60 minutes (19).

Statistical Analysis

We classified the data into two regions, Western and Eastern regions based on geographical conditions. Discrete variables were tested using the chi-square test; abnormal distribution data were tested using the Mann-Whitney U. Logistic regression model was used to calculate the odds ratios (OR) of the risk factor of dyspepsia, including age, sex, Body Mass Index (BMI), and nutrition intake. The OR and 95 % confidence interval (CI) were used to estimate the risk. A *p*-value of less than 0.05 was accepted as statistically significant. The analysis was performed using SPSS statistical software version 23.0 (IBM Corp., Armonk, NY, USA).

RESULTS

Characteristics of Respondents

From January to August 2019, we included a total of 378 respondents, consisting of 143 males and 235 females with a mean age of 43.81±14.5 years. We collected data from 8 cities in Indonesia, including 69 respondents from Banda Aceh (Sumatera Island); 59 from Jakarta, 53 from Yogyakarta, 19 from Surabaya, 42 from Malang, and 27 from Jember (Java Island); 52 from Palu, and 57 from Manado (Sulawesi Island). Most of the respondents (342/378, 90.5 %) were included in the dyspepsia group, whilst the remaining (36/378, 9.5 %) were included in the control group. There was no significant difference between age in dyspeptic and control groups with median Inter Quartile Range (IQR) 43 (20.3) vs. 45 (22.0), p= 0.957. In addition, there was no association between sex in the proportion of dyspepsia p= 0.224.

When we categorized the cities into 2 regions, the Western and Eastern regions (Table 1), there was no difference in age, sex, body weight, and BMI between 2 regions (p>0.05 for all), but there was a significant difference in body height (p=0.033).

Table 1

Baseline Characteristics in each location respondents

Characteristics	West Region						East Region		
	Banda Aceh n = 69	Jakarta n = 59	Jember n = 27	Surabaya n = 19	Malang n = 42	Yogyakarta n = 53	Palu n = 52	Manado n = 57	p
Age	44.1±15.3	45.4±10.0	46.5±19.0	48.8±18.3	42.9±15.4	43.1±11.3	33.1±12.4	50.0±12.7	0.120
Sex, n (%)									
Male	17 (24.6)	24 (40.7)	7 (25.9)	8 (42.1)	23 (54.8)	20 (37.7)	10 (19.2)	34 (59.6)	0.518
Female	52 (75.4)	35 (59.3)	20 (74.1)	11 (57.9)	19 (45.2)	33 (62.3)	42 (80.8)	23 (40.4)	
Body weight (kg)	55.8±10.1	61.1±14.5	55.8±7.6	56.8±10.7	58.1±14.8	60.5±13.8	57.4±9.1	61.4±10.3	0.104
Height (cm)	156.4±7.0	160.5±8.7	154.9±6.2	157.9±5.0	156.1±10.0	158.9±7.2	156.3±3.6	162.1±6.9	0.033
BMI (kg/m^2)	22.8±4.0	23.6±4.7	23.3±3.3	22.8±4.2	23.7±4.5	23.8±4.6	23.5±3.6	23.3±3.2	0.367

BMI = Body mass index, (mean±SD) described as (xx.x±yy.y)
p-value was calculated based on a comparison between the Western and Eastern Region

Differences in Nutrients Intake between Cities and Regions

When we categorized the cities into 2 regions, Western and Eastern regions as depicted in Table 1, there was no difference in age, sex, body weight, and BMI between 2 regions (p>0.05 for all), but there was a significant difference in body height (p=0.033). Analysis of macronutrient and micronutrient intake revealed a variation pattern between the two regions. There was a difference in fat intake between the East and West regions (37.8±24.0 vs. 40.4±22.6, p=0.027, Table 2). Moreover, the fat intake of Banda Aceh subjects was significantly higher than non-Sumatra (46.6±21.9 vs. 35.9±23.0, p=0.001). On the contrary in carbohydrate intake, although there was no difference in the East and West regions (144.7±68.6 vs. 141.5±66.0, p=0.154), the carbohydrate intake was significantly higher in Java islands compared to non-Java island subjects (p=0.046).

The difference between macronutrient and micronutrient intake among cities was observed in Indonesia (Table 2). The highest calorie and fat intake are in Banda Aceh (1242.3 and 46.6, respectively), while the lowest calorie intake is in Jember (884.9). Manado showed a significant difference in macronutrient intake compared to non-Manado subjects such as the highest carbohydrates (171.3±70.2 vs. 144.4±65.5, p=0.009) and protein consumption (53.4±23.2 vs. 42.8±18.4, p=0.008), but as the lowest fat consumption (29.2±20.4 vs. 39.0±23.3, p=0.001). We also found significant differences in micronutrient intake between the East and West regions such as fiber (5.6±3.3 vs. 6.4±4.3, p=0.015), calcium (249.3±230.4 vs. 270.5±473.1, p=0.005), and iron (6.3±3.3 vs. 8.2±2.0, p<0.001). The cities in the East region such as Manado and Palu showed lower iron intake compared to the West region (5.1±2.5 vs. 8.2±2.0, p=0.007) and (5.4±4.1 vs. 8.2±2.0, p=0.003), respectively. A similar trend also was observed in sodium intake in Manado and Palu compared to the West region (556.4±939.7 vs. 991.5±111.7, p<0.001) and Palu (1412.0±943.4 vs. 991.5±111.7, p=0.001).

The Impact of Factors on The Severity of Dyspepsia Including Nutrients

Some baseline characteristic factors, location, and nutrient intake are suspected to be contributed to the incidence of dyspepsia. Bivariate analysis showed there was a significant association in the age group 50-59 years old with dyspepsia (p=0.022) compared to other ages. Binary logistic analysis was performed to analyze

Table 2

Comparison of nutritional intake of dyspepsia group in each region

Nutrient	Banda Aceh n = 49	Jakarta n = 59	Jember n = 26	Surabaya n = 19	Malang n = 42	Yogya-karta n = 38	Palu n = 52	Manado n = 57	Western Region	Eastern Region	p
Energy (kkal)	1 242.3	1 225.7	884.9	1 067.5	1 117.7	1 042.4	1 076.5	1 179.4	1 096.8	1 096.7	0.648
Protein (g)	46.9	46.1	46.2	39.7	43.7	41.4	40.4	53.4	44.0	43.8	0.330
Fat (g)	46.6	45.9	32.4	41.6	38.1	37.8	40.0	29.2	40.4	37.8	0.027*
Carbohydrate (g)	161.2	158.8	112.7	135.6	150.4	130.0	139.5	171.3	141.5	144.7	0.154
Fiber (mg)	7.8	7.1	6.9	5.4	5.5	5.6	5.4	5.2	6.4	5.6	0.015*
Vitamin C (mg)	30.8	27.4	25.8	48.4	30.1	24.7	26.7	24.4	31.2	30.9	0.112
Sodium (mg)	493.7	467.4	301.8	349.9	934.9	529.1	1412.0	556.4	991.5	795.6	0.805
Calcium (mg)	294.9	282.9	216.6	306.0	339.0	183.3	189.4	207.9	270.5	249.3	0.005**
Magnesium (mg)	209.6	201.0	184.4	134.9	164.1	133.7	166.9	148.1	171.3	153.2	0.440
Zinc (mg)	5.0	4.8	4.7	4.5	4.7	4.1	3.8	5.4	4.6	4.5	0.327
Iron (mg)	11.9	11.0	7.0	6.3	7.0	5.7	5.4	5.1	8.2	6.3	0.0001***

p was calculated based on Western Region and Eastern Region Comparison
*p< 0.05, ** p< 0.01, *** p< 0.001

the association between various factors with dyspepsia. Subjects in the age group 50-59 years as the highest risk to get dyspeptic symptoms (OR = 4.058). Interestingly, this association was also in concordant with the tendency of the dyspepsia severity level reflected on the GIS score. A significant difference was observed between the regions and the GIS score (p=0.001). Compared to the control group, the dyspeptic patient had a lower macronutrient fat consumption (37.32±23.0 vs. 43.12±17.5, p=0.032, Table 3). Among micronutrients, low magnesium consumption had an association with dyspepsia (173.47±81.6 vs. 175.76±69.0, p=0.025).

Table 3

The different between micronutrient and macronutrient intake in dyspepsia symptoms

Nutrient	Dyspepsia Group (Mean±SD)	Control (Mean±SD)	p	CI
Macronutrient				
Protein (g)	46.76±19.1	43.93±12.1	0.610	0.999-1.056
Fat (g)	37.32±23.0	43.12±17.5	0.032*	0.963-0.998
Carbohydrate (g)	150.53±65.6	148.30±43.6	0.810	0.990-1.001
Micronutrient				
Sodium (mg)	500.28±735.2	317.29±236.2	0.240	1.000-1.001
Fiber (mg)	6.21±4.0	5.22±2.3	0.308	0.930-1.260
Vitamin C (mg)	28.04±34.8	18.91±15.4	0.800	0.990-1.013
Calcium (mg)	233.81±257.1	246.69±274.7	0.343	0.999-1.000
Magnesium (mg)	173.47±81.6	175.76±69.0	**0.025***	0.988-0.999
Zinc (mg)	4.78±2.3	4.39±1.4	0.276	0.914-1.368
Iron (mg)	7.34±8.4	8.56±20.1	0.939	0.952-1.055

Macronutrient and Micronutrient Intake Contributed to Dyspepsia Symptoms according to GIS

We then further analyzed the dyspepsia case group to analyze nutrient intake and dyspeptic symptoms. Our results showed that most of each nutrient intake was significantly different among the dyspepsia symptoms (p<0.05). However, the vitamin C intake was not different between the severity levels in almost all symptoms. Vitamin C-intake only affects heartburn and nausea (p=0.007 and p=0.016 respectively). Heartburn and retrosternal discomfort were also not affected by protein and sodium intake (p=0.118, p=0.442, and p=0.125, p=0.652, respectively). To evaluate the tendency, Figure 1 shows that the correlation between the dyspepsia symptoms and the most nutrient intake was negative with an r coefficient correlation ranging from -0.132 to -0.340 (p<0.005), suggesting that symptoms of dyspepsia associated with reduced macronutrient and micronutrients intake. For example, the decrease in carbohydrate and fat intake were associated with a higher severity of all symptoms. Concordant with the Kruskal-Wallis result, a non-significant and weak correlation was also found in vitamin C in almost all symptoms (p=0.016, r= -0.132). Interestingly, a positive correlation was found in sodium intake, indicating that sodium intake was increased during severer symptoms (p=0.004, r=0.159).

DISCUSSION

We comprehensively evaluated the influence of macronutrient and micronutrient intake in dyspeptic patients. We found that compared to the control group, dyspepsia patients had a lower fat consumption and lower magnesium intake. In addition, reduced macro- and micronutrients intake symptoms tend to reduce dyspeptic

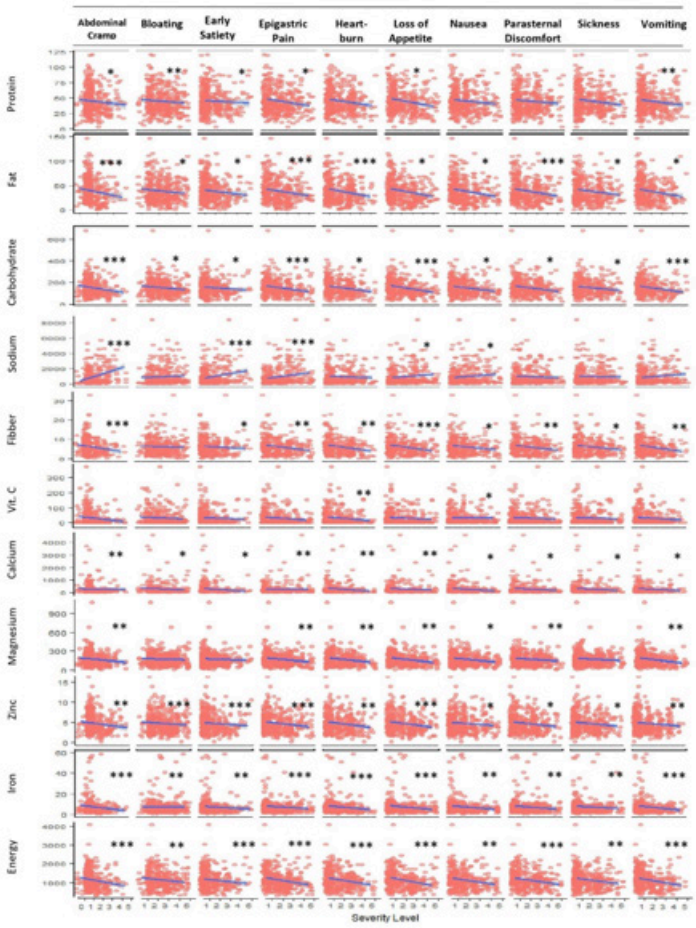

Figure 1. The Different between Micronutrient and Macronutrient Intake in Dyspepsia Symptoms
* $p<0.05$, ** $p<0.01$, *** $p<0.001$

symptoms. Factors such as age and geographical location also were found to correlate with dyspepsia in this study.

Our present results indicate that lower fat consumption tended to affect dyspeptic symptoms. Dyspepsia patients consumed fewer meals, similarly to a previous study (14), suggesting that dyspepsia patients may consume smaller fat meals in an attempt to reduce their symptoms (12). This is in agreement with the previous study in which there was also a trend for decreased fat and energy intake in dyspepsia patients (12). Given that the occurrence of symptoms was related to fat and energy intake, this may suggest an essential first point-of-call for dietary therapy, that is, reducing fat meals intake may alleviate symptoms, particularly fullness and bloating (12).

Our results showed that lower magnesium intake has a relationship with the dyspeptic symptom. Magnesium is known as the fourth most abundant essential mineral in the body. A deprived dietary pattern such as low vegetable intake resulting in magnesium deficiency can lead to several diverse medical conditions in gastrointestinal tract organs such as nausea (20) as well as possibly disturb smooth muscle relaxation in the upper gastrointestinal tract (21). Moreover, magnesium can reduce the acidity of stomach acid directly, resulting in relief of

dyspepsia (i.e. heartburn), thus magnesium is also a widely accepted and effective approach to treating dyspepsia (22). To our knowledge, this study might be the first report about the relationship between lower magnesium intake with dyspepsia.

We found a significant difference in the macronutrient and micronutrient intake between each of the dyspepsia symptoms according to the GIS score profile. This is in line with a previous study reporting that different macronutrients and micronutrients intake may be related to some species of dyspepsia symptoms (14). Macronutrients were reported to play roles in almost all dyspepsia symptoms by a different mechanism. Protein ingestion can affect gastric motility and carbohydrate could give an osmotic effect or increase luminal volume; hence it may induce fullness and early satiety (23). Fat can increase the gut emptying time by inducing Cholecystokinin (CCK) production and inducing hypersensitivity of the stomach to postprandial distension resulting in occurring more symptoms of nausea, fullness, and bloating in dyspeptic patients (24). Micronutrients may also play roles in some of the specific dyspepsia symptoms due to each effect on gastrointestinal tract function (25). For example, sodium intake was different in epigastric pain, abdominal cramps, but not different in vomiting symptoms and heartburn, this result is concordant with a previous study (26). Sodium can affect the sodium channel in the peripheral nervous system in the stomach responsible for hyperalgesia (27), this also explains our positive correlation result found in sodium intake, indicating that sodium intake was increased during severer symptoms. Magnesium intake was also different among the different levels of heartburn but not different in bloating and early satiety symptoms (28). Consumption of magnesium might reduce gastric acid resulting in reduced heartburn symptoms (22).

Several factors aside from nutrients were reported to correlate with dyspepsia. This study showed that age and geographical location were proven to correlate with dyspepsia. We observed that 50-59 years old was an age group that related to the incidence of dyspepsia which may be associated with time to enter the senile period resulting from a decline in gut defensive factor and psychologically is a transition from productive age to retirement period that can induce stress (29). Besides the age, some of the geographical locations in Indonesia showed a significantly different occurrence of dyspepsia, especially in Sulawesi and Sumatra Island. The GIS score was also significantly different between the islands; hence it may indicate that the different patient's residence affects the dyspepsia severity. These results were in concordant with the previous study that geographical location also plays a role in the epidemiology of dyspepsia worldwide (30). The different ethnicities in a different geographical locations in Indonesia may influence different food, diet, gene polymorphism, and epigenetic interaction which had been reported to have an association with gastrointestinal diseases such as dyspepsia and cancer pathogenesis (31). Moreover, the significant difference in fat, fiber, calcium, and iron intake that was observed between the Western and Eastern regions of Indonesia may also indicate the role of culture and geographical region in the nutrient intake associated with dyspepsia. In general, Indonesian have a 29 % lower intake than the recommendation of dietary allowance of the country. Regarding micronutrient intake, 100 million people in Indonesia suffer from micronutrient intake deficiency especially iron, vitamin A, and zinc (32). This finding agrees with ours which shows that almost all macro- and micronutrient intake was lower than the recommendation.

There were several limitations to this study. First, the sample number of this study cannot fully represent the whole population country, the number of control subjects might be not enough due to most patients who were coming to the hospital having a history of dyspepsia before. In addition, this study did not specify which kind of fat was consumed by the respondents. Also, the 24h recall questionnaire method could still possibly cause biased recall even though it was already minimalized by a face-to-face interview done by a trained hospital nutritionist. Further studies with more detailed information on macro- and micronutrients are needed to distinguish what specific kinds of macro- and micronutrient consumption are correlated with dyspepsia. Furthermore, this kind of study focused on ethnics phenomenon might be important to clearly understand which dietary habit is correlated with dyspepsia in the Indonesian population.

CONCLUSION

We reported the low consumption of fat and magnesium was related to dyspepsia. Nutrient intake was significantly different between dyspepsia symptoms. Senile age and geographical differences were also found to correlate with the incidence of dyspepsia. The geographical difference in the region needs to follow by further examination to determine the effect of some host factors. From this study, a raise of awareness from society and better regulation development by the government is expected.

CONFLICT OF INTEREST

The authors declare no potential conflicts of interest.

REFERENCES

1. Upendra K, Shrivastava AG, Arun G, Arati B. Role of *Helicobacter pylori* in functional dyspepsia. Indian J Surg. 2004;66:341-346.
2. Amini E, Keshteli AH, Jazi MS, Jahangiri P, Adibi P. Dyspepsia in Iran: SEPAHAN Systematic Review No. 3. Int J Prev Med. 2012;3:S18-25.
3. Mahadeva S, Yadav H, Rampal S, Goh KL. Risk factors associated with dyspepsia in a rural Asian population and its impact on quality of life. Am J Gastroenterol. 2010;105:904-912.
4. Syam AF, Simadibrata M, Makmun D, Abdullah M, Fauzi A, Renaldi K, et al. National Consensus on Management of Dyspepsia and *Helicobacter pylori* Infection. Acta Med Indones. 2017;49:279-287.
5. Miwa H, Ghoshal UC, Fock KM, Gonlachanvit S, Gwee KA, Ang TL, et al. Asian consensus report on functional dyspepsia. J Gastroenterol Hepatol. 2012;27:626-641.
6. Miftahussurur M, Nusi IA, Akil F, Syam AF, Wibawa IDN, Rezkitha YAA, et al. Gastric mucosal status in populations with a low prevalence of *Helicobacter pylori* in Indonesia. PLoS One. 2017;12:e0176203.
7. Verma A, Verma D, Bansal P, Bansal A. The study of risk factors associated with dyspepsia. Intern J Biomed Advance Res. 2016;7(9):468-471.
8. Pen J. Diet in the etiology and management of functional dyspepsia. Dyspepsia: advances in understanding and management. Rijeka: InTech. 2013:95-109.
9. Lee YY, Mahendra Raj S, Graham DY. *Helicobacter pylori* infection--a boon or a bane: Lessons from studies in a low-prevalence population. Helicobacter. 2013;18:338-346.
10. Duboc H, Latrache S, Nebunu N, Coffin B. The Role of Diet in Functional Dyspepsia Management. Front Psychiatry. 2020;11:23.
11. Pen J. Diet in the Etiology and Management of Functional Dyspepsia. Intech. 2013. doi: 10.5772/57138.
12. Pilichiewicz AN, Horowitz M, Holtmann GJ, Talley NJ, Feinle-Bisset C. Relationship between symptoms and dietary patterns in patients with functional dyspepsia. Clin Gastroenterol Hepatol. 2009;7:317-322.
13. Kearney J, Kennedy NP, Keeling PW, Keating JJ, Grubb L, Kennedy M, Gibney MJ. Dietary intakes and adipose tissue levels of linoleic acid in peptic ulcer disease. Br J Nutr. 1989;62:699-706.
14. Mullan A, Kavanagh P, O'Mahony P, Joy T, Gleeson F, Gibney MJ. Food and nutrient intakes and eating patterns in functional and organic dyspepsia. Eur J Clin Nutr. 1994;48:97-105.
15. Carvalho RV, Lorena SL, Almeida JR, Mesquita MA. Food intolerance, diet composition, and eating patterns in functional dyspepsia patients. Dig Dis Sci. 2010;55:60-65.
16. Goktas Z, Koklu S, Dikmen D, Ozturk O, Yilmaz B, Asil M, et al. Nutritional habits in functional dyspepsia and its subgroups: A comparative study. Scand J Gastroenterol. 2016;51:903-907.
17. Adam B, Liebregts T, Saadat-Gilani K, Vinson B, Holtmann G. Validation of the gastrointestinal symptom score for the assessment of symptoms in patients with functional dyspepsia. Aliment Pharmacol Ther. 2005;22:357-363.
18. Barton WWHPJAK. A short review of dietary assessment methods used in National and Scottish Research Studies2003. Located at: Monitoring Scottish Dietary Targets Workshop.
19. NIH. Dietary Assessment Primer. 24-hour Dietary Recall (24HR) At a Glance [cited; Available from: https://dietassessmentprimer.cancer.gov/.
20. Guerrera MP, Volpe SL, Mao JJ. Therapeutic uses of magnesium. Am Fam Physician. 2009;80:157-162.
21. Uberti F, Morsanuto V, Ruga S, Galla R, Farghali M, Notte F, et al. Study of Magnesium Formulations on Intestinal Cells to Influence Myometrium Cell Relaxation. Nutrients. 2020;12.
22. Holtmeier W, Holtmann G, Caspary WF, Weingartner U. On-demand treatment of acute heartburn with the antacid hydrotalcite compared with famotidine and placebo: a randomized double-blind cross-over study. J Clin Gastroenterol. 2007;41:564-570.

23.Miwa H. Why dyspepsia can occur without organic disease: pathogenesis and management of functional dyspepsia. J Gastroenterol. 2012;47:862-871.

24. Khodarahmi M, Azadbakht L. Dietary fat intake and functional dyspepsia. Adv Biomed Res. 2016;5:76.

25. Mullan A, Kavanagh P, O'Mahony P, Joy T, Gleeson F, Gibney M. Food and nutrient intakes and eating patterns in functional and organic dyspepsia. Eur J Clin Nutri. 1994;48:97-105.

26. Dwijayanti H, Ratnasari N, Susetyowati S. Asupan natrium dan kalium berhubungan dengan frekuensi kekambuhan sindrom dispepsia fungsional. Jurnal Gizi Klinik Indonesia. 2008;5(1):36-40.

27. Gebhart GF, Bielefeldt K, Ozaki N. Gastric hyperalgesia and changes in voltage gated sodium channel function in the rat. Gut. 2002;51 Suppl 1:i15-18.

28. Filipović BF, Randjelovic T, Kovacevic N, Milinić N, Markovic O, Gajić M, et al. Laboratory parameters and nutritional status in patients with functional dyspepsia. Eur J Internal Med. 2011;22:300-304.

29. Piotrowicz G, Stępień B, Rydzewska G. Socio-demographic characteristics of patients with diagnosed functional dyspepsia. Przeglad Gastroenterologiczny. 2013;8:354-365.

30. Mahadeva S, Goh K-L. Epidemiology of functional dyspepsia: a global perspective. World J Gastroenterol. 2006;12:2661-2666.

31. Miftahussurur M, Waskito LA, Syam AF, Nusi IA, Wibawa IDN, Rezkitha YAA et al. Analysis of risks of gastric cancer by gastric mucosa among Indonesian ethnic groups. PLoS One. 2019;14:e0216670.

32. Ickowitz A, Rowland D, Powell B, Salim MA, Sunderland T. Forests, Trees, and Micronutrient-Rich Food Consumption in Indonesia. PLoS One. 2016;11:e0154139.