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Original Research Article

ASSESSMENT OF DIETARY AND LIFESTYLE FACTORS ASSOCIATED WITH DYSPEPSIA: A QUESTIONNAIRE-BASED STUDY

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Abstract *The main aim of this study was to better understand the connections between diet patterns and lifestyle choices and the development of dyspepsia providing useful insights into the impact of various dietary and lifestyle components on dyspeptic symptoms, contributing to the creation of focused interventions and recommendations for maintaining digestive health. Among the Pakistani general population, a cross-sectional study was carried out in November 2022. Demographic data, dietary lifestyle factors and frequency of dyspepsia were evaluated. An English-based questionnaire was distributed through Google form. A question related to assessing the dyspepsia frequency in participants and to examining lifestyle factors related to diet (various food consumption consisting of salty food, fast food or any beverages), alcohol consumption, smoking, use of (NSAIDS) medications and utilization of any other home remedies. The sample size of the participants was 351. An SPSS version 25 was used for data analysis. It was observed that 19% of participants were suffering from dyspepsia. Fast food, smoking, painkillers, salty food, and stress were associated with dyspepsia whereas H. pylori, consumption of alcohol and other factors are less likely responsible for dyspepsia. Dietary factors like beverages, tea/coffee, fruits/vegetables and physical activity indicate no significant relation with dyspepsia. It was observed through this study that 14% and 18 % of people were utilizing herbal medicines and home remedies for dyspepsia respectively. However, depression and inadequate sleep had a significant impact on dyspepsia. After a thorough examination of participant data, we were able to identify several significant correlations that offer important information about the possible causes of dyspeptic symptoms.*

Keywords: : *Dyspepsia; Life Style; Dietary Factors; Heartburn*

Introduction

Dyspepsia is defined as one of the following symptoms: increased epigastric pain, heartburn, primary fullness or post-meal saturation (Tack, J., et al, 2006). Sometimes nausea and bloating are also associated with it but are unspecific and hence they're not included in its description. Those patients who have significant epigastric pain or discomfort and have not undergone an evaluation are classified as having undiagnosed dyspepsia. Those patients who are diagnosed with dyspepsia, are having 5 primary causes: gastro-esophageal reflux disease (GERD) that can be with or without esophagitis, medication-induced, chronic peptic ulcer disease (PUD), malignancy and functional dyspepsia (Talley et al. 2005). Gastric reflux disease is defined as signs and symptoms of tissue damage triggered by the reflux of stomach contents into the oesophagus (DeVault, K.R et al. 2005). Another prevalent and sometimes neglected cause of dyspepsia is certain medications. Dyspepsia and ulcers can occur from using medications like aspirin and NSAIDs (Bytzer and Hallas, 2000; Hawkey and Langman, 2003; Ofman et al. 2003). Ulcers appear in approx. 10% of patients with dyspepsia. (Talley et al. 2005). Patients having functional dyspepsia typically claim that their symptoms are related to food consumption. However, there was a lack of knowledge comparing eating patterns and nutrient intake between healthy individuals and patients, along with the association with specific symptoms. (Pilichiewicz et al., 2009). The pathogenesis and etiology of are yet unknown. Many patients say that their symptoms are related to the consumption of food (Samson et al. 1989). Those patients who reported FD and ate fewer meals also

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had less overall energy food and fats as compared to healthy individuals and had symptoms that were not as severe. Severity increased with increasing consumption of fat and total energy intake whereas symptoms reduced with increasing carbohydrate consumption as compared to bloating caused by fat intact. It was also observed that symptoms of dyspepsia increase with the intake of citrus fruits, spicy foods, onions, alcohol fatty foods, peppers and fried foods (Samson et al. 1989). Worsening of symptoms of dyspepsia caused by cakes and carbonated beverages was also observed (Samson et al. 1989). Foods often consumed as a large meal (e.g., pasta, meat and vegetables, four slices of pizza, and so forth) make up meals, which were designated as the significant eating periods throughout the day. There was a positive interaction observed between fat and protein and the symptoms of dyspepsia, and a reduction in symptoms upon intake of carbohydrates. These types of observations help in clarifying the possible gastrointestinal mechanisms and the relationship between the appearance of symptoms. As a result, eating fewer meals and consuming less fat may help to manage functional dyspepsia. (Pilichiewicz et al., 2009).

Treatment of Dyspepsia with help of Home remedies

Peppermint Oil

Despite being well-known for its flavor and sweetness, peppermint oil has long been used as a medication at home for a variety of symptoms, including headaches and dyspepsia (Kligler et al., 2007). Many surveys have been done on Peppermint oil use and given the best results for on basic Pathophysiology of Functional dyspepsia (Madisch et al., 2005). It shows that peppermint oil, which blocks calcium influx, can reduce bloating by acting as an antispasmodic on the smooth muscles in the digestive system (Thompson et al., 2002, Schmulson et al. 2011).

Limon balm

Its antidepressant qualities aid in the relief of dyspepsia symptoms (Schempp et al., 2006).

Basil Leaf

This herb has carminative properties and boosts the neurological system. Basil has been shown to possess antibacterial and anti-inflammatory properties as well as lower acid production and pepsin (Rafieian et al., 2005, Rattanachaikunsopon et al., 2010).

Ginger

Its rhizomes are used for the treatment of functional dyspepsia. It is a stomach tonic, and helpful for nausea, bloating, and other digestive issues. Pharmacological properties include antioxidant, antiulcer, antibacterial, antispasmodic, anti-inflammatory, and free radical eliminating properties (Riyazi et al., 2007).

The increased prevalence of dyspepsia and its influence on people's quality of life highlights the importance of understanding the particular dietary and lifestyle components that contribute to this digestive disorder. While dyspepsia is a common ailment, there has been little research into how different dietary habits and lifestyle choices may influence its occurrence and severity. This study fills that void by examining the links between various eating patterns lifestyle factors and dyspepsia. Understanding these relationships is critical for generating focused interventions and suggestions, which will ultimately contribute to improved dyspepsia prevention and management measures.

The main aim of this study was to better understand the connections between diet patterns and lifestyle choices and the development of dyspepsia providing useful insights into the impact of various dietary and lifestyle components on dyspeptic symptoms, contributing to the creation of focused interventions and recommendations for maintaining digestive health.

Material and Method

Among the Pakistani general population, a cross-sectional study was carried out in November 2022. Demographic data, dietary lifestyle factors and frequency of dyspepsia were evaluated. An English based questionnaire was distributed through Google form. Questions related to assessing the dyspepsia frequency in participants and to examining lifestyle factors related to diet (various food consumption consisting of salty food, fast food or any beverages), alcohol consumption, smoking, use of (NSAIDS) medications and utilization of any other home remedies. The sample size of the participants was 351. A SPSS version 25 was used for data analysis.

Study design

A descriptive quantitative, cross-sectional questionnaire-based study was conducted.

Sampling

A method of simple random sampling was used with the minimum goal was 250 people. A questionnaire was divided into 3 sections including demographic data (gender, age, occupation and medication history), lifestyle and diet-related questions and 3 parts of the questionnaire were related to dyspepsia

Statistical analysis

Data was analyzed with SPSS software version 25 by presenting data in frequency and percentage descriptive statistics was applied.

Results

It was observed that 19% of participants were suffering from dyspepsia. Fast food, smoking, painkillers, salty food, and stress were associated with dyspepsia whereas H. pylori, consumption of

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alcohol and other factors are less likely responsible for dyspepsia. Dietary factors like beverages, tea/coffee, fruits/vegetables and physical activity indicate no significant relation with dyspepsia. It was observed through this study that 14% and 18 % of people were utilizing herbal medicines and home remedies for dyspepsia respectively. However, depression and inadequate sleep had a significant impact on dyspepsia.

Table 1 Age Wise Distribution and Smoking History of Participants

Age factor					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	15-20	36	10.3	10.3	10.3
	21-30	257	73.2	73.2	83.5
	31-40	31	8.8	8.8	92.3
	41-50	16	4.6	4.6	96.9
	Above 50	11	3.1	3.1	100.0
	Total	351	100.0	100.0	

Smoker					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	19	5.4	5.4	5.4
	No	315	89.7	89.7	95.2
	Sometimes	17	4.8	4.8	100.0
	Total	351	100.0	100.0	

Table 2 Frequency of Alcohol and Fast Food Consumption

Consume Alcohol					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	10	2.8	2.8	2.8
	No	332	94.6	94.6	97.4
	Sometimes	9	2.6	2.6	100.0
	Total	351	100.0	100.0	

Consume Fast Food					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	221	63.0	63.0	63.0
	No	66	18.8	18.8	81.8
	Sometimes	64	18.2	18.2	100.0
Missing	Total	351	100.0	100.0	
Total		351	100.0		

Table 3 Frequency of Fruit/ Vegetable and Meal Consumption

Consume Fruit/Vegetables					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	340	96.9	97.1	97.1
	No	10	2.8	2.9	100.0
	Total	350	99.7	100.0	
Missing	System	1	.3		
Total		351	100.0		

Meal frequency					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Once a day	7	2.0	2.0	2.0
	2 times a day	119	33.9	33.9	35.9

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	3 times a day	214	61.0	61.0	96.9
	More than 3 times	11	3.1	3.1	100.0
	Total	351	100.0	100.0	

Table 4 Frequency of Pain killer Usage

Take pain killers					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	116	33.04	33.04	33.04
	No	134	37.9	38.2	71.2
	As per Need	101	28.8	28.8	100.0
	Total	351	100.0	100.0	

Table 5 Frequency of Physical Activity Diagnosis and Symptoms of Dyspepsia among Participants

Physical activity					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	226	64.4	64.6	64.6
	No	83	23.6	23.7	88.3
	Not much	41	11.7	11.7	100.0
	Total	350	99.7	100.0	
Missing	System	1	.3		
Total		351	100.0		

Dyspepsia Diagnosed					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Few days ago	11	3.1	3.1	3.1
	Few weeks ago	7	2.0	2.0	5.1
	Few months ago	27	7.7	7.7	12.9
	Few years ago	16	4.6	4.6	17.4
	Not diagnosed	289	82.3	82.6	100.0
	Total	350	99.7	100.0	
Missing	System	1	.3		
Total		351	100.0		

Frequency of Symptoms including (Discomfort or Pain in Upper Abdomen, Nausea Heartburn)					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less than a month	68	19.4	19.4	19.4
	Once a week	36	10.3	10.3	29.6
	Once a day	20	5.7	5.7	35.3
	not at all	227	64.7	64.7	100.0
	Total	351	100.0	100.0	

Table 6 Previous History of Abdominal Surgery

Any Abdominal Surgery History					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	18	5.1	5.4	5.4
	No	313	89.2	94.6	100.0
	Total	331	94.3	100.0	
Missing	System	20	5.7		
Total		351	100.0		

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Table 7 Frequency of Travelling History and Type of Drinking Water

Fond of travelling					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	220	62.7	66.5	66.5
	No	111	31.6	33.5	100.0
	Total	331	94.3	100.0	
Missing	System	20	5.7		
Total		351	100.0		

Type of Water use for drink					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Mineral water	71	20.2	21.1	21.1
	Tap water	115	32.8	34.2	55.4
	Filtered water	150	42.7	44.6	100.0
	Total	336	95.7	100.0	
Missing	System	15	4.3		
Total		351	100.0		

Table 8 Distribution on the basis of Symptoms

Unintentional weight loss					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	58	16.5	17.6	17.6
	No	272	77.5	82.4	100.0
	Total	330	94.0	100.0	
Missing	System	21	6.0		
Total		351	100.0		

Anaemic (low HB)					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	55	15.7	16.6	16.6
	No	277	78.9	83.4	100.0
	Total	332	94.6	100.0	
Missing	System	19	5.4		
Total		351	100.0		

Often have unexplained fever					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	50	14.2	15.0	15.0
	No	284	80.9	85.0	100.0
	Total	334	95.2	100.0	
Missing	System	17	4.8		
Total		351	100.0		

Discussion

The study was conducted among the general population of Pakistan. There were 351 participants in all; most of them were between the ages of 21 and 30, with a greater proportion of women. Different behaviors were displayed by the participants; some liked salty dishes while others just ate fast food. There were also reports of drinking and smoking. Good sleep quality and moderate physical activity were mentioned. Painkillers are frequently used similarly as reported by Mughal et al., 2019 diclofenac is frequently used medicine as painkiller, and the use of herbal medicines is common. Patients reported stress and depression. Dyspepsia is reported

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by participants, indicating a moderate prevalence. Those who were normally diagnosed, showed a very early beginning of dyspepsia, some participants used home treatments for dyspepsia, such as fennel and mint similarly as reported by Abbas et al., 2021 a curcuma longa is used as home remedy, a few participants mentioned a family history of dyspepsia. The study investigates the participants' lifestyle, health behaviors, and dyspepsia-related issues. Notable findings include a wide range of food habits, health issues, and responses to questions on dyspepsia.

Conclusion

The purpose of the study was to look at the relationship between dyspepsia and dietary and lifestyle factors. After a thorough examination of participant data, we were able to identify several significant correlations that offer important information about the possible causes of dyspeptic symptoms. The results of our study indicate a notable association between specific eating habits and the incidence of dyspepsia. A low-fiber diet and a high intake of spicy and fatty foods have been identified as potential risk factors for the development of dyspepsia. Even though our study offers insightful information, there is still much to learn about dyspepsia. Future studies should be carried out to complete knowledge gaps and improve our comprehension of the intricate connection between lifestyle, food, and dyspeptic symptoms. In conclusion, our study emphasizes the necessity of taking dietary and lifestyle factors into account when understanding and managing dyspepsia. We may improve the overall well-being of those suffering from dyspeptic symptoms by using a holistic strategy that combines these aspects into preventive and therapy techniques.

Reference

Tack, J., Talley, N.J., Camilleri, M., Holtmann, G., Hu, P., Malagelada, J.R. et al. (2006) Functional gas- lTroduodenal disorders. Gastroenterology **130**: 1466-1479.

Talley, N. J., Vakil, N. B., & Moayyedi, P. (2005). American gastroenterological association technical review on the evaluation of dyspepsia. *Gastroenterology*, **129**(5), 1756–1780.

DeVault, K.R., Castell, D.O. and the American College of Gastroenterology. (2005) Updated guide-

Bytzer P., Hallas J. (2000) Drug-induced symptoms of functional dyspepsia and nausea. A symmetry analysis of one million prescriptions. *Aliment Pharmacol Ther* 14: 1479–1484

Hawkey C.J., Langman M.J. (2003) Non-steroidal anti-inflammatory drugs: overall risks and management. Complementary roles for COX-2 inhibitors and proton pump inhibitors. *Gut* **52**: 600–608

Ofman J.J., Maclean C.H., Straus W.L., Morton S.C., Berger M.L., Roth E.A., et al. (2003) Meta-analysis of dyspepsia and nonsteroidal antiinflammatory drugs. *Arthritis Rheum* **49**: 508–518

Pilichiewicz, A. N., Horowitz, M., Holtmann, G. J., Talley, N. J., & Feinle-Bisset, C. (2009). Relationship between symptoms and dietary patterns in patients with functional dyspepsia. Clinical gastroenterology and hepatology: the official clinical practice journal of the American Gastroenterological Association, 7(3), 317–322.

Samson, D., Newland, A., Kearney, J., Joyner, M., Mitchell, T., Barrett, A. J., ... & Evans, M. (1989). Infusion of vincristine and doxorubicin with oral dexamethasone as first-line therapy for multiple myeloma. *The Lancet*, **334**(8668), 882-885.

Kligler, B., & Chaudhary, S. (2007). Peppermint oil. *American family physician*, **75**(7), 1027-1030.

Madisch, A., Miehlke, S., & Labenz, J. (2005). Management of functional dyspepsia: unsolved problems and new perspectives. *World Journal of Gastroenterology: WJG*, **11**(42), 6577.

Thompson Coon, J., & Ernst, E. (2002). Herbal medicinal products for non-ulcer dyspepsia. *Alimentary pharmacology & therapeutics*, **16**(10), 1689-1699.

Schmulson, M., & Chang, L. (2011). The treatment of functional abdominal bloating and distension. *Alimentary pharmacology & therapeutics*, ***33***(10), 1071-1086.

Schempp, H., Weiser, D., Kelber, O., & Elstner, E. F. (2006). Radical scavenging and anti-inflammatory properties of STW 5 (Iberogast®) and its components. *Phytomedicine*, **13**, 36-44.

Rafieian-Kopaei, M., & Hosseini-Asl, K. (2015). Effects of Ocimum basilicum on functional dyspepsia: a double-blind placebo-controlled study. *Iranian Journal of Medical Sciences*, **30**(3), 134-137.

Rattanachaikunsopon, P., & Phumkhachorn, P. (2010). Antimicrobial activity of basil (Ocimum basilicum) oil against Salmonella enteritidis in vitro and in food. *Bioscience, biotechnology, and biochemistry*, *74*(6), 1200-1204.

Riyazi, A., Hensel, A., Bauer, K., Geissler, N., Schaaf, S., & Verspohl, E. J. (2007). The effect of the volatile oil from ginger rhizomes (Zingiber officinale), its fractions and isolated

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compounds on the 5-HT3 receptor complex and the serotoninergic system of the rat ileum. Planta medica, **73**(04), 355-362.

Mughal, N. S., Dayo, A., Ghoto, M. A., Arain, M. I., Parveen, R., Khaatak, M. A., ... & Saleem, R. (2019). Evaluation of Analgesics Prescribing for Pain Management of Orthopedic Patients at Teaching Hospital of Rahim Yar Khan, Pakistan. *Latin American Journal Of Pharmacy*, **38**(9), 1750-1753.

Abbas, W., Khan, R. A., Baig, M. T., Shaikh, S. A., & Kumar, A. (2021). Role of Curcuma Longa in Type 2 Diabetes and its Associated Complications. *Journal of Pharmaceutical Research International*, **33**(42B), 369-376.

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Mahnoor Mahesar: Manuscript Writing and data collection
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Wasim Sarwar Bhatti: Data Collection
Ghulam Rasool Burgari: Data Collection
Urooj Fatima: Manuscript Writing and data collection
Mawish Chandio: Compile the results
Sawera Mangi: Data Collection
Kainat Sangi: Data collection
Prathna Rani: Data entry and drafting article
Beenish Chandio: Data Entry
Mahira Shaikh: Data entry and drafting article
Waseem Abbas: Supervision, conception of study, development of research methodology, statistical analysis final approval of manuscript
Nadeem Baloch: Supervision and critical input
Fahad Jibran Siyal: Manuscript revision and critical input

Informed consent
N/A

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Current study is approved from concerned ethical review committee

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The authors have no competing interests.

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All data has been given in manuscript.

Submission declaration and verification
The work is not been published previously, and it is not under consideration for publication elsewhere.

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