Journal of Population Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE
DOI: 10.53555/c859w418

DIETARY DIVERSITY AND SOCIO DEMOGRAPHIC RISK FACTORS OF GASTRO INTESTINAL CANCERS AMONG THE PASHTUN POPULATION OF KHYBER PAKHTUNKHWA

DR. Fazia Ghaffar*

*Assistant Professor & HOD, Department of Food & Nutrition Sciences, College of Home Economics, University of Peshawar, Khyber Pakhtunkhwa, Pakistan, faziaghaffar@uop.edu.pk

***Corresponding Author:** DR. Fazia Ghaffar
*Assistant Professor & HOD, Department of Food & Nutrition Sciences, College of Home Economics, University of Peshawar, Khyber Pakhtunkhwa, Pakistan, faziaghaffar@uop.edu.pk

ABSTRACT

Gastrointestinal cancers (GI cancers) present a diverse distribution pattern all over the world. Overall, the GI cancers are responsible for more cancers and more deaths from cancer than any other cancers as reported by epidemiological studies. There is an increasing burden (incidence and mortality) in GI cancer worldwide and Pakistan is no exception. Khyber Pakhtunkhwa with its distinctive dietary patterns is famous for high meat, green tea, fresh fruits & nuts intakes. However, the burden of cancers is increasing every single day. There is a serious paucity of studies and knowledge regarding the risk factors associated with the GI cancer in Pakistan in general and KPK in particular.

OBJECTIVES: The current study was undertaken to determine (1). The socio-demographic risk factors among the GI cancer patients. (2) to determine the dietary risk factors and state of dietary diversity among the household of the GI cancer patients born in KPK with Pashtun background.

METHODOLOGY: This study adopted the descriptive cross-sectional design. The study followed a consent based convenient random sampling technique. The sample consisted of 150 consenting newly diagnosed cancer patients (87 males and 63 females) who were investigated for the risk factors Data was collected through self- constructed questionnaire. Information regarding socio-demographic and socio- economic status, anthropometric and biochemical assessment was done as per standard procedures. A thorough investigation of dietary intake patterns, retrospective food preferences were collected through a semi quantitative Food Frequency Questionnaire (FFQ) containing 10 food groups and 177 local food items and DDS were calculated. Activity and exercise record and sleep hours were also recorded.

RESULTS: The percent distribution of GIT cancers among the patients indicated colorectal and Oro-esophageal cancers were most common among males (28.9%, 31.6%) while gastric cancer was more common among females (41.7%). About 78.6% males and 72.4% female patients belonged to the rural areas. About 41.5 % males and 84.5% females were illiterate. 47.6% males were in sitting jobs, labor work (11.8%) and long-distance drivers (14.3%). The smoking history among the male patients showed that 63.05% had a history of tobacco smoking and 34.29 % had a history of Smokeless Tobacco Product (STP). An overall trend in the BMI trend was towards overweight and that too was common in the female patients. Higher percentage of the households used unbranded and unpackaged black and green tea and spices with a strong probability of being contaminated. The mean DDS indicated 3.39± 5.26 for the 47% of the households falling in the low category and 52% households

fell in the moderate category with a mean DDS to be 5.3 ± 11.5 with significant differences. Majority of the patients had poor sleep and physical activity patterns.
CONCLUSION: Mass illiteracy, low family incomes, larger family sizes being the major demographic factors along low diversity in the diet, unbranded food commodities were found to be the potential risk factors that need to be investigated further.

KEY WORDS: GI cancers, sociodemographic risks, dietary intake patterns, dietary diversity, anthropometry, Physical activity

1. INTRODUCTION

Cancer is becoming an increasingly rapidly growing burden in Pakistan recently with multifaceted significant concerns. The World Health Organization has also reported a steady increase in the incidence of cancers in Pakistan [1]. The global landscape of the incidence of cancer presents a grim situation specifically in the 91 out of 172 countries [2, 3]. It is considered to be the leading cause of death in these countries with estimated 29.5 million cancer patients and 16.3 million deaths by the year 2040 [4. 5]. The emerging challenges of these increasing burden is being attributed to rapid urbanization [6], aging [7, 8], inactivity [8, 9], unhealthy lifestyle [10, 11], and air pollution [12, 13]. According to a study at Agha Khan University, Pakistan the most common malignancies among males were oral cavity, lymphoma, colorectal. Esophageal, and stomach while among females it was breast esophagus, and oral cavity [14].

Gastro intestinal cancers are multifunctional diseases having several non-modifiable factors such as genetics, advancing age, sex, and a family history along with modifiable factors such as dietary patterns, obesity, smoking and alcohol consumption [15]. Several epidemiological studies had investigated the diet as a potential modifiable and preventable factor. Plant based diets being preventive while the intake of saturated fats, consumption of red and processed meats had potentially been associated with colorectal cancers [16, 17]. Some studies have also identified the role of dietary diversity as a protective approach against some cancers [18. 19].

Food insecurity has been defined as to be the consistent lack of access to safe, nutritious, and adequate supply of food to maintain healthy life [20]. Food insecurity cannot be attributed to one single factor, rather it is a systematic challenge ranging from poverty, unemployment, discrimination, and chronic health conditions [21]. The incidence and impact food insecurity always follow a far from uniform patterns based on socio- demographic characteristics of health and their outcomes over time [22-24].

Gastrointestinal cancers are the leading cancers after breast cancer in Pakistan but there is serious paucity of knowledge regarding the role of diet, dietary diversity, and food insecurity, and most importantly the role of diet as an etiological factor. The current study was conceived as to (1) to determine the sociodemographic characteristics of GI cancer patients. (2) to analyze the household dietary diversity and retrospective dietary intake patterns of newly diagnosed GI cancer patients from Khyber Pakhtunkhwa, Pakistan.

2. METHODOLOGY

2.1. STUDY DESIGN

This study adopted the descriptive cross-sectional design and used a structured questionnaire to get both qualitative and quantitative information.

2.2. STUDY POPULATION & SAMPLING

The study population was newly diagnosed GI cancer patients. The sample consisted of 150 consenting cancer patients (87 males and 63 females) between February to May 2019 at the Institute of Radiology & Nuclear Medicine (IRNUM), Peshawar and the Oncology Department of Hayatabad Medical Complex Peshawar. Patients in the Gastro clinics were also selected through convenient random sampling at the time of registration and were recruited to participate in the study after

procuring written consent from the patients or their care givers. The study was approved by the Institutional Ethical Review Committee based on Helsinki protocols.

2.3. INCLUSION AND EXCLUSION CRITERIA

The study included patients ages of 18years to 60 years who were diagnosed with any GI cancer and were not suffering cachexia, free from other comorbidities, had no near history of infections. Patients who were critically ill and were diagnosed with advanced stages of caners, incapable of responding to questions or had suffered some other serious illnesses were not recruited. Patients with Afghan origin & those below 18 years (were considered and attending the pediatric section) were not included.

2.4. DATA COLLECTION

The data was collected through a self-constructed pre-standardized questionnaire and was divided into the following sections:

2.4.1. Socio-Demographic Data: In order to obtain an in-depth information on socio-demographic and socio- economic status data regarding marital status, residential background, educational and occupational background, smoking history in males, the frequency of UTIs in females, family income and the like were investigated.

2.4.2. Anthropometric, Biochemical, And Nutritional Assessment: Each patient was assessed for height, weight, Mid Upper arm Circumference (MUAC), and Body Mass Index (BMI) as per standard procedures. Biochemical and nutritional assessment of the patients were based complete blood count (CBC) being performed as per standard lab procedures

2.4.3. Dietary Intake Patterns: A comprehensive data of retrospective dietary intake patterns, food preferences and household dietary diversity was procured through a comprehensive semi quantitative food frequency questionnaire consisting of eleven (11) food groups and 177 food items indigenous to this region or grown locally

2.4.4. Dietary Diversity Scores: Dietary diversity score was assessed by dividing the Semi quantitative food frequency questionnaire into 10 food groups (grains, white roots, tubers and plantain; pulses (beans, peas and lentils); nuts and seeds; dairy; meat, fish and poultry; eggs; dark green leafy vegetables; vitamin A-rich fruits and vegetables; other vegetables and other fruits) described by Food and Agricultural Organization. Data was obtained for previous week and month household intakes and the intake was recorded as 1 and absence as 0. The means DDS were calculated as per WHO criteria for each food group.

2.4.5. Physical Activity Record and Sleep Duration were recorded through questions based on hourly, daily, weekly and monthly basis in order to ascertain the possible role of these factors in the prognosis of the disease (beyond the scope of this article).

2.5. STATISTICAL ANALYSIS: The data procured from all the sections was analyzed through IBM Statistical Package for Social sciences (SPSS) version 19 for frequencies, percentage, mean, standard deviations, ANOVA and Pearson Correlation coefficients.

3. RESULTS & DISCUSSION

3.1: DISTRIBUTION OF GI IN THE SAMPLE

The percent distribution of GIT cancers among the patients (Figure 1) indicated colorectal and Oro-esophageal cancers were most common among males (28.9%, 31.6% respectively) while gastric cancer was more common among females (41.7%). These results are quite contrary to the findings of other studies where gastric cancer has been reported to be more common in males but it was also suggested that female gender was an independent factor (due to the hormonal effects) for poor cancer survival although this role of being female in stomach is still unclear [25].

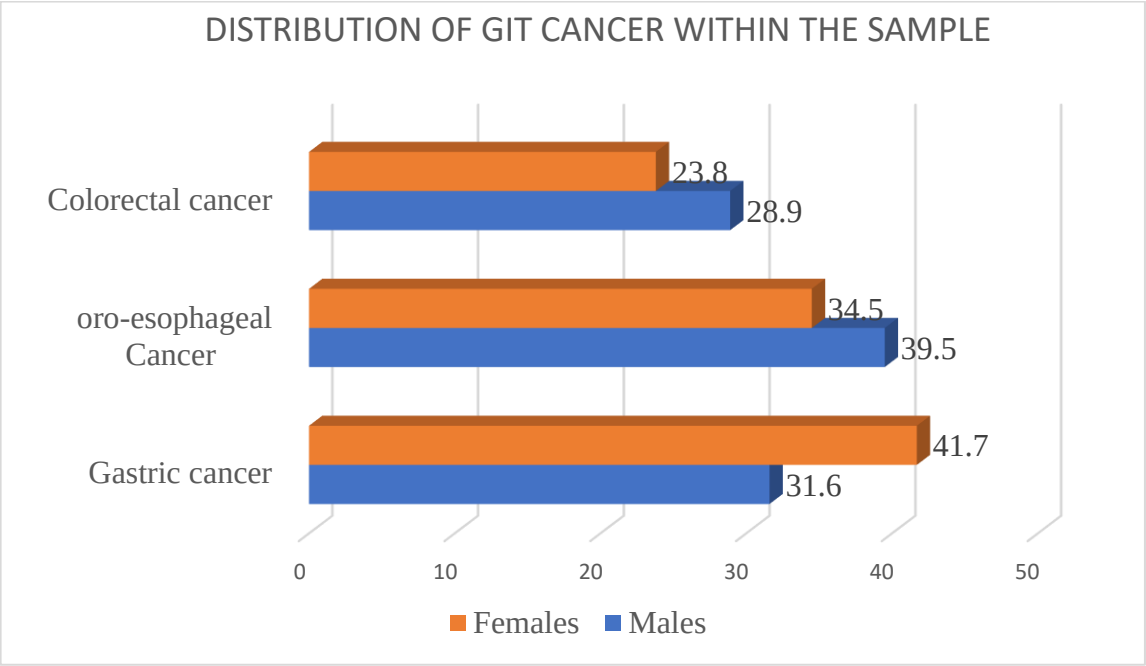

Figure 1: Gender Wise Distribution of the GI Cancer in the Sample

3.2. SOCIO-DEMOGRAPHIC CHARACTERISTICS OF THE SAMPLE

The socio-demographic profiles of the patients showed (Figure 2) that 97.6% males and 91.4 % females were married with 94.9$ females being housewives. About 78.6% males and 72.4% female patients belonged to the rural areas of KP while 41.5 $ males and 84.5% females were illiterate and 47.6% males being engaged in either sitting jobs (office workers, shopkeepers, teachers), labor work (11.8%) and long-distance drivers (14.3%). These findings are in strong agreement with a with a large population-based study in China which reported sex, age, and overall lower socio-economic status and individuals with low educational levels to be at high risk of developing neoplastic lesions [26].

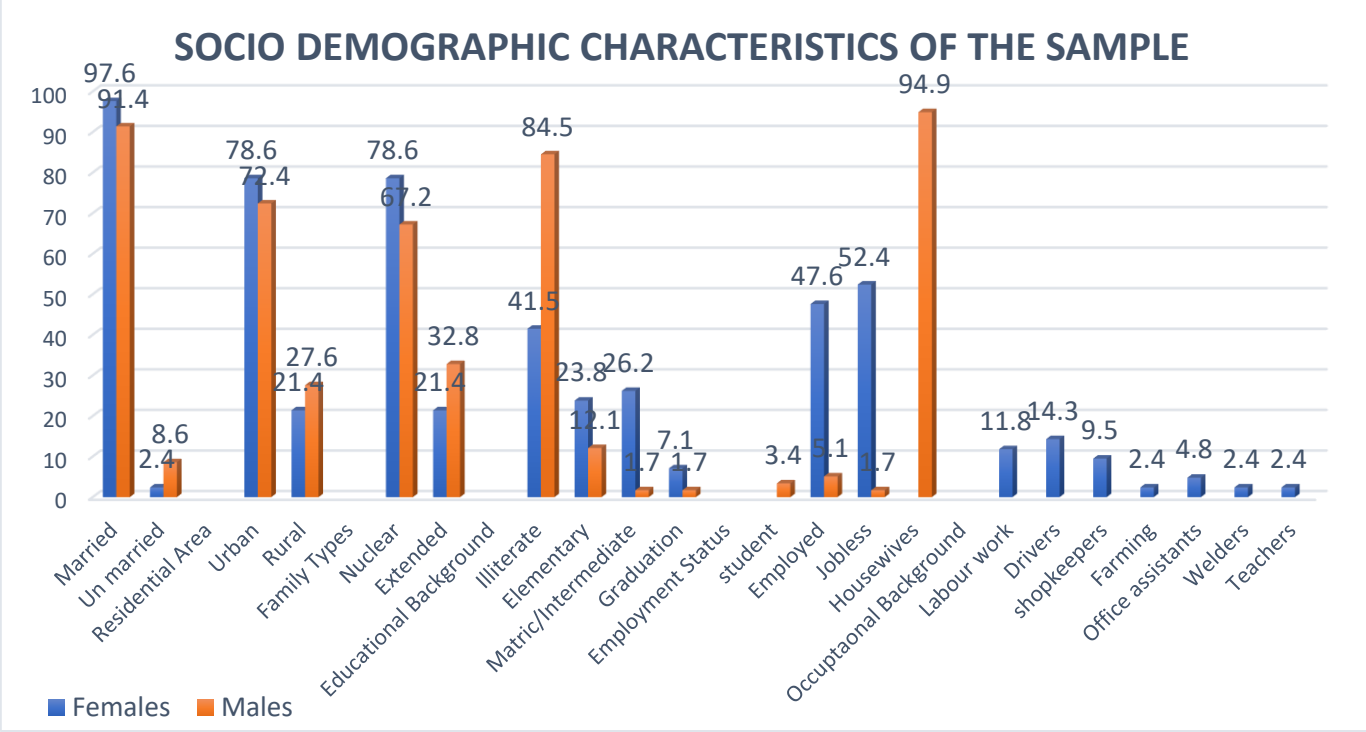

Figure 2: Socio-Demographic Characteristics of the Sample

3.3. PRE-DIAGNOSIS SYMPTOMS AMONG THE PATIENTS

The symptoms before the diagnosis indicated that 51% patients did not experience any symptoms while 49% patients experienced mild to severe symptoms. The most common symptoms were bloating after eating (53.4%), nausea (51.3%), indigestion (50%), GERD (38.7%), vomiting (31%), and stomach aches and diarrhea (28% and 23% respectively). These reported symptoms are usually the most common complaints that patients experience and usually are ignored by many patients until these become severe.

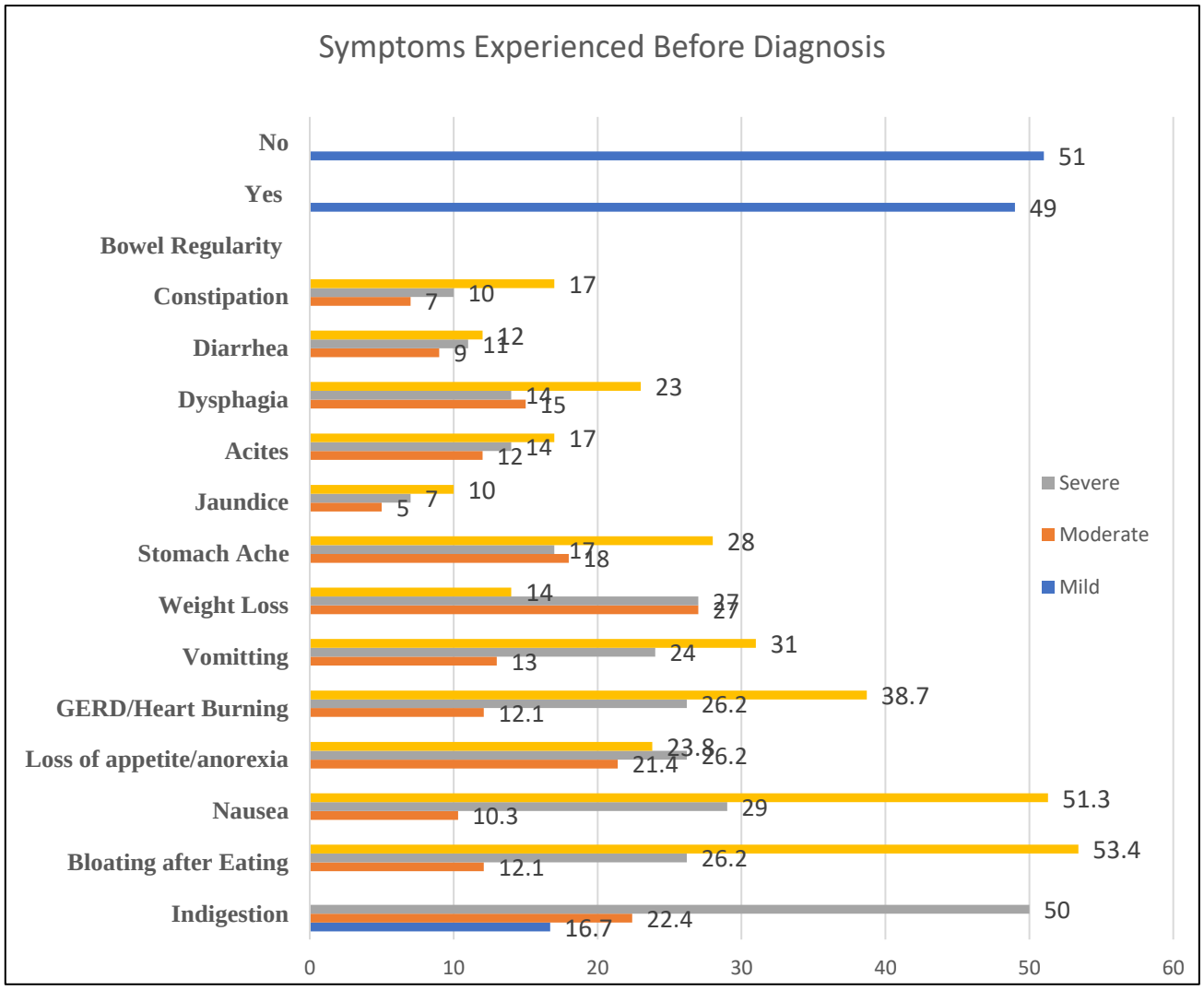

Figure 3: Pre diagnosis Symptoms among the Patients

3.4: SMOKING HISTORY IN MALE PATIENTS

The smoking history (Figure 4) among the male patients showed that 63.05% had a history of tobacco smoking (cigarette smoking), while 34.29 % had a history of Smokeless Tobacco Product (STP) locally called as Naswaar/snuff, while 2.68% had a history of cannabis/hemp/hashish. The data indicated smoking can be a strong predictor of cancers among these male patients as evident om many such studies.

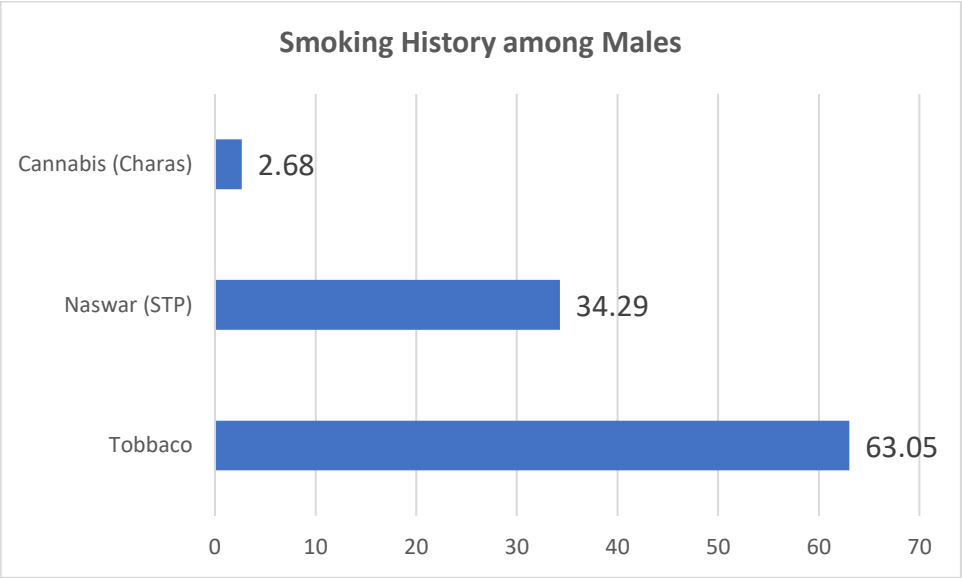

Figure 4: Smoking History of the Male Patients

3.5: ANTHROPMETRIC MEASUREMENT OF THE SAMPLE

The anthropometric measurements of the patients sowed mean ages to be 47.2± 7.23 and 43.3 ± 11.9 in males and females respectively with highly significant differences in BMI status. The overall mean BMI of the males was 22.62± 9.23 and 23.8 ± 4.10 in females. The normal mean BMI among the male sample was 21.07 ± 2.18 and was 23.67 in females. The mean BMI of the underweight patients was 19.24 ± 0.74 and 19.6 ± 1.45 in males and females respectively. An overall trend in the BMI trend was towards overweight and that too was common in the female patients. Although the mean BMI was 24.67 ±3.41, however, as evident from the interquartile range women up to 32.35 BMI were among the sample and there was a highly significant variation (P value= 0.003) within this group. The current study shows that that overweight and obesity was present among these patients although many also suffered pre diagnosis symptoms. These results are in agreement with the findings of a similar study which proposed the association of relative risk (RR) of 1.1 – 1.6 per 5kg/m^2 incremental increase in BMI in the overall study population [27], while in female obesity may carry some different risk of high BMI and the subsequent hormonal effects along the role of central obesity in women [28].

Table 1: Anthropometric Profiles of the Patients

Parameters	Males			Females		
	Inter-Quartile Range	Mean± SD	P Value	Inter-Quartile Range	Mean± SD	P Value
Age (Year)	18-57	47.2 ± 7.23	0.005	14 - 56	43.3 ± 11.9	0.011
Height (Inches)	63-72	68.3 ± 0.59	0.049	45.7.68.3	62.1 ± 4.01	0.00
Weight (lbs.)	108.0 - 176.0	127.3 ± 11.2	0.000	67.9 – 132.3	138.6 ± 6.41	0.0
Normal to Over Weight	118.0-176.0	138.65± 19.49	0.023	67.9 – 186.0	127.98 ± 25.40	0.007
Under Weight	108.0 – 123.0	114.94 ± 5.45	0.019	90.6 – 132.3	127.61 ± 16.90	0.039
BMI	15.81 – 25.62	22.62 ±9.23	0.013	13.62 – 32.53	22.8 ± 4.10	
Normal- Over Weight	18.19 – 25.62	21.07 ± 2.18	0.389	19.02 – 32.35	24.67 ±3.41	0.003
Under Weight	17.81 – 20.86	19.24 ± 0.74	0.064	17.63 ± 1959	19.6 ± 1.45	0.224
MUAC (Inches)	8.0 – 13.0	9.9 ± 1.25	0.054	9.2 – 15.2	10.2 ± 3.78	0.039

3.6: RETROSPECTIVE FOOD PREFERNCES, SOURCE OF TEA & SPICES, AND WATER

The retrospective food preferences (Figure 5) showed likeness for sour food (66.7%), salty food (51.7%) and fried foods (45.2%) were moderately liked while sweets and desserts (38.9 %) and spicy food (36.2%) were highly liked and preferred across the study sample. Hot beverages although were moderately liked (might be due to the seasonal effect at the time of data collection) but 100% of the sample consumed tea on daily basis. In lieu of the food preferences when the investigation about the purchase and use of tea leaves, spices and herbs was done (Figure 6) a shockingly higher percentage of the households/sample used unbranded and unpackaged black and green tea from the open market (62%, 93%), red chilies powder (67%), ground black pepper (46%), ground turmeric (43%), cinnamon powdered (69%), and different types of curry masalas /recipe mixes of spices and herbs (79%). Beside the fact that all these tea leaves, indigenous spices, and herbs had been reported to help prevent cancers in many reported studies, the contamination of these beneficial items with aflatoxins due to inappropriate storage conditions has also been reported to be major risk factor in low- income countries [29, 30]. This gravity of the problem may further be exasperated with the possibility of adulteration in these un branded food commodities (future work of the author). This similarly can be applied to the domestic source of drinking water (Figure 7). The main source of drinking water was indigenous bore well (56.7% & 51.5%) with few hand-pump source (4.1% & 7.2%) as compared to the municipality tube wells. The chances of contamination of the water with fecal matter are quite high and needs to be further investigated.

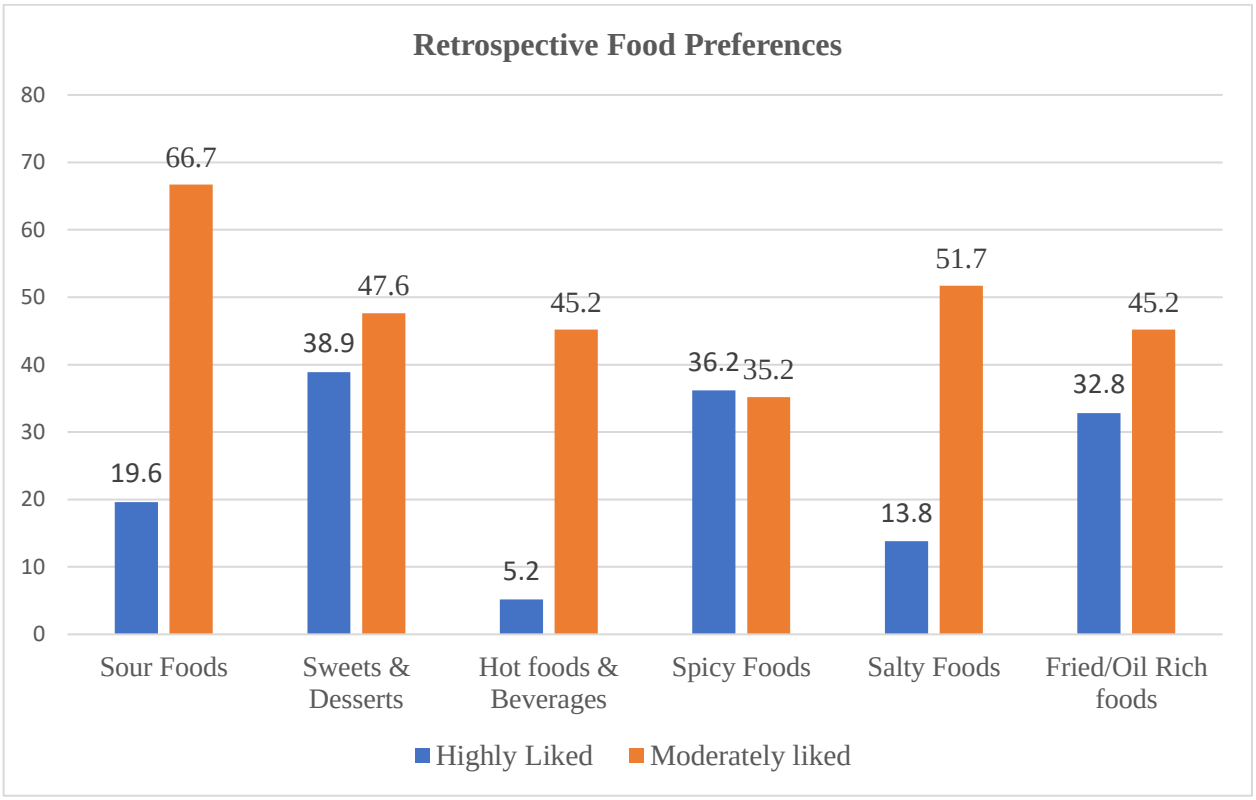

Figure 5: Retrospective Food Preferences among the Patients

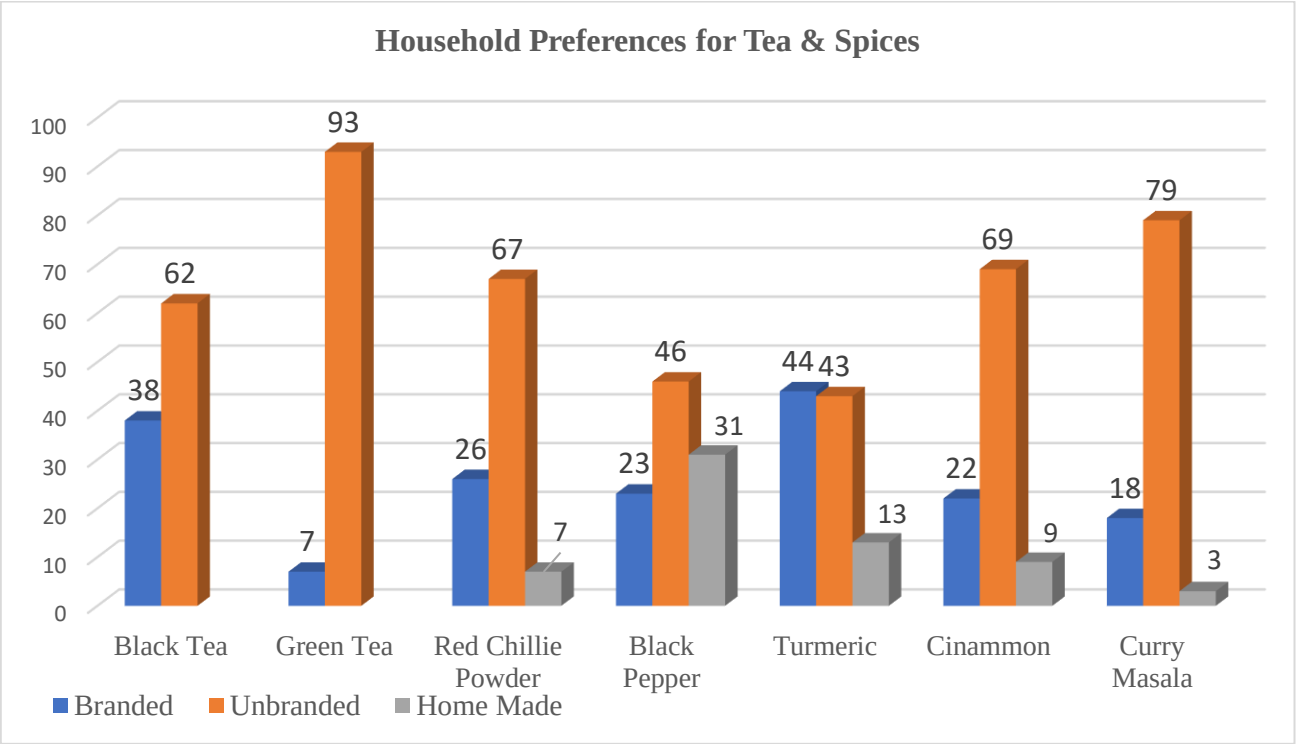

Figure 6: Household Preferences of Tea and Spices

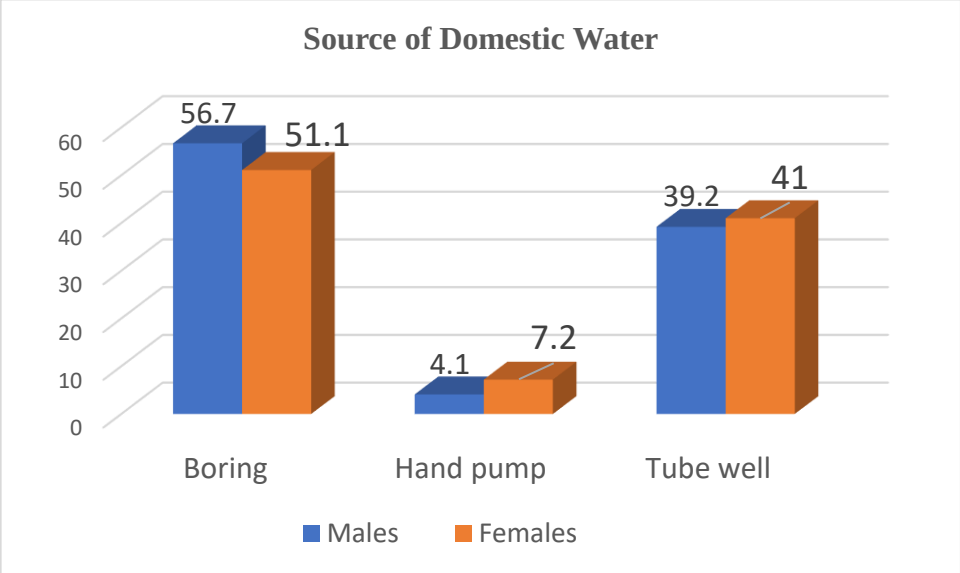

Figure 7: Household Source of Drinking water

3.7. DISTRIBUTION OF FOOD GROUPS IN THE HOUSEHOLD DIETARY DIVERSITY

The data regarding the percent distribution of different food groups in the HDDS (Figure 8) in the current study reports the major food groups were vanaspati ghee (hydrogenated fats), starchy vegetables, refined flour-based bakery products and tea. These figures are further strengthened from the data of Table 2 in which the intake of wheat, rice and cereals were 100% on daily basis, beans and vegetables on weekly basis meat intake was also once a week in majority of the households while the intake of fruits was quite low. The addition of sugar and jaggery in the milk tea and green tea and ghee and oils to cooking was 100% on daily basis. The mean DDS indicated 3.39± 5.26 for the 47% of the households falling in the low category (< 4 food groups) as per the WHO criteria, while 52% households fell in the moderate category (5-8 food groups) in a week or month with a mean DDS to be 5.3 ± 11.5 with significant differences between the groups and within the groups, only one percent

of sample consumed 9-12 food groups in the last week and month with mean DDS of 9.83 ± 2.1. When DDS were correlated with the family income and educational level of the patients (Table 3) only the family income showed a strong significant correlation indicating family income to be the strong factor for the Dietary Diversity Scores. These results are positively aligned with an Iranian study which showed greater dietary diversity scores among the colorectal cancer families and has suggested that higher dietary diversity may reduce the risk of these cancers and that the consumption of refined grains may increase the risks [31].

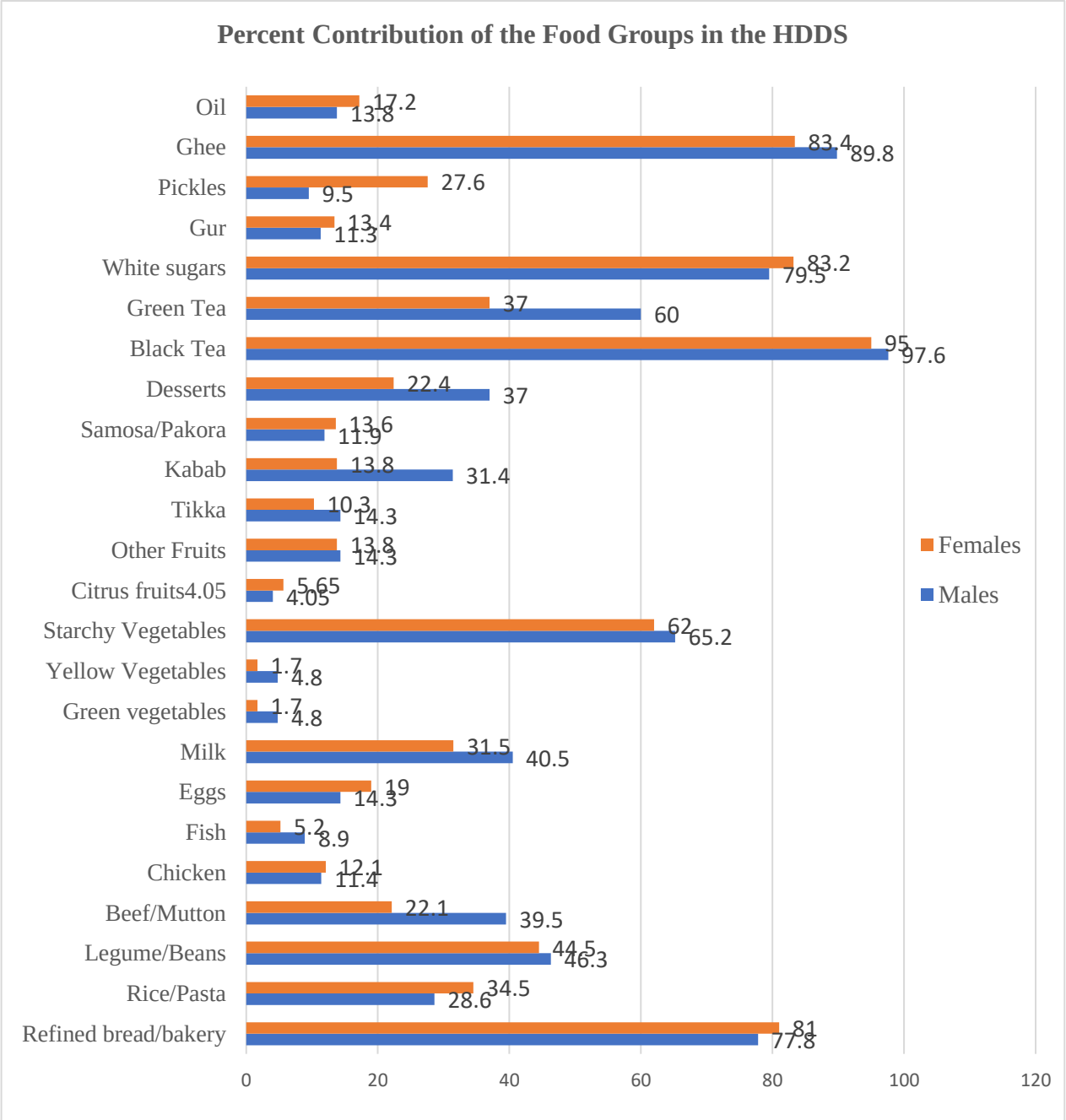

Figure 8: Distribution of Food Groups in the Household Dietary Diversity Scores

TABLE 2: DIETARY DIVERSITY SCORES AND STATUS OF THE PATIENTS' HOUSEHOLDS

Food groups Weights	Weight (WHO)	Percent Food Frequency /Week			DDS				
					Status	Percentage	Mean DDS	Status	
		Daily	Weekly	Rarely or never	≤4 food groups	Low	47	3.39± 5.26	0.05
Wheat, rice, cereals	2	100	100	-					
Pulses & beans	3	19	68	13					
Vegetables	1	22	74	4	5- 8 food group	Moderate	52	5.3± 1.5	0.021
Fruits	1	01	30	61					
Meat and eggs	4	-	46	54					
Dairy Products (In tea only)	4	54	100	-	9-12 food groups	High	01	9.82±2.1	Ns
Sugar, jaggery	0.5	100	100	-					
Ghee & oil	0.5	100	100	-					

TABLE 3: RELATIONSHIP OF DIETARY DIVERSITY SCORES WITH FAMILY INCOME & EDUCATIONAL LEVELS

DDS	Status	Percentage	Mean DDS	Correlation Coefficient Income	Correlation Coefficient Educational Background
≤4 food groups	Low	37	5.3 ± 11.5	r= 0.81*	r= 0.38
5 to 8 food group	Moderate	62			
9 to 12 food groups	High	1			

3.8. ACTIVITY AND SLEEP RECORDS OF THE PATIENTS

The physical activity record and exercise profiles of the patients showed that 45.2 % males and 27.6% females were involved in the minimum type of physical activity (20-30 minutes' walk). Sleeping patterns indicated that 50% of the males slept only 5-6nhours daily while 46.2% females slept 7-8 hours daily. The National Cancer Institute has reported a 19% reduction in GI cancer with physical activity while the current study showed majority of the patients with sedentary life style [32]. Previous studies have also shown a strong association between the disruption of 24-hr sleep -wake cycle and the risk of colorectal cancers. In the current study the incidence of colorectal cancer was more common among males and poor sleep hours were also observed in men indicating higher probability of the association of poor sleep and the cancer among these patients as suggested by the studies [33, 34].

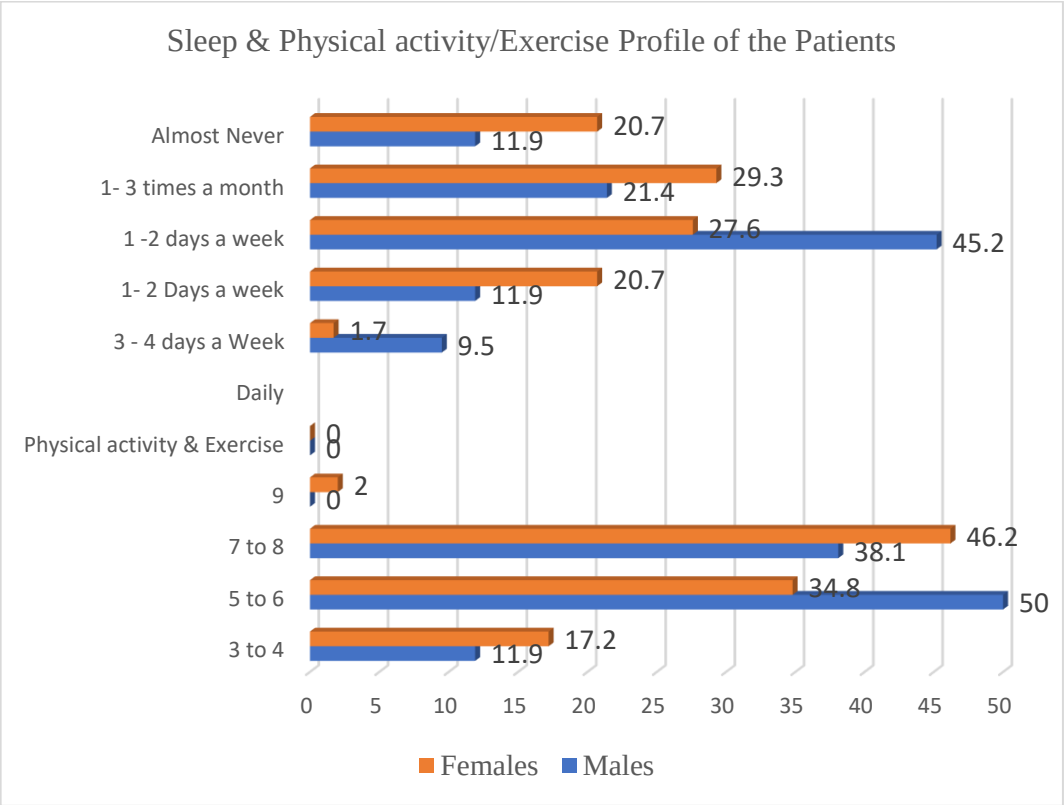

Figure 9: Sleep Duration and Activity/Exercise Profile of the Patients

4. CONCLUSION

The current study is concluded on the findings that many epidemiologic, sociodemographic factors are strong predisposing risks of GI cancers. Poor dietary intake, lower dietary diversity, intake of unsafe tea and spices, smoking among men, unsafe drinking water, sedentary lifestyle and poor sleep patterns are the modifiable risks that can be corrected. In order to mitigate the steadily rising rates of GI nutrition and health education is to be made part of governmental policies and both national and local leadership shall address this aspect on priority basis. Additionally, the health stakeholders shall inculcate nutrition education in the cancer treatment process by involving qualified nutritionists & dietitians to counsel patients both at hospital & clinic level considering the consider the affordability of food.

5. REFERENCES

1. Tufail, M., Wu, C. Exploring the Burden of Cancer in Pakistan: An Analysis of 2019 Data. *J Epidemiol Glob Health* **13**, 333–343 (2023). https://doi.org/10.1007/s44197-023-00104-5
2. Bray F, et al. Global cancer statistics 2018: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA: a cancer journal for clinicians. 2018;68(6):394–424.
3. Sheik A, et al. The anti-cancerous activity of adaptogenic herb *Astragalus membranaceus.* Phytomedicine. 2021;91: 153698.
4. Wong CH, et al. Prioritizing Chinese medicine clinical research questions in cancer palliative care from patient and caregiver perspectives. Health Expect. 2021;24(4):1487–97.
5. Abdel-Wahab M, et al. Global radiotherapy: current status and future directions—white paper. JCO Glob Oncol. 2021; 7:827–42.
6. Altunal Ç, Şahiner IT. The relationship of breast cancer deaths with age groups and urbanization of the population: a multi-country analysis. J Health Sci Med. 2022;5(4):973–6.
7. Wen D, et al. Urban–rural disparity in colorectal cancer incidence and increasing trend in relation to socioeconomic development and urbanization in China. J Int Med Res. 2018;46(10):4181–96.

8. Berben L, et al. Cancer and aging: two tightly interconnected biological processes. Cancers. 2021;13(6):1400.
9. Yonenaga Y, et al. Impact of physical inactivity on the risk of disability and hospitalization in older patients with advanced lung cancer. J Multidiscip Healthc. 2021; 14:1521
10. Minihan AK, et al. Proportion of cancer cases attributable to physical inactivity by US state, 2013–2016. Med Sci Sports Exerc. 2021.
11. Li X, et al. Accelerated aging mediates the associations of unhealthy lifestyles with cardiovascular disease, cancer, and mortality: two large prospective cohort studies. medRxiv, 2022.
12. Huang Y, et al. Air pollution, genetic factors, and the risk of lung cancer: a prospective study in the UK Biobank. Am J Respir Crit Care Med. 2021;204(7):817–25.
13. Sima M, et al. The impact of air pollution exposure on the MicroRNA machinery and lung cancer development. J Personal Med. 2021;11(1):60.
14. Ahmad, Z., Idress, R., Fatima, S., Uddin, N., Ahmed, A., Minhas, K., Memon, A., Fatima, S., Arif, M., Hasan, S., Ahmed, R., Pervez, S., Naila Kayani, N. (2016). Commonest cancers in Pakistan - findings and histopathological perspective from a premier surgical pathology center in Pakistan. *Asian Pac J Cancer Prev, 17*(3), 1061-1075
15. Kolligs F T. Diagnostics and epidemiology of colorectal cancer. Visc Med 32, 158–164
16. Vogtmann E, Xiang Y-B, Li H-L, et al. (2013) Fruit and vegetable intake and the risk of colorectal cancer: results from the Shanghai men's health study.2016. Cancer Causes Control 24, 1935–1945.
17. Aune D, Chan DS, Lau R. Dietary fibre, whole grains, and risk of colorectal cancer: systematic review and dose-response meta-analysis of prospective studies. 2011; Br Med J. 343, d6617
18. La Vecchia C, Muñoz SE, Braga C. Diet diversity and gastric cancer. Int J Cancer Res. 1997; 72, 255–257
19. Kant AK, Schatzkin A, Harris T B. Dietary diversity and subsequent mortality in the first national health and nutrition examination survey epidemiologic follow-up study. Am J Clin Nutr. 1993; 57, 434–440
20. Feeding America. What is food insecurity? https://www.feedingamerica.org/hunger-in-america/food-insecurity
21. National Institute on Minority Health and Health Disparities (NIMHD). Food accessibility, insecurity and health outcomes. Available at: https://www.nimhd.nih.gov/resources/understanding-health-disparities/food-accessibility-insecurity-and-health-outcomes.html
22. Drewnowski A. Food insecurity has economic root causes. Nat Food. 2022;3(8):555
23. Food and Agriculture Organization of the United Nations (FAO). The state of food security and nutrition in the world 2022. 2022. Available at: https://www.fao.org/publications/home/fao-flagship-publications/the-state-of-food-security-and-nutrition-in-the-world/en
24. U.S. Department of Agriculture (USDA) Economic Research Service (ERS). Key statistics & graphics. 2023. Available at: https://www.ers.usda.gov/topics/food-nutrition-assistance/food-security-in-the-u-s/key-statistics-graphics/.
25. Huafu Li, Zhewei Wei, Chunming Wang, Wei Chen, Yulong He, Changhua Zhang. Gender Differences in Gastric Cancer Survival: 99,922 Cases Based on the SEER Database, Journal of Gastrointestinal Surgery,2020; 24(8): 2020: 1747-1757
26. Sun D, Lei L, Xia C, Li H, Cao M, He S, Zhang Z, Guo G, Song G, Peng J, Chen W. Sociodemographic disparities in gastric cancer and the gastric precancerous cascade: A population-based study. Lancet Reg Health West Pac. 2022 25; 23:100437. doi:10.1016/j. lanwpc.2022.100437.
27. Calle E., Rodriguez C., Walker-Thurmond K., Thun M. (2003) Overweight, obesity, and mortality from cancer in a prospectively studied cohort of U.S. adults. N Engl J Med 348: 1625–1638

28. Moore L., Bradlee M., Singer M., Splansky G., Proctor M., Ellison R. BMI and waist circumference as predictors of lifetime colon cancer risk in Framingham Study adults. Int J Obes Relat Metab Disord. 2004; 28: 559–567
29. Talib Wamidh H., AlHur Mallak J., Al.Naimat Sumaiah , Ahmad Rawand E. , Al-Yasari Arkan Hadi , Al-Dalaeen Anfal , Thiab Samar , Mahmod Asma Ismail .Anticancer Effect of Spices Used in Mediterranean Diet: Preventive and Therapeutic Potentials. Frontiers in Nutrition, 9: 2022.
30. World Cancer Research Fund. Wole grains, vegetables, and the risk of Cancers https://www.wcrf.org/wp-content/upload
31. Bahrami A, Shirani P, Sohouli M, et al. Dietary diversity score (DDS) and odds of colorectal cancer and adenoma: a case–control study. Journal of Nutritional Science. 2022;11: e34. doi:10.1017/jns.2022.30
32. National Cancer Institute. Physical Activity and Cancer. https://www.cancer.gov/about-cancer/causes-prevention/risk/obesity/physical-activity-fact-sheet
33. McTiernan A, Friedenreich CM, Katzmarzyk PT, et al. Physical activity in cancer prevention and survival: A systematic review. Medicine and Science in Sports and Exercise 2019; 51(6):1252-1261
34. Kamyab P, Kouchaki H, Motamed M, Boroujeni ST, Akbari H, Tabrizi R. Sleep disturbance and gastrointestinal cancer risk: a literature review. J Investig Med. 2023 Mar;71(3):163-172. doi: 10.1177/10815589221140595