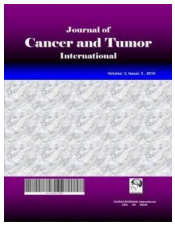

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Diet of Benghazi Cancer Patients; Quality and Associated Factors

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Authors' contributions

This work was carried out in collaboration between all authors. Author FN designed and conducted the study, wrote the protocol, managed the literature search and wrote the first draft of the manuscript. Authors FN, EIM, MO and Manal Younis performed the study analyses, data reporting and tabulation and contributed to literature search. Authors FN, EIM and MO collected the data and provided technical support in clinics. Authors Manal Younis and Moftah Younis participated in the critical revision of the article. All authors read and approved the final manuscript.

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ABSTRACT

Dietary habits and food consumption patterns in Libya have changed markedly during the past three decades and the Libyan cancer patients are not exception. There has been great move from traditional dishes and foods to more westernized food style, which is characterized by high sugar, high total fats, high cholesterol, high sodium and low fiber. The interaction of dietary intake, nutritional status and cancer is multifaceted and complex. This paper presents a cross-sectional study which aims to investigate the quality of diet among cancer patients in Benghazi. The total studied sample was 400 cancer patients, (27.8%) were males and (72.2%) were females. Mean

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age ± Standard Deviation were 52.8 years ± 11.5. (6.8%) of the subjects had poor diet quality, while (60%) of the subjects their diet need improvement, only (33.2%) had diet with good quality. Age, income level, food intolerances and allergies, food dislike, eating out, and food preferences were associated with quality of diet among cancer patients in Benghazi. Fruits and vegetables had the lowest consumption score, while sodium and cholesterol had the highest consumed score. All these factors call for community based intervention and prevention strategies.

Keywords: Diet; quality; cancer; patients; Benghazi; associated factors.

1. INTRODUCTION

Changes in dietary intake involve both qualitative and quantitative aspects of food consumption patterns. The adverse dietary changes include shift in the structure of the diet towards a higher energy density diet with a greater role of added sugar and fat in food, reduced intake of complex carbohydrates and dietary fiber and reduced vegetable and fruit intake, greater intake of saturated fat (mostly from animal sources). These modifications have led to adverse consequences on the nutritional status and health of the population, particularly sick people in developing countries [1,2] Cancer describes a group of disorders characterized by an uncontrolled and abnormal cell division which if untreated eventually leads to death [3]. Cancers are classified in many methods. They may be classified by the type of tissue in which the cancer originates (histological type), and by primary site, or the location in the body where the cancer first initiated [4]. There were around 12.3 million new cases of cancer in the world [5]. In 2003, a research carried out to collect information from the Benghazi Cancer Registry about new cases of cancer from eastern Libya revealed a total of 997 cases of primary cancers from among its 1.6 million inhabitants and confirms that its incidence is lower than in western countries. According to this research the most common two frequently diagnosed cancers in males were lung cancer (19%) and colorectal cancer (10%). Among females, these were breast cancer (26%), and colon and rectum cancer [6]. Cancer is the third leading cause of all deaths in developing countries, as well as in Libya, cancer is the second main cause of death (13%) following cardiovascular disease (37%) [7]. The interaction between diet, genetic and environmental predisposition is essential in many chronic diseases including cancer. Nutrition and dietary factors may interact with the process of carcinogenesis in all three stages of initiation, promotion and progression [8]. Epidemiological studies over the last few decades have highlighted the contribution of dietary factors and nutritional influences on different types of cancer [9,10]. Ample evidence states that planned and continued nutritional support increases the chances of successful medical therapy in the care of cancer patients [11]. Adequate and varied diet helps to maintain nutritional status among cancer patients by ensuring that these patients meet their high energy and protein needs and decreasing the complications of cancer therapy, and promoting the tolerance of cancer therapy [1]. Cancer therapy can cause significant nutritional complications related to localized or systemic side consequences that interfere with foods intake, alter metabolism or increase nutritional losses. The incidence of malnutrition in cancer patients has been found to be as high as 80% and has been associated with a reduced response to treatment, survival and quality of life [5]. In a study carried on Benghazi breast cancer female patients by Nouh et al. [7] reported that only (1.5%) of subjects were well nourished, (25%) of the studied females were severely malnourished; while (73.5%) were either at risk of malnutrition or suspected to develop malnutrition in the future. Similar results were also reported when lung cancer pateints were considered [12]. Nouh et al. stated that out of 121 lung cancer patients; Only(7.5%) of subjects were well nourished, (22.3%) were severely malnourished; while (70.2%) were either at risk of malnutrition or suspected to develop malnutrition in the future. Food choices are affected by nutrient needs, geographical location, socioeconomic and cultural factors, food availability, lifestyle, income level, living conditions, education, and health status. The Healthy Eating Index (HEI) is a validated tool, correlating with a wide range of blood nutrients. The HEI, the only index developed by the Unites States (US) Federal government to be used regularly for assessing the overall quality of diets in US. HEI has also been recommended by the American Dietetic Association (ADA) and applies to all individuals at age of two years and above [13,14]. The aim of this paper to assess the diet quality of cancer patients in Benghazi using the Healthy Eating Index

(HEI) and the factors associated with their diet quality.

2. METHODOLOGY

2.1 Subjects

A cross-sectional study was conducted from 10th July 2016 to 30th August 2017 on cancer patients attending Benghazi Medical Center (BMC). Out of 1053 patients who attended the cancer outpatients clinic in BMC; 462 cancer patients were randomly approached during the period of data collection (1st August 2016 and 30th March 2017) to participate in the study. Out of 462 patients who were deemed fit to participate in the study, 29 refused to participate, 33 patients dropped out from the study or were excluded because of incomplete or implausible data. A total of 400 cancer patients (out of the 462 possible study recruits) comprising 111 males and 289 females, with complete questionnaires with clearly filled up entries were finally enrolled in the study giving a response rate of (86.58) %. The inclusion criterion for enrolment in the present study was all oncology patients who were receiving radiotherapy and/ or chemotherapy and had a body weight record for the previous two weeks and one month. In case the previous six months body weight was not available then a record taken one month back was acceptable. All participants have agreed to provide 24 hours recall for three different days.

2.2 Data Collection

Data was collected by trained dieticians. To avoid subjective bias data collectors underwent training sessions on interviewing skills, anthropometry measurements and data entering, and coding at Department of Nutrition, Benghazi University. A small pilot study was carried out and 10 questionnaires were tested from 15th to 20th July 2017 to test questionnaire and feasibility of study methods.A detailed structured interview based questionnaire was prepared for collecting information about the studied subjects. The questionnaire collected information regarding selected socio-economic characteristics, dietary information and anthropometric measurements. The questionnaire was reviewed before being translated in Arabic, the local language. The questionnaire was divided into various sub-sections. The first section covered various characteristics like preliminary information: age, gender, nationality, marital status, family information, monthly family income and self perceived adequacy to purchase nutritious food. Living conditions include type of housing and food preparation. A detailed information was collected regarding the type of cancer, duration of cancer (date of the first diagnosis), type of cancer therapy followed and its duration. It also contained sub-sections for collecting medical information related to chronic diseases and surgery. Height and weight measurements were used to calculate Body Mass Index (BMI). Anthropometric measurements were the taken in a private area using standard techniques as recommended by the World Health Organisation (WHO) [15].

2.3 24 Hour Meal Details

Each patient was requested to recall a 24 hours of food consumption for 3 days. The three consecutive days include Friday ((weekend in Libya)) where Libyan family consume atypical diet comparing to other working days during the week. The three days were Thursday, Friday and Saturday. And is some patients Friday, Saturday and Sunday. In case added or discretionary salt was used, the subjects were cautioned to report its amount as accurately as possible in standardised household measures (teaspoon). Food likes and dislikes, eating out home. Eating out home means eating in fast foods restaurants, fast food outlets cafeterias, vending machines and other food service outlets, preference of healthy or junk foods were also reported. The food diary collected from each patient was used to calculate the intakes of energy (Kilocalorie), total fat (grams), saturated fat (grams), cholesterol (milligrams) and sodium (milligrams). The nutritive values of foods consumed by subjects were analysed using the US food composition table. The nutritive value of prepared dishes, based on the nutritive value of its ingredients was also calculated using the online US food composition table. For pre-packaged food items, drinks, and beverages the nutritive value considered was as indicated on its wrapping [16].

2.4 Eating Index

In order to provide a complete picture of the quantities and types of food people consume the variety in their diet, and their compliance with specific dietary recommendations, the eating index was used [13,17]. The total index score is the sum of 10 dietary items, weighted equally and representing the various aspects of a

healthful diet. A maximum score of 10 was assigned to each of the five food components of the index. People whose diet exceeded or met the recommended number of servings for a food group received a maximum score of 10. A score of zero was assigned to the respective component if a person did not consume any item from the food group. High component scores indicate intakes close to recommended range or amounts while low component scores indicate less compliance with recommended range or amounts. The first five components measure the degree to which a person's diet conforms to the USDA Food Guide Pyramid serving recommendations for the five major food groups; grain, vegetables, fruits, milk, and meat. The sixth component measures total fat consumption as a percentage of total food energy intakes; while the seventh component measures saturated fat consumption as a percentage of total food energy intakes. The components from eight to ten measure total cholesterol intake, total sodium intake and the variety in a person's intake respectively. The recommended numbers of servings as food groups are based on the appropriate energy intake as recommended by the Dietary Guidelines for Americans. Pyramid serving recommendation for 1600, 2200 and 2800 Kilocalories (Kcal) were used as the basis to interpolate recommendations for age/gender groups not described in the pyramid [13] If certain composite foods were consumed, then the commodity compositions were identified. Commodities were assigned to appropriate food group based on their gram/serving size factors that were calculated. Dry beans and peas were first assigned to the meat group if the meat group recommendations were not met, after which they were added to the vegetable group. The variability and the subjective nature of serving sizes is a dilemma for researches involved in dietary assessment of populations and their interpretation [13]. Commonly used household measures and easily recognizable units aid in the usage of the Food Guide Pyramid [17]. Index scores for fat and saturated fat intakes were examined in proportion to total food energy expressed as kilocalories. Total fat intake of less than or equal to 30 percent of total daily calories was assigned a score of 10 points. This percent based on the Dietary Guidelines for Americans. Fat intake of equal to or greater than 45 percent of total calories in a day was assigned a score of zero. An intake of fat between 30 and 45 percent was scored proportionally. Saturated fat intake of less than 10 percent of total calories in a day was assigned a maximum score of 10. Its intake at equal to or greater than 15 percent daily energy was assigned a score of zero. Intakes of saturated fat between 10 and 15 percent were scored proportionately. The upper limits for total fat (45 percent) and saturated fat (15 percent) were based on consultations with nutrition researchers and exploration of consumption distribution of these components. The score for cholesterol was based on the amount of cholesterol consumed in milligrams. A maximum score of 10 was assigned when daily cholesterol intake was 300 milligrams (mg) or less. This amount is based on the recommendations of the Committee on Diet and Health of the National Research Council and represents a consensus of experts in foods and nutrition, medicine, epidemiology, public health and related fields. A score of zero was assigned when daily intakes reached 450 mg or more. Intakes between 300 and 450 mg of cholesterol were scored proportionally. The upper limits were based on consultations with nutrition researchers and exploration of consumption distribution of these components. The score for sodium was based on the amount consumed in mg per day. A maximum score of 10, based on the recommendations of the Committee on Diet and Health of the National Research Council was assigned when daily sodium intake was 2400 mg or less. A score of zero was assigned when daily intakes reached 4800 mg or more. Intakes between 2400 and 4800 mg of cholesterol were scored proportionally. The upper limits were based on consultations with nutrition researchers and exploration of consumption distribution of these components. A maximum variety score of 10 was assigned if a person consumed at least half a serving each of 8 or more different types of food in a day. A score of zero was assigned if 3 or fewer different foods were consumed by a person in a day. The upper and lower limits to gauge food variety were based on consultations with nutrition experts. The HEI, a single summary measure of diet quality that conformed to the US Dietary Guidelines and the Food Guide Pyramid 18 has the following overall HEI score for diet quality, ranging from 0 to 100. Good diet equals to score between 81-100, while diet needs improvement equals to score of 51-80. Poor diet has score between 0-50 [13,17].

2.5 Ethical Approval

Informed consent was obtained from subjects who were also assured of the confidentiality of the information collected. The research was

approved by the administration of the concerned hospital and University of Benghazi. Prior to the start of the project the respective hospital administration were informed in writing about the aim of the study to obtain the maximum possible cooperation to conduct the study.

2.6 Statistical Analysis

All data was coded prior to being entered into a computer. Description and analysis of data were carried using SPSS version 21. Chi Square was used to test the association between two qualitative variables. Level of significance was set at p value < 0.05. Analysis of variance by ANOVA was carried out to see if the mean overall HEI scores and scores of the components of the HEI were different.

3. RESULTS

The total studied sample of 400 cancer patients, 27.8% (n = 111) were males with females (n = 289) representing 72.2% of the total sample. Mean age ± SD were 52.8 years ± 11.5. More than half of subjects (58%) were between 40-59 years old and they were non employed (55.25%). Most of the subjects (95.3%) were Libyan and married (95.8%). The education level of the subjects varied with the highest segment belonging to secondary school level (32%). BMI of subjects was varied with (34.2% and 36.5%) for under-weight and obese respectively. Most of subjects were sedentary (80.3%). The most common cancer among males was colon (40.5%), while among females was breast cancer (38.6%). More than half of subjects (73.75%) were receiving chemotherapy. Only (9%) of subjects had food allergy/intolerance; (33%) of them dislikes some food groups or items. More than half of subjects (77.75%) were eating out home (81%) of subjects reported preferring junk foods rather than healthy foods. The mean score for grains as per the HEI was 8.00, slightly better in females (8.20) as compared to males (7.47). Meat scores for both genders were slightly lower at 6.99 while those for milk, fruit, and vegetable were still lower at 5.84, 5.70, and 4.36 respectively. The mean average scores for total fat (7.77) saturated fat (6.09) and cholesterol (9.59). Sodium scores were high (9.70), a trend seen among both males and females. Variety of diet received a score of 8.46 among both females and males. (6.8%) of the subjects had poor diet quality, while (60%) of subjects needed diet improvements, only (33.2%) had diet with good quality. Age group, marital status, and income were the socio-economic factors associated with the diet quality of subjects. Poor diet quality was higher among older age group (92.9%). Marital status was associated ($p< 0.05$) with diet quality. More percentage of married subjects (85.7%) had a good diet as compared to their unmarried counterparts (32.9%). None of the married subjects were found to have a poor diet while this figure was 8.7% in case of single subjects. Only 14.3% of married subjects needed an improvement in their diet quality as against 58.3% among the unmarried subjects. Income level was associated ($p< 0.05$) with the diet status of the subjects. A lower income level was associated ($p< 0.05$) with poorer diet intake. There was a shift of patients from the need to improve diet to poor diet quality as the income level dropped. Among the dietary characteristics, food intolerances and allergies, food dislike and eating out and food preferences while eating out were associated ($p< 0.05$) with diet quality of subjects. Subjects who reported having food tolerance or food allergy had less good diet quality (16.7%) and more poor diet quality (19.4%) as compared to those who had no complaints of any food allergy or food intolerance. Subjects who admitted having dislikes for certain foods had both a greater percentage of those who actually had a poor quality diet (12.1%) or needed an improvement in their diet quality (65.9%). Subjects who ate out had less good diet quality (16.7%) and more poor diet quality (19.4%) as compared others (34.9% and 5.5% respectively). Among subjects who ate out, those who selected healthy food over junk or canned food had more good quality diet (32.2% versus 16.7%). This healthy food selection group also had less requirement for diet quality improvement (59.3%) as compared to the junk or canned food preferring group (74.65). Analysis of variance by ANOVA showed that in terms of the mean overall HEI, the group with a good quality diet (87.64 ± 5.96)), the group with a diet requiring improvement in its quality (67.15 ± 7.97) and poor diet quality group (45.66 ± 4.14) differed significantly ($p< 0.05$) from each other. The three groups of subjects categorised according to their diet quality as assessed by the HEI also differed ($p < 0.05$) in their mean scores for all the components of the HEI except for cholesterol and sodium. All the components except for cholesterol and sodium had a statistically significant ($p < 0.05$) positive moderate correlation ($r = 0.45$-0.66) with the overall HEI score.

Table 1. Subject characteristics

Variables	Sex		Total
	Male	Female	
20-39	20(5)	45(11.25)	65(16.25)
40-59	61(15.25)	171(42.75)	232(58)
≥60	30(7.5)	73(18.25)	103(25.75)
Mean ± SD	50.1±2.3	54.1±1.2	52.8 ± 11.5
Libyan	80(72)	200(69.2)	304(76)
Others	31(28)	89(30.8)	96(24)
Married	108(97.3)	275(95.2)	383(95.8)
Single	3(2.7)	14(4.8)	17(4.3)
Illiterate/RW*	39(35.1)	69(23.9)	108(27)
Basic education	23(20.7)	69(23.9)	92(23)
Secondary and its level	34(30.6)	94(32.5)	128(32)
University degree	15(13.5)	57(19.7)	72(18)
Employment			
Yes	104(93.7)	75(24.9)	179(44.75)
No	7(6.3)	214(74)	221(55.25)
Family income (LD)			
< 250	1(0.9)	5(1.7)	6(1.5)
250 < 500	55(49.5)	168(58.1)	223(55.8)
≥ 500	55(49.5)	116(40.1)	171(42.8)
Underweight	37(33.3)	100(34.6)	139(34.2)
Normal	45(40.5)	70(24.2)	115(28.75)
obese	27(24.3)	119(41.2)	146(36.5)
Sedentary	76(68.5)	245(84.8)	321(80.3)
Low active	14(12.6)	12(4.2)	26(6.5)
Active	13(11.7)	12(4.2)	25(6.3)
Very active	8(7.2)	20(6.9)	28(7)
Cancer Type			
Colon	45(40.5)	79(27.3)	124(67.8)
Lung	30(27)	0	30(27)
Breast	0	112(38.6)	112(38.6)
Prostrate	20(18)	0	20(18)
Ovary & uterus	0	68(23.5)	68(23.5)
Others	16(11)	30(10.4)	46(21.4)
Type of cancer therapy			
CT *	83(74.7)	212(73.4)	295(73.75)
RT **	17(15.4)	45(15.6)	62(15.5)
Both	11(9.9)	32(11.0)	43(10.75)

*LD: Libyan Diner RW: Reading and writing only * RT: Radiotherapy ** CT: Chemotherapy*

Table 2. Subject diet characteristics

Variables	Male	Female	Total
Food intolerance/allergy			
Yes	3(2.7)	33(11.4)	36(9)
No	108(97.3)	256(88.6)	364(91)
Food dislike			
Yes	21(18.9)	111(38.4)	132(33)
No	90(81.1)	178(61.6)	268(67)
Eating out			
Yes	88(79.3)	223(77.2)	311(77.75)
No	23(20.7)	66(22.8)	89(22.25)
Weekly frequency of eating out			
< 3	3(3.4)	125(11.2)	28(9)

Variables	Male	Female	Total	
3-6	77(87.5)	184(82.5)	261(83.9)	
≥ 7	8(9.1)	14(6.3)	22(7.1)	
Foods during eating out				
Junk/canned	69(78.4)	183(82.1)	252(81)	
Healthy	19(21.6)	17.9(59)	59(19)	
Added salt				
Yes	66(59.5)	156(54)	222(55.5)	
No	45(40.5)	133(46)	178(44.5)	
Daily discretionary salt (Tsp*)				
Quarter	27(40.9)	74(47.4)	101(25.25)	
Half	27(40.9)	50(32.1)	77(19.25)	
1 or more	12(18.2)	32(20.5)	44(11)	
Diet Quality				
Poor	3(2.7)	24(8.3)	27(6.8)	
Needs improvement	77(69.4)	163(56.4)	240(60.0)	
Good	31(27.9)	102(35.3)	133(33.3)	
	Mean±S.D	**Mean±S.D**	**Mean**	**S.D**
Grain	7.47±1.72	8.20±2.02	8.00+	1.96
Vegetable	3.82±2.59	4.57±3.44	4.36+	3.24
Fruit	4.54±3.06	6.15±3.61	5.70+	3.54
Milk	5.01±2.80	6.16±3.22	5.84+	3.14
Meat	7.30±2.24	6.86±3.02	6.99+	2.84
Total fat	8.68±2.25	7.41±3.56	7.77+	3.30
Saturated fat	6.88±4.22	5.79±4.28	6.09+	4.28
Cholesterol	9.73±0.94	9.54±1.52	9.59+	1.39
Sodium	9.56±1.41	9.76±1.09	9.70+	1.19
Variety	8.60±1.39	8.41±2.05	8.46+	1.89
Total	71.63±10.62	72.85±14.97	75.52+	13.90

** Tsp: Teaspoon*

Table 3. Variables associated with diet quality of the subjects

Variables	Percentage of subjects according to diet quality		
	Good	**Needs improvement**	**Poor**
Age group (Years)			
<40	92.9	7.1	0
≥ 40	28.8	64.0	7.3
Single	32.9	58.5	8.7
Married	85.7	14.3	0
Income			
< 250	0	47.4	52.6
250-500	2.6	69.3	28.1
> 500	0	88.1	11.9
Intolerance or allergy			
Yes	16.7	63.9	19.4
No	34.9	59.6	5.5
Food dislike			
Yes	22.0	65.9	12.1
No	38.8	57.1	4.1
Eating out			
Yes	16.7	63.9	19.4
No	34.9	59.6	5.5
Junk/canned	16.7	74.6	8.9
Healthy	32.2	59.3	8.5

Table 4. Components of dietary index

Components of HEI	Mean (± SD) scores of subjects		
	Good	Needs improvement	Poor
Grain	8.90* (1.30)	7.73* (1.90)	6.60* (2.93)
Vegetable	6.80* (2.63)	3.42* (2.78)	0.70* (1.73)
Fruit	8.07* (2.40)	4.76* (3.40)	2.46* (2.98)
Milk	8.20* (2.14)	4.89* (2.84)	2.67* (2.72)
Meat	8.53* (1.58)	6.60* (2.75)	2.78* (3.04)
Total fat	9.45* (1.60)	7.09* (3.51)	5.50* (4.07)
Saturated fat	9.17* (2.33)	4.95* (4.17)	1.00* (2.68)
Cholesterol	9.53 (1.59)	9.60 (1.33)	9.89 (0.58)
Sodium	9.78 (0.97)	9.65 (1.81)	9.81 (0.96)
Variety	9.18* (1.15)	8.48* (1.72)	4.85* (2.25)
Total	87.64* (5.96)	67.15* (7.97)	45.66* (4.14)

Table 5. Correlation of the HEI component scores with the overall HEI score among subjects

HEI component		Correlation coefficient (r)
Score for component number	Component	
1	Grain	0.45*
2	Vegetable	0.66*
3	Fruit	0.57*
4	Milk	0.59*
5	Meat	0.58*
6	Total fat	0.48*
7	Saturated fat	0.65*
8	Cholesterol	0.05
9	Sodium	0.48
10	Variety	0.53*

4. DISCUSSION

Nutritional transitions have a major impact on the health and nutrition of populations, especially those with chronic diseases, notably as an increase in diet related complications [18]. Preventive interventions early in cancer patients offer lifelong benefits and it is essential to inculcate positive healthy behaviours during the stages of cancer [19]. The dietary quality of the study subjects shows that it was good only in 33.3% of the subjects. More males had a good quality diet than females but this difference was statistically not significant. The percentage of subjects actually having a poor quality diet may not have been high (6.8%) but there were around 60% subjects who were found to be in need of improvement in their dietary quality. In spite of HEI not being recent, there are very few published studies that have evaluated diet quality, either in its original format or in a slightly modified version for better regional compatibility [20-22]. A direct comparison of the findings of this study with those that have used a similar diet quality assessment tool in similar group would not be possible since published studies that have either used the original HEI or its modified version as a tool to evaluated dietary quality have either included the entire population or have included adults of all ages; or used the assessment to discover the influence of diet on cancer incidence [23-25]. In an American study [26], 100 cancer patients, the The average HEI score was 65.24. National Health and Examination Survey (NHANES) data exclusively on adults also shows that 18.3% of surveyed persons are consuming poor quality diets [27]. In another recent research done by *Polanski J et a and publish in (2017),* the authors revealed that up to 51.1% of patients were undernourished, 23.9% were at risk of malnutrition, and only 25.0% showed a normal nutrition. The authors concluded that malnutrition has an impact on quality of life and on the presentation of symptoms in lung cancer patients and diet quality is part of life quality [28].

4.1 Socio-economic Factors

A higher age group was associated with poorer diet quality. Ageing is generally associated with a decline in various physiological functions leading

to malnutrition. Increasing age has been linked to a higher incidence of disease which causes low variation in dietary intake. Oral health, denture, swelling problems and dysphagia all are common in older age and decrease consumption of a variety of foods items [29,30]. Income level was associated with the diet quality in this study. It showed a worsening of diet quality with a lowering income level. Literature review and critical appraisal by a multidisciplinary group of experts, with feedback from specialists in cancer care delivery stress on the need for social and economic data to be collected as a part of clinical practice guidelines to improve the quality of health care and outcome for cancer patients. The association of lower income level with poor diet emphasizes the need of supplementary financial support of cancer patients, especially those in less fortunate economic position. The social and political changes in Libya in the past few years have also impacted on economic level and consequently nutrition status of Libyan population and cancer patients will not be exception. Limited health resources available in low- and middle-income countries in post war era highlights the need for health service planning to focus on the subgroup of severe cases that are most likely to benefit from access to treatment. Further point, component of such inequity relates to restricted financial access to health-care services as well as well as access to high quality and varity of foods [31,32]. Similar results comes from American study [26]; the paper stated that individuals who have less economic stability and paid bills late due to medical expenses reported significantly lower diet quality than those who did not [26]. Sankaranarayanan et al. [33] and Porter et al. [34] have stated tha the prevalence of poor diet quality also appears to be dependent upon the healthcare system and the economic situation of the country where the study was performed. Marriage can affect health and dietary intake. Research indicated that cancer patients who live with a spouse have better diet quality than those living with other household arrangements. Marriage partners influence each other's dietary intake. Indeed, marriage has a positive and negative impact on diet. Higher positive marital adjustment has been associated with greater compliance with dietary intake Marriage is a consequences of economic stability [35,36].

4.2 Dietary Characteristics

Among the dietary characteristics, food intolerances and allergies, food dislike and eating out and food preferences while eating out were associated ($p< 0.05$) with the nutritional status of the subjects. Subjects who reported not having any food intolerance or food allergy or having no dislikes for any food had better quality diets. Dietary considerations play an important role in the treatment and management of food allergies and intolerances. Avoidance of some foods may not cause nutritional problems, but the practical and nutritional implications of allergies to staple foods such as cow's milk, eggs and wheat are far greater [37]. Cancer patients with food allergies are forced to limit foods in their diet that are safe and comfortable for them to eat. Elimination diets must therefore be monitored carefully for nutritional adequacy [37-39]. While food preferences and eating habits are learned as a part of each individual's family, cultural, national and social background; people tend to eat what they like. Personal preferences for taste, smell, appearance, and texture affect food consumption [37,40]. Personal preferences at times are so dominant that they overrule wise and logical judgment of choosing healthy foods over not so healthy foods. It is said for Libyans that the increase in the percentage of cancer, there might be several reasons that are related to changed lifestyle especially diet with decreased roughage and increased consumption of soft and sweet diet and drinks [40]. It could therefore be suggested in context to this study that cancer patients who happen to have food intolerances, food allergies or dislike for certain foods should look for alternative foods that contain the same type and level of nutrients that they are forced to avoid because of the food allergy or dislike [37]. Subjects who ate out and subsequently selected unhealthy foods while eating out had a poorer diet quality. This finding seems logical since away from home, foods are generally higher in saturated fat, total fat, cholesterol and sodium and lower in dietary fibre, iron and calcium. Away from home sites included restaurants, fast food outlets cafeterias, vending machines and other food service outlets. When eating out, people consume a greater amount of food or they choose energy dense foods or both. Cancer patients acknowledge the importance of a healthy diet and have a positive attitude toward healthy eating, however, personal preferences tended to dominate food choices. The high fat content increases it's palatability and since taste is an established factor in food choice, this could be a reason for choosing these energy dense but nutrient poor foods over comparatively healthier foods with lower fat content [41,42].

4.3 Analysis of Variance

Mean sodium and cholesterol intake scores were higher than 9.5 out of a maximum possible score of 10, however, these two dietary components were not statistically different among the three diet quality groups. These findings imply that all the three diet quality groups equally followed healthy eating as far as cholesterol and sodium consumption is concerned. However, there were major differences in the other eight components of the dietary index as reflected in their statistically different mean overall scores. This seems to be expected since each of the food choices contributes to the diet as a whole. No single food choice is good or bad by itself but all the food choices combined make up a dietary pattern that is either healthy or not entirely healthy [43]. This study shows that cancer patients in Benghazi do not fulfil the recommended serving grains, fruits, vegetables, milk and meats. Similar findings have been reported from studies elsewhere where most cancer patients were found not fulfilling the recommendations of their respective Food Guide Pyramid recommendations [44-46]. Fruit and vegetable intake among cancer patients has been found to be favourably related to intake of dietary fiber, calcium, magnesium, potassium, folate, and vitamins C, E, A, B1 and B6, and inversely related to saturated and trans fatty acids and cholesterol. The mean scores for the vegetables (5.38) and fruits (6.) components among cancer patients in this study turned out to be the lowest two scores among the ten components of the eating index and indicate that on an average both food groups were highly deficient with respect to their recommended daily servings. This trend has been seen in other studies too where only 64% of cancer patients had a daily consumption of fruits and vegetables. Even among those who did consume fruits and vegetables daily its intake was less than the recommended servings in as many as 80% to 88% of cancer patients [47-49]. Daily milk or dairy consumption was found to be inadequate in 32% of cancer patients while others has shown otherwise [50]. Milk and dairy products group among cancer patients had a mean score of 5.84 out of 10 indicating a general insufficient intake of the recommended daily servings of milk and dairy products. Milk and milk products are important sources of many nutrients, notably calcium which is important for bone health. Milk product consumption has been associated with overall diet quality and adequacy of many nutrients [51]. Studies conducted on cancer patients showed that subjects with lower total fat intakes are the ones who desire lean meat food choices. Unlike meat, poultry, lamb, mutton, beef or camel-being an important part of Libyan meals- subjects in this study did not score well on the meat component of the eating index. Studies on cancer patients show variable results for percent energy from total fat, ranging from 30% to 40% [52,54]. This study also shows low mean scores for intake of both total and saturated fat. Therefore while selecting and preparing meat, poultry and milk or milk products, choices should include lean, low fat or fat free options. The fat intake should preferably come from food sources of polyunsaturated fatty acids and monounsaturated fatty acids. The Dietary Guidelines for Americans recommend choosing and preparing foods with less salt. Salt contains both sodium and chloride. Studies in the US have shown that mean sodium intake excluding the discretionary table salt among cancer patients was more than the recommended daily intake for sodium [44,45].

Subjects in this study may have scored well on the sodium, but it is suggested that a periodic reassessment of diet quality could help detect a possible future deviation from this healthy eating habit. Variety in diet means including various food groups in the diet [10,12].

Cross sectional study with single assessment of dietary intake is a limitation of the current study. Another limitation is the proportionally large presentation from middle age group that resulted from random sampling approach. Also use of US food composition tables because lacking of Libyan food composition table. Non national indexes from other populations (non Libyan based) and the lack of comparison of previous Libyan studies; all are limitations of the current study.

5. CONCLUSION

Age, income level, food intolerances and allergies, food dislike, eating out, and food preferences were associated with quality of diet among cancer patients in Benghazi. The overall diet quality of the subjects was related to eight of the ten components of the HEI: grains, vegetables, fruits, milk and dairy products, meat group, saturated fat, total fat and variety. Subjects had the lowest HEI component scores compliance for vegetables and the second lowest for fruits. Subjects had the highest HEI component scores compliance for sodium and

the second highest for cholesterol. A general strategy to promote healthy diet and food choices is required to promote healthier eating habits among cancer patients in Benghazi. Nutritional education programmes planned for cancer patients in Benghazi in general should have a focus on those belonging to a older age group, those with food allergies, food intolerances or dislike for certain foods. More representative studies need to be carried out among cancer patients for details micronutrients such as vitamins and minerals. Larger scale studies are needed to assess the contribution of different modifiable and non-modifiable factors to the dietary intake among cancer patients.

CONSENT

As per international standard or university standard, patient's written consent has been collected and preserved by the authors.

ETHICAL APPROVAL

As per international standard or university standard, written approval of Ethics committee has been collected and preserved by the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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