Int J Cancer Manag. 2018 January; 11(1):e59271. doi: 10.5812/ijcm.59271.

Published online 2018 January 15. **Research Article**

Investigating Lifestyle and Dietary Style in Patients with Lymphoma of the Head and Neck Admitted to Razi Hospital in the City of Rasht

Maryam Basirat,[1] Ebrahim Gholipour,[2] and Bita Rohani[3,*]

[1]Assistant Professor, Dental Sciences Research Center, Department of Oral and Maxillofacial Medicine, Faculty of Dentistry, Guilan University of Medical Sciences, Rasht, Iran
[2]Dentist, Private Clinic
[3]Assistant Professor, Department of Oral Medicine, Faculty of Dentistry, AJA University of Medical Sciences, Tehran, Iran

[*]*Corresponding author*: Bita Rohani, Assistant Professor, Department of Oral Medicine, Faculty of Dentistry, AJA University of Medical Sciences, Tehran, Iran. Tel: +98-9127201069, Fax: +98-2188410770, E-mail: rohani_bita@ajaums.ac.ir

Received 2017 July 31; **Revised** 2017 November 05; **Accepted** 2018 January 07.

Abstract

Background: In recent years, the incidence of various types of cancer including lymphoma has been on the rise. Although there have been developments in terms of knowledge of its biology and treatments, its etiology is still less known. In this respect, lifestyle and dietary factors can play important roles in the etiology of lymphoma. Thus, the purpose of the present study was to investigate the lifestyle and the dietary style in patients with lymphoma of the head and neck.
Methods: This study was a retrospective case-control research. The patient group (57 people) was selected from the department of oncology at Razi hospital in the city of Rasht and the control group (57 individuals) was selected out of healthy individuals referred to Guilan school of dentistry. Then, both groups completed questionnaires concerning the research variables. After collecting the required information, the data were entered into the SPSS Software (version 21) to evaluate the dietary style and the lifestyle in the both groups.
Results: Comparing the lifestyle in both study groups, the rate of smoking ($P < 0.0001$) as well as the Body Mass Index (BMI) ($P = 0.0001$) in the patient group was higher than those in the control group. Moreover, comparing the dietary style in both groups showed that the rates of red meat intake ($P = 0.005$) in the patient group, and the consumption of fresh herbs ($P = 0.009$) and fruits ($P = 0.043$) in the control group were high. These differences were also statistically significant.
Conclusions: The consumption of red meat, herbs, and fruit, as well as the body mass index were considered as predictors of lymphoma. Furthermore, smoking was directly correlated with the incidence of lymphoma.

Keywords: Lifestyle, Lymphoma, Nutrition

1. Background

Lymphoma is known as a neoplastic disease originating from lymphoid cells which can affect lymphatic tissues and organs and can be seen inside lymph nodes or regions outside glands (1, 2). It is recognized as the seventh most common cancer across the world and the second most common malignancy within the head and neck (3, 4). Clinically and pathologically, lymphoma is divided into Hodgkin lymphoma (HL) and non-Hodgkin lymphoma (NHL) (1, 4). The incidence of lymphoma is going up. In this regard; viral factors, childhood social environment, genetic factors, environmental factors, as well as defects in the immune system have been involved in the creation of the HL. On the other hand, factors such as immune deficiency, viral factors (Epstein-Barr virus, human T-lymphotropic virus 1, Human Herpes virus-8, and Hepatitis C Virus), genetic factors, chemicals and respiratory exposure, lifestyle, and factors including exposure to ionizing radiation can play roles in developing the NHL. Moreover, it has been argued that smoking can play a part in follicular lymphoma (FL). Accordingly, chronic smoking is likely to interfere with the production of antibodies and T cell proliferation (5). Given the chemical composition and the duration of consumption, dying hair can similarly intensify the risk of FL (6). It is also assumed that the type of diet can play a role in the etiology of lymphoma particularly the NHL type. Besides, it is believed that fruits and vegetables are rich in antioxidants and they can have a protective role against cancer (7, 8). Cruciferous vegetables can protect humans against cancer, and studies on animals have shown that these vegetables can reduce chemically induced tumor formation (9). It was shown that reactive oxygen species (ROS) can modulate various physiological processes such as the regulation of growth factor signaling, the hypoxic response, the inflammatory process, and

the immune response in mammalian cells (10).

Obesity, high-calorie intake, as well as increased consumption of carbohydrates and proteins are similarly associated with an augmented risk of the NHL, while a significant reduction can be observed in the given risk following a growing intake of vegetables (11). Sedentary lifestyle, obesity, and a diet full of meat and milk can be as well associated with an augmented risk of the FL, while a diet rich in fruit, vegetables, unsaturated fatty acids, vitamin D, and antioxidants is inversely associated with the risk of the FL (12). However, the accurate etiology of lymphoma is still unknown (4).

Therefore, the aim of the present study was to examine the role of some factors and risk factors related to lifestyle and dietary style in individuals affecting lymphoma of the head and neck.

2. Methods

This study was a case-control retrospective research. The case group (patient group) with their medical records and receiving treatment was selected from the department of oncology at Razi Hospital. On the other hand, the control group was selected from healthy individuals referring to the school of dentistry, Guilan University and it was homogeneous with the case group in terms of their age and gender. The inclusion criteria were patients suffering from lymphoma of the head and neck with definite and final records confirming lymphoma infection; in addition, the individuals were able to answer the research questions and they aged above 10 years. The exclusion criteria were infection with cancers other than lymphoma, as well as serious gastrointestinal diseases or people with a history of gastrointestinal system surgery that had altered their dietary style. All the participants signed consent forms. The data were also collected in a strictly confidential environment. They were used only for the purpose of the study at all stages of the project, and were maintained considering their confidential nature.

The sample size for investigating lifestyle and dietary style of patients with lymphoma according to the results of a study carried out in Oman by Ali et al. (11) and table (8) in the given study with 99% confidence level and 95% test power and based on lower sampling formula was 35 individuals in each group to examine the effect(s) of consumption of vegetables. Since the present study investigated the role of nine other factors along with consumption of vegetables, the final sample size for this study based on the given formula was equal to 57 people per group. Sampling in this study was conducted gradually and it was of non-probability type (convenience sampling method) that was performed at the time period from the 22 December, 2013 to the 20 June, 2014 on patients with lymphoma of the head and neck referred to the department of oncology at Razi Hospital as well as healthy individuals referred to the school of dentistry. Ethical approval of the research was granted by Guilan University committee numbered IR.GUMS.REC.1396.245.

The measuring tool of this study was a questionnaire based on the table of the study variables which was comprised of three parts: demographic characteristics, lifestyle characteristics, and dietary style characteristics. Within the part of the demographic characteristics, information such as age, gender, employment status, systemic diseases, and sports activities, was taken into account. Moreover, the information related to the five factors of smoking, Body Mass Index(BMI), place of residence, level of education, and marital status was recorded in the part of the lifestyle characteristics. In addition, the part of dietary style characteristics included Food Frequency Questionnaire (FFQ) containing 116 variables whose validity and reliability had been investigated in the national screening plan for esophageal cancer in Iran (13). The given questionnaire reviews the rate of consumption for food categories such as bread and grains, meat and its products, milk and dairy products, beans, oils and butter, vegetables, fruit, sugar and sweets, drinks, as well as spices in 11 sections. The response to the rate of consumption was predicted in five options (never, yearly, monthly, weekly, and daily) and it was registered for each case. The questions were raised through interviews and the information was recorded accurately in a questionnaire specific to each patient.

After collecting the data, they were entered into the SPSS Software (version 21). In this respect, Chi-square test and Fisher's exact test were used to determine the frequency of the variables of the dietary style and the lifestyle in both study groups. Also, Mann-Whitney U test was employed to compare the rate of food stuff intake in both groups. The amount of food consumption was shown in the Table 1 as the average rating. Considering multiple analyses to determine lymphoma risk factors based on the lifestyle and the dietary style, multiple logistic regression models was used. The significance level of the tests was also considered $P < 0.05$ and the tests were discussed bilaterally.

3. Results

In this study, 114 individuals in two groups i.e. 57 patients admitted to the department of oncology at Razi Hospital and 57 individuals as the control group from patients referred to the school of dentistry were compared and evaluated in terms of the dietary style and the lifestyle. The

Table 1. Comparison of Meat Product, Milk and Dairy, Beans, the Vegetables and Fruitage Consumption in Two Groups

Food Product	Patient	Control	P Value	Food Product	Patient	Control	P Value
Meat product				Raw onion	61.07	53.93	0.208
Red meat and lamb	62.54	52.46	0.035[a]	Boiled onion	59.64	55.36	0.456
Grinded red meat	60.77	54.23	0.039[a]	Raw vegetable	51.22	63.77	0.030[a]
Heart, liver and kidney	66.42	48.58	0.002[a]	Fried vegetable	51.22	63.77	0. 750
Chicken leg	55.86	59.14	0. 484	Vegetable for soup and porridge	52.93	62.07	0.099
Chicken breast	57.65	57.35	0. 952	Green bean	57.47	57.53	0.993
Chicken wing	57.25	57.75	0. 913	Peas	55.85	59.15	0.575
All chicken part	62.34	52.66	0. 088	Bean	59.42	55.58	0.497
Chicken liver, heart and gizzard	59.36	55.64	0.498	Lettuce	61.22	53.78	0.190
Egg	56.15	58.85	0.546	Raw zucchini	50.21	64.79	0.010[a]
Fish	52.73	62.27	0.095	Baked Pumpkin	58.32	56.68	0.777
Hamburger	60.55	54.45	0.551	Raddish horse	57.83	57.17	0.911
Beluga	56.36	58.64	0.578	Sliced cabbage leaves	61.62	53.68	0.143
Fresh water fish	55.99	59.01	0.575	Mushroom	60.23	54.77	0.334
Tuna fish	58.00	57.00	0.861	Green pepper	57.03	57.97	0.870
Smoked fish	60.11	54.89	0.365	Sweet peppers	56.46	58.54	0.704
Kielbasa	58.13	56.87	0.558	Raw carrots	54.07	60.93	0.223
Sausages	59.71	55.29	0.439	Raw garlic	54.74	60.26	0.333
Milk and dairy				**Fruitage**			
Pasteurized milk	54.04	60.96	0.239	Watermelon	49.960	65.40	0.006[a]
Pasteurized cheese	55.39	59.61	0.457	Melon	49.34	65.66	0.004[a]
Fat and normal yogurt	52.88	62.12	0.075	Cucumber	54.83	60.17	0.272
Strained yogurt	64.45	50.55	0.014[a]	Orange	54.75	60.85	0.049[a]
Pasteurized curd	59.90	55.10	0.387	Tangerine and others citrus	54.14	60.85	0.230
Home-made curd	57.99	57.01	0.757	Grapes	51.23	63.77	0.025[a]
Beans				Apple	56.00	59.00	0.010[a]
White beans	57.96	57.04	0.809	Yellow plum, yellow gold drops	51.89	63.11	0.059
Red beans	59.45	55.55	0.403	Cherry, sour cherry	52.53	62.47	0.046[a]
Pinto beans	57.96	57.04	0.835	Peach/nectarine	51.23	63.77	0.032[a]
Pea	59.77	55.23	0.293	Pear	48.35	66.65	0.001[a]
Split pea	58.96	56.04	0.535	Date	55.86	59.14	0.037[a]
Soy bean	56.75	58.25	0.778	Banana	56.25	58.75	0.643
Lentils	58.20	56.80	0.785	Pomegranate	50.24	64.76	0.008[a]
Vegetables							
Boiled potato	61.28	56.25	0.645				
Raw tomatoes	59.24	55.76	0.173				
Baked tomatoes	55.03	59.97	0.430				
Common eggplant	53.71	61.29	0.125				

[a]The results were noted as average rating.

mean and the standard deviation of age in the patient group were 37.2 $\pm$ 12.1 years and they were 37.7 $\pm$ 12.6 years in the control group. Given the results of the t-test, both groups were homogeneous in terms of age with no statistically significant difference (P = 0.827). It should be noted that 11 patients (19.3%) were suffering from the HL and 46 individuals (80.7%) were diagnosed with the NHL.

In terms of gender, 56.1% (32) of the patients in the case group were male and 43.9% (25) were women. These percentages in the control group were respectively 49.1% (28) and 50.9% (29) which was not statistically different considering the results of the Chi-square test (P = 0.453).

In total, 28 patients in this study were smokers; of these, 21.9% (25) were already smoking and 2.6% (3 patients) had quitted it. The history of smoking in the patient group was 38.6% (22) and that was 10.5% in the con-

trol group (6); thus, such a difference was statistically significant based on the results of the Chi-square test ($P < 0.0001$). The mean and the standard deviation of the number of cigarettes used per day in the patient group was 18.6 $\pm$ 11.8 and they were 14.8 $\pm$ 14.9 in the control group. Accordingly, the rate of smoking in the case group was reported higher but no statistically significant differences were found based on the results of the independent t-test ($P = 0.516$). The mean and the standard deviation of the years of smoking among patients were also 6.3 $\pm$ 3 years, but none of the 6 smokers in the control group mentioned the years of their smoking.

In total, 31.6% (36) of the individuals in this study had been suffering from a systemic disease. Of these, 36.8% (21) were in the patient group and 26.3% (15) were in the control group whose difference based on the results of the Chi-square test with a difference of 10% was not statistically significant ($P = 0.227$).

Overall, 7% (8) of the study samples had a history of cancer in their families. Of these, 10.5% (6) were in the patient group and 3.5% (2) were in the control group which had no statistically significant differences based on the results of Fisher's exact test ($P = 0.136$). It should be noted that no history of lymphoma in family members was reported by the individuals in both study groups.

The mean and the standard deviation of the BMI in the patient group was 28.5 $\pm$ 4.5 which was 3.5 scores higher than those in the control group (25.1 $\pm$ 3.7). This difference based on the results of the independent t-test was significant ($P = 0.0001$). The percentage of the obese individuals (BMI > 30) in the patient group (35.1%) was almost 5 times higher than those in the control group (7%); thus, the distribution of the BMI status according to the defined cut-off points was statistically significant ($P = 0.001$) as revealed by the results of the Chi-square test.

Besides, the distribution of the employment status (stay-at-home, self-employed, farmer, worker, employee, hairdresser, school student, and university student) in the two study groups were statistically homogeneous and no significant difference was observed in this respect ($P = 0.714$).

The individuals in the control group were 10% more than those in the patient group in urban areas; however, the two groups were statistically homogeneous in terms of place of residence with no significant difference ($P = 0.202$).

None of the individuals in both study groups had a history of prior consumption of immunosuppressive drugs for more than two weeks and they also had no bone marrow transplants.

Considering the frequency distribution of level of education, sport activities, and marital status in the study groups, the percentage of individuals with degrees lower than diploma was higher in the individuals in the patient group but it was not statistically significant. Furthermore, the two groups were homogeneous in terms of marital status and sport activities and they did not have significant differences.

Comparing the consumption rate of meat products within the two study groups using Mann-Whitney U test, the consumption rates of red meat (beef and lamb) ($P = 0.035$), minced red meat ($P = 0.039$), as well as heart, kidney, and liver ($P = 0.002$) in the case group were higher than those in the control group. This difference was statistically significant, but no statistically significant differences were found concerning other categories of meat products (Table 1).

The comparison of the consumption rate of milk and dairy products in both study groups also showed a statistically significant difference between the two study groups about strained yogurt ($P = 0.014$) so that strained yogurt intake was higher in the patient group but there was no significant difference between both groups in terms of other dairy products (Table 1).

Given the consumption of beans in both study groups, no statistically significant difference was reported between the two groups in this study.

Comparing the consumption of vegetables in the two study groups, there was only a statistically significant difference in terms of herbs ($P = 0.03$) and zucchini ($P = 0.01$) between the two groups so that the consumption rates of herbs and zucchini in the patient group were lower than those in the control group and no statistically significant differences were observed in other cases (Table 1).

Considering fruit intake in both study groups, a statistically significant difference was found in the study groups in the majority of the cases such as watermelon ($P = 0.006$), melon ($P = 0.004$), orange ($P = 0.049$), apricot ($P = 0.01$), cherry and sour cherry ($P = 0.046$), peach and nectarine ($P = 0.032$), pear ($P = 0.001$), grapes ($P = 0.001$), date ($P = 0.037$), and pomegranate ($P = 0.008$); so that the consumption of fruit in the patient group was lower than that in the healthy control group in all the significant cases mentioned above (Table 1).

Given the multiple analyses of the factors associated with lymphoma based on logistic regression model using backward stepwise LR, the consumption rate of red meat ($P = 0.005$), herbs ($P = 0.009$), fruit ($P = 0.043$), and BMI ($P < 0.0001$) were considered as predictors of lymphoma out of the various factors associated with this disease. Accordingly, the consumption of red meat could increase the risk of lymphoma by 1.87 times (odds ratio = 1.87) but the consumption of herbs (OR = 0.52) and fruit (OR = 0.65) could decrease the risk of infection with lymphoma. The increase

by 1 score in the amount of the BMI could add to the risk of lymphoma by 1.3 times (OR = 1.26) (Table 2).

4. Discussion

Following squamous cell carcinoma, lymphoma is considered as the second most common neoplasm within the head and neck region (3, 4). The incidence of different types of cancer in recent years including lymphoma and particularly the NHL has seen a rising trend and its growth in some countries has been faster than other types of cancer. Although knowledge of the biology and treatment of cancer has broadened, its etiology is poorly understood (4, 14). The main cause of lymphoma is also unknown. However, various studies have investigated the role of some factors and risk factors related to lifestyle and dietary style, genetic factors, as well as viral diseases in this respect (5, 7, 8, 11, 12). In this study, a number of factors associated with lifestyle and dietary style involved in lymphoma of the head and neck were also investigated in the target group.

Examining the prevalence of smoking in the two groups, there was a significant growth in the rate of smoking in the patient group. In fact, the prevalence of smoking was higher among patients affected by lymphoma. These results were consistent with the findings from studies by Lim et al. (15) suggesting that smokers and those who had recently quitted smoking had a higher risk of lymphoma compared with individuals who had never smoked. However, the results of the present study were not in line with those concluded by Matsuo et al. (16) implying that no increased risk was observed for smoking. Thus, there was a need to do further investigations.

Evaluating the distribution of the BMI status in the two study groups, a significant rise was observed in the size of the BMI in the patient group so that the BMI > 30 in the patient group was almost 5 times higher than that in the control group. As well, obesity (BMI > 30) in this study was considered as a risk factor for lymphoma so that increasing the size of the BMI by 1 score could increase the risk of lymphoma by 1.3 times. These results were in agreement with the findings of the study by Larsson and Wolk (17) in Sweden in 2011 as well as those by Litchman et al. (18) in the United States in 2010 indicating where the BMI was positively associated with the increased risk of the NHL and the HL. The given findings were also consistent with the results of the study by Willet et al. (19) suggesting that individuals with the BMI equal or more than 30, five years before the diagnosis of their disease had a greater risk of infection with HL. In a way that it was argued to have an initial focus on the prevention of cancer to reduce obesity.

There are biological mechanisms lying beneath the relationship between cancer and obesity. These complex and not well understood mechanisms are consist of growth factors, hormones, modulation of energy balance and calorie processes, affecting cell cancer promotion and progression (8, 20, 21).

In addition, there was no significant relationship between the control group and the case group regarding the level of education between the two study groups. The given findings were consistent with the results from the study by Ali et al. (11) revealing a significant reduction in the risk of infection with NHL following an increase in level of education. This could be due to the geographical location of study samples or limited sample size.

Comparing place of residence and marital status, no significant relationship was found between the control group and the patient group; in fact, both groups were homogeneous in terms of marital status and place of residence (urban or rural) and these results were in agreement with the findings of the study conducted by Ali et al. (11).

Given the consumption rate of meat and its products between the two study groups, red meat intake by itself was significantly high in the patient group. However, no significant difference was observed between the two groups concerning other meat products. In this study, consumption of red meat was considered as a predictor of lymphoma so that red meat intake higher than the normal level in patients could escalate the risk of lymphoma infection by 1.87 times which could be associated with mutagens of meat and fat. These findings were consistent with the results from the study by Ambinder et al. (12) in the state of Atlanta in the United States in 2012 as well as the investigation by Aschebrook-Kilfoy et al. (22) in France in 2012 indicating that a diet replete with red meat could increase the risk of infection with the NHL. Furthermore, the findings of the present study were in line with the results of the investigation by Dong and Wu suggesting that consumption of poultry meat and egg was not related to an increased risk of the NHL (23). Bertrand et al. stated that increased risk of NHL is not associated with intakes of total, animal, saturated, and trans fat (24); however, more research is needed. In Rohrmann's study, no consistent associations were seen between red and processed meat consumption and lymphoma risk, but they found that the consumption of poultry was related to an increased risk of B-cell lymphomas (25).

Comparing the consumption of milk and majority of dairy products between the two study groups, no significant difference was observed and the given results were not consistent with the findings from the study by Ambinder et al. (12) signaling that a diet rich in milk was associated with an increased risk of being affected with the NHL. This difference could be due to variations in methodology, sample size, geographical location, and the use of

Table 2. Regression Coefficients and Odd Ratio of Predictors of Lymphoma

Food Product	Regression Coefficient	Std. Error	Odd Ratio	95% Confidence Interval		P Value
				Upper Bound	Lower Bound	
Meat	0.625	0.223	1.868	2.893	1.206	0.005
Fresh vegetable	-0.647	0.246	0.524	0.323	0.848	0.009
Fruit	-0.430	0213	0.650	0.429	0.987	0.043
BMI	0.235	0.063	1.265	1.431	1.119	> 0.0001
Fixed value (effect of unknown factors)	-4.062	1.812	0.017			

substances to enrich milk and dairy products between the two study groups.

Moreover, there was no significant difference between the control group and the case group regarding the consumption of beans. According to the results of the study by Ali et al. (11), animal proteins but not vegetables could augment the incidence of lymphoma by increasing protein intake. Some other studies had similarly suggested that animal proteins can cause long-term antigenic stimulation and the risk of lymphoma by induction of no immune response or tolerance (7, 26). The recall bias of the individuals in this study concerning the accurate consumption rate of these materials or differences in their cooking were also considered as the limitations of this study; thus, conducting further research studies to obtain the required information from the target group in this domain seems important.

Considering the use of vegetables in the two study groups, the consumption rate of fresh herbs in the group of healthy individuals was higher so that having fresh herbs in one's diet was likely to lower the possibility of incidence of lymphoma almost by 50% (OR = 0.52). These results were consistent with the findings of the studies by Ambinder (12) in the state of Atlanta in the United States and Holtan (8) in Hungary, suggesting that consumption of vegetables could reduce the risk of infection with the NHL. This decreased risk could be due to the presence of antioxidants in vegetables. It should be noted that vegetables are the rich source of carotenoids, vitamin E and C, folate, fibers, and phytochemicals that can lower the oxygen radicals generated by endogenous and exogenous mechanisms and prevent damage to DNA and genetic mutations (27). These results were not in line with the findings by Rohrmann et al. owing to genetic differences, sample size, and statistical methods. It should be noted that Cox proportional hazard models were used in the study by Rohrmann et al. (25).

Comparing fruit intake in the two study groups, consumption of the most of fruit categories was higher in the control group and the fruit intake was also considered as a predictor so that a diet rich in fruit could significantly lessen the risk of the incidence of lymphoma (OR = 0.65). The given findings were consistent with the results from the study by Ambinder et al. (12) as well as Holtan et al. (8) stating that consumption of antioxidants found in fruit and vegetables was taken into account as an effective support to lessen the risk of lymphoma infection. In addition to reducing oxidative mechanisms, the consumption of fruit and vegetables moderates obesity which can contribute to the prevention of cancer including lymphoma (27). In the present study, individuals' dietary habits were investigated using Food Frequency Questionnaire and there was no possibility to examine all micronutrients and macronutrients separately. Therefore, it is recommended to conduct further research studies employing other accurate questionnaires.

Based on the findings of this study, lifestyle and dietary style play roles in the incidence of head and neck lymphoma. Among the factors associated with lifestyle, smoking and obesity (BMI > 30) were directly correlated with the probability of the incidence of lymphoma risk and high BMI was also considered as a risk factor for the given disease. Among the factors related to dietary style, red meat consumption was taken into account by itself as a risk factor for lymphoma and it was concluded that a diet rich in red meat could significantly increase the risk of the incidence of lymphoma. Furthermore, consumption of fresh herbs and fruit was a limiting factor for lymphoma according to their antioxidants, and their sufficient inclusion in the food basket can decrease the probability of the risk of lymphoma. It is hoped to take the valuable steps by designing precise questionnaires according to the diets of different regions of the country and conducting similar and prospective studies in this regard, as well as the study of all micronutrient and macronutrient to prevent and even treat lymphoma.

Acknowledgments

The authors would like to thank Dr. Behrouz Najafi for oncology consultation, Dr. Ehsan Kazem Nejad for performing statistical analysis, Dr. Jabiz Modaresi for nutritional consultation, and personnel of oncology department of Razi Hospital in Rasht for cooperation in this research.

Footnotes

Authors' Contribution: None declared.

Conflict of Interest: The authors declare that they have no conflict of interest.

Financial Disclosure: None declared.

References

1. Jaffe ES, Harris NL, Stein H, Isaacson PG. Classification of lymphoid neoplasms: the microscope as a tool for disease discovery. *Blood*. 2008;**112**(12):4384–99. doi: 10.1182/blood-2008-07-077982. [PubMed: 19029456].
2. Rohani B, Gholizadeh N, Khoeini poorfar H, Pourshahidi S, Ebrahimi H. Oral manifestations of hematologic malignancies. *Jundishapur Sci Med J*. 2015;**14**(4):477–85.
3. Rabiei M, Basirat M, Rezvani SM. Trends in the incidence of Oral and Pharyngeal Cancer (ICD00-14) in Guilan, North of Iran. *J Oral Pathol Med*. 2016;**45**(4):275–80. doi: 10.1111/jop.12369. [PubMed: 26426284].
4. Basirat M, Rabiei M, Bashardoust N. Incidence of Head and Neck Lymphoma in Guilan Province, Iran. *Asian Pac J Cancer Prev*. 2016;**17**(S3):1–4. [PubMed: 27165198].
5. Kalra R, Singh SP, Savage SM, Finch GL, Sopori ML. Effects of cigarette smoke on immune response: chronic exposure to cigarette smoke impairs antigen-mediated signaling in T cells and depletes IP3-sensitive Ca(2+) stores. *J Pharmacol Exp Ther*. 2000;**293**(1):166–71. [PubMed: 10734166].
6. Zhang Y, Sanjose SD, Bracci PM, Morton LM, Wang R, Brennan P, et al. Personal use of hair dye and the risk of certain subtypes of non-Hodgkin lymphoma. *Am J Epidemiol*. 2008;**167**(11):1321–31. doi: 10.1093/aje/kwn058. [PubMed: 18408225].
7. Bassig BA, Lan Q, Rothman N, Zhang Y, Zheng T. Current understanding of lifestyle and environmental factors and risk of non-hodgkin lymphoma: an epidemiological update. *J Cancer Epidemiol*. 2012;**2012**:978930. doi: 10.1155/2012/978930. [PubMed: 23008714].
8. Holtan SG, O'Connor HM, Fredericksen ZS, Liebow M, Thompson CA, Macon WR, et al. Food-frequency questionnaire-based estimates of total antioxidant capacity and risk of non-Hodgkin lymphoma. *Int J Cancer*. 2012;**131**(5):1158–68. doi: 10.1002/ijc.26491. [PubMed: 22038870].
9. Steinkellner H, Rabot S, Freywald C, Nobis E, Scharf G, Chabicovsky M, et al. Effects of cruciferous vegetables and their constituents on drug metabolizing enzymes involved in the bioactivation of DNA-reactive dietary carcinogens. *Mutat Res*. 2001;**480-481**:285–97. [PubMed: 11506821].
10. Gorlach A, Dimova EY, Petry A, Martinez-Ruiz A, Hernansanz-Agustin P, Rolo AP, et al. Reactive oxygen species, nutrition, hypoxia and diseases: Problems solved?. *Redox Biol*. 2015;**6**:372–85. doi: 10.1016/j.redox.2015.08.016. [PubMed: 26339717].
11. Ali A, Al-Belushi BS, Waly MI, Al-Moundhri M, Burney IA. Dietary and lifestyle factors and risk of non-hodgkin's lymphoma in Oman. *Asian Pac J Cancer Prev*. 2013;**14**(2):841–8. [PubMed: 23621249].
12. Ambinder AJ, Shenoy PJ, Malik N, Maggioncalda A, Nastoupil LJ, Flowers CR. Exploring risk factors for follicular lymphoma. *Adv Hematol*. 2012;**2012**:626035. doi: 10.1155/2012/626035. [PubMed: 23028387].
13. Malekshah AF, Kimiagar M, Saadatian-Elahi M, Pourshams A, Nouraie M, Goglani G, et al. Validity and reliability of a new food frequency questionnaire compared to 24 h recalls and biochemical measurements: pilot phase of Golestan cohort study of esophageal cancer. *Eur J Clin Nutr*. 2006;**60**(8):971–7. doi: 10.1038/sj.ejcn.1602407. [PubMed: 16465196].
14. Smedby KE, Hjalgrim H. Epidemiology and etiology of mantle cell lymphoma and other non-Hodgkin lymphoma subtypes. *Semin Cancer Biol*. 2011;**21**(5):293–8. doi: 10.1016/j.semcancer.2011.09.010. [PubMed: 21945518].
15. Lim U, Morton LM, Subar AF, Baris D, Stolzenberg-Solomon R, Leitzmann M, et al. Alcohol, smoking, and body size in relation to incident Hodgkin's and non-Hodgkin's lymphoma risk. *Am J Epidemiol*. 2007;**166**(6):697–708. doi: 10.1093/aje/kwm122. [PubMed: 17596266].
16. Matsuo K, Hamajima N, Hirose K, Inoue M, Takezaki T, Kuroishi T, et al. Alcohol, smoking, and dietary status and susceptibility to malignant lymphoma in japan, results of a hospital based case control study at aichi cancer center. *Jpn J Cancer Res*. 2001;**92**(10):1011–7. doi: 10.1111/j.1349-7006.2001.tb01054.x.
17. Larsson SC, Wolk A. Body mass index and risk of non-Hodgkin's and Hodgkin's lymphoma: a meta-analysis of prospective studies. *Eur J Cancer*. 2011;**47**(16):2422–30. doi: 10.1016/j.ejca.2011.06.029. [PubMed: 21733676].
18. Lichtman MA. Obesity and the risk for a hematological malignancy: leukemia, lymphoma, or myeloma. *Oncologist*. 2010;**15**(10):1083–101. doi: 10.1634/theoncologist.2010-0206. [PubMed: 20930095].
19. Willett EV, Morton LM, Hartge P, Becker N, Bernstein L, Boffetta P, et al. Non-Hodgkin lymphoma and obesity: a pooled analysis from the InterLymph Consortium. *Int J Cancer*. 2008;**122**(9):2062–70. doi: 10.1002/ijc.23344. [PubMed: 18167059].
20. Vucenik I, Stains JP. Obesity and cancer risk: evidence, mechanisms, and recommendations. *Ann N Y Acad Sci*. 2012;**1271**:37–43. doi: 10.1111/j.1749-6632.2012.06750.x. [PubMed: 23050962].
21. Chen J. Prevention of obesity associated colon cancer by (-) epigallocatechin 3 gallate and curcumin. *Transl Gastrointest Cancer*. 2012;**1**(3):243–9. doi: 10.3978/j.issn.2224-4778.2012.09.04.
22. Aschebrook-Kilfoy B, Ollberding NJ, Kolar C, Lawson TA, Smith SM, Weisenburger DD, et al. Meat intake and risk of non-Hodgkin lymphoma. *Cancer Causes Control*. 2012;**23**(10):1681–92. doi: 10.1007/s10552-012-0047-2. [PubMed: 22890783].
23. Dong Y, Wu G. Lack of association of poultry and eggs intake with risk of non Hodgkin lymphoma, a meta analysis of observational studies. *Eur J Cancer Care (Engl)*. 2017;**26**(5). doi: 10.1111/ecc.12546. [PubMed: 27405484].
24. Bertrand KA, Giovannucci E, Rosner BA, Zhang SM, Laden F, Birmann BM. Dietary fat intake and risk of non hodgkin lymphoma in 2 large prospective cohorts. *Am J Clin Nutr*. 2017;**106**(2):650–6. doi: 10.3945/ajcn.117.155010. [PubMed: 28659300].
25. Rohrmann S, Becker N, Linseisen J, Nieters A, Rudiger T, Raaschou-Nielsen O, et al. Fruit and vegetable consumption and lymphoma risk in the European Prospective Investigation into Cancer and Nutrition (EPIC). *Cancer Causes Control*. 2007;**18**(5):537–49. doi: 10.1007/s10552-007-0125-z. [PubMed: 17443415].
26. Zheng T, Holford TR, Leaderer B, Zhang Y, Zahm SH, Flynn S, et al. Diet and nutrient intakes and risk of non-Hodgkin's lymphoma in Connecticut women. *Am J Epidemiol*. 2004;**159**(5):454–66. [PubMed: 14977641].
27. Aune D, Chan DS, Vieira AR, Rosenblatt DA, Vieira R, Greenwood DC, et al. Fruits, vegetables and breast cancer risk: a systematic review and meta-analysis of prospective studies. *Breast Cancer Res Treat*. 2012;**134**(2):479–93. doi: 10.1007/s10549-012-2118-1. [PubMed: 22706630].