RESEARCH ARTICLE

Case-control Study of Risk Factors for Non-Hodgkin Lymphoma in Mumbai, India

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Abstract

Background: In the year 2010, it is estimated that nearly 0.36 million new cases and 0.19 million deaths with Non-Hodgkin lymphoma occurred. In India, among males, NHL incidence rates vary across the country which has encouraged us to conduct a case-control study to study risk factors. Materials and Methods: The present unmatched hospital-based case-control study conducted at Tata Memorial Hospital included subjects registered between the years 1997-99. There were 390 'lymphoma cases' and 1,383 'normal controls. Results: Data on age, tobacco habits, occupational history, dietary factors, tea, coffee were collected by the social investigators. Univariate and multivariate methods were applied for obtaining the odds ratios for risk factors. Conclusions: In the study, cigarette smoking (OR=2.0) and bidi smoking (OR=2.8), were associated with excess risk of lymphoma. Among the dietary items, only consumption of mutton showed 7.3-fold significant excess risk for lymphoma. Consumption of milk showed a 6-fold excess risk (OR=1.5); while coffee showed a 50% reduction in risk for lymphoma. Among occupational exposure, exposure to use of pesticides showed 3-fold excess risk for lymphoma.

Keywords: Non-Hodgkin lymphoma - risk factors - case-control study - smoking - milk - coffee - red meat - India

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Introduction

Globally, it is estimated that there are approximately 13 million new cancer cases and 8 million cancer deaths (Ferlay et al., 2010). Nearly 12.7 million new cancer cases and 7.6 million cancer deaths occurred in 2008 worldwide. The number of new cancer cases ranges from 3.7 million in Eastern Asia to about 1800 in Micronesia/Polynesia. In men, the incidence of cancer is high in Northern America (ASR 334 per 100,000), Australia/New Zealand (ASR 356.8) and in Northern and Western Europe (ASRs 288.9 and 335.3 respectively) as a consequence of the high rates of prostate cancer in these regions (ASRs greater than 80 per 100,000 in all).

In the year 2010, it is estimated that nearly 0.36 million new cases and 0.19 million deaths with non-hodgkin lymphoma (NHL) would have occurred. In more developed countries, the incidence rates are 8.6 per 100,000 while in less developed countries, the rates was 3.5 per 100,000. In India, as per the estimates, there are approximately 23,718 new NHL cases reported each year, though the age-standardized incidence rates are low (2.4 per 100,000) compared to the rates in other parts of the world (Ferlay et al., 2010). The incidence rates of NHL are very low and vary across India as well (NCRP, 2009). There are studies reporting on the risk factors for NHL from other parts of the globe, but none from India.

The present study was carried out to study the risk factors for NHL with regard to life-style habits, diet and occupational history. This study was partially funded by International Agency for Research in Cancer (IARC), and was carried out between the years 1997-99.

Lifestyle does not seem to be a major risk factor for NHL. Some studies have suggested that obesity may increase risk, but this association is not definite. Other studies have investigated the role of diet. Although some research has indicated an increased risk for diets high in consumption of red meat and lower risk for diets high in vegetables, for the most part a strong association remains speculative. There is no evidence that smoking increases the risk for NHL itself, although it has been linked with high-grade and follicular NHLs in people with lymphoma.

The Indian population is known to be less obese than the western population, basically attributed to the life-style. The body mass index is quite low for Indians. As per the recent survey in India , the mean BMI for Indian men (15-54 years) is 20.3 and for women (15-49 years) it is 20.5 (NFHS, 2007). The Indian diet includes a major portion of vegetables and fruits. Non-vegetarian diet is rarely consumed on a daily basis, unlike in western countries. The present study thus attempts to determine the various factors associated with NHL, such as tobacco, alcohol drinking, dietary items and occupational exposure history.

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Materials and Methods

The present study, a hospital-based case-control study, was conducted at the Tata Memorial Hospital (TMH), Mumbai, India. The period of data collection was 1997-99 that included subjects who visited TMH for diagnosis and treatment. Only male patients are included in the study. Patients were interviewed at the Out-patient department of TMH. The information was recorded in a pre-designed questionnaire, which was pre-tested at the hospital; this included demographic characteristics (age, sex, religion etc), life-style (habits such as smoking, chewing, alcohol drinking etc), dietary habits and occupational exposure. The hospital being a comprehensive cancer centre for diagnosis and treatment attracts patients from all parts of India. In general, in a year 30-40% of patients of total registrations are diagnosed as free of cancer. These cancer-free patients were considered as 'controls' by scrutinizing their medical history and diagnosis. Cases were microscopically proven cancer cases of lymphoma. Controls were classified as those that were diagnosed by microscope as 'free of cancer' and not having any ailments and thus diagnosed as 'no evidence of disease'. Only male subjects and above the age of 24 years are included in the study. During the period 1997-99, 390 patients microscopically confirmed as NHL were considered as Cases and were interviewed for the study. Likewise, 1,383 patients who were diagnosed as 'free of cancer' were considered as Controls. Thus there were 390 'NHL' Cases and 1383 Controls that were considered as eligible entrants for this study.

The questionnaire contained socio-demographic information, life-style habits like chewing, smoking, alcohol consumption and dietary items. The questionnaire on food items were based on recollection of consumption of routine food items prior to one-year of the date of interview. Information on food frequency per week was also collected. The dietary items were classified as vegetarian diet and non-vegetarian diet. The non-vegetarian diet included items as fish, chicken and red-meat. Red-meat included mutton, liver, pork, brain etc. Consumption of vegetables, fruits, chilly was recorded. Intake of beverages as tea, coffee, milk was also recorded. Unconditional logistic regression model was applied for obtaining the risk estimates (odds ratio) and its 95% confidence limits using SPSS Version 15.0 software. In the analysis, independent variables were categorized into binary form and entered into the model. The results were considered for statistical significance at 5%.

Results

Demographic characteristics of Cases and Controls are shown in Table 1. It is seen that the ratio of cases to controls is approximately 1: 3. The average age for cases and controls was 46.1 years and 46.4 years respectively. 53.1% and 37.4% of patients were aged less than 45 years among cases and controls respectively. Controls had a higher proportion of literates (93.3%) than cases (85.4%). Proportion of those with family history of hematopoetic cancer was only 0.3% in cases and 1% in controls. With regard to the occupation history, it is seen that history of working in pesticides industry was 7.4% among the cases while it was 1.2% of cases who were working in cotton-

Table 1. Demographic Characteristics of Cases and Controls: Lymphoma Case-control Study

Factor	Characteristics	Cases	%	Controls	%
Total		390	22	1383	78
Age	<45	207	53.1	736	37.4
(years)	≥45	183	46.9	647	62.6
Average Age (in years)		46.1		46.4	
Education	Literate	333	85.4	1290	93.3
	Illiterate	57	14.6	93	6.7
History of Hemato-lymphoid Cancer					
	Yes	1	0.3	14	1
	No	389	99.7	1369	99
Occupational history					
Pesticide worker	Yes	29	7.4	18	1.3
	No	359	92.6	1365	98.7
Cotton-dust worker	Yes	5	1.2	67	4.8
	No	385	98.8	1316	95.2

Table 2. Odds-Ratio (crude) and 95% Confidence Interval for Life-Style Factors

Factor	Characteristics	Cases	Controls	Crude Odds Ratio 95%CI (Lower,Upper)
Cigarette Smoking	Smokers	162	412	1.7 (1.3, 2.1)*
	Non - Smokers	228	971	1
Bidi Smoking	Smokers	84	145	2.3 (1.7, 3.1)*
	Non - Smokers	306	1238	1
Pan Tobacco Chewing	Chewers	61	297	0.7 (0.5, 0.9)*
	Non-Chewers	329	1086	1
Tobacco Lime Chewing	Chewers	20	38	1.9 (1.1, 3.3)*
	Non-Chewers	370	1345	1
Pan Parag Chewing	Chewers	0	43	Can't estimate
	Non-Chewers	390	1340	1
Betel Nut Chewing	Chewers	4	63	0.2 (0.1, 0.6)*
	Non-Chewers	386	1320	1
Alcohol Drinking	Drinkers	26	63	1.5(0.9, 2.4)*
	Non Drinker	364	1320	1
Fish Consumption	Yes	312	884	2.3 (1.7 , 2.9)*
	No	78	499	1
Chicken Consumption	Yes	315	862	2.5(1.9, 3.3)*
	No	75	521	1
Red-Meat Consumption	Yes	314	820	3.9 (2.9, 5.3)*
	No	55	562	1
Egg Consumption	Yes	320	895	2.4 (1.8, 3.3)*
	No	70	488	1
Vegetable Consumption	No	20	8	0.1 (0.05, 0.2)*
	Yes	370	1375	1
Fruit Consumption	No	14	13	0.3 (0.1, 0.5)
	Yes	376	1370	1
Chilly Consumption	Yes	238	973	0.3 (0.2, 0.3)*
	No	152	410	1
Milk Consumption	Yes	297	523	9.5 (8.9, 13.1)*
	No	51	855	1
Tea drinking	Yes	344	1372	0.4 (0.1, 1.3)
	No	4	6	1
Coffee drinking	Yes	206	1166	0.3 (0.2, 0.3)*
	No	142	212	1
History of Hemato-lymphoid Cancer				
	Yes	1	14	0.2 (0.1, 1.9)
	No	389	1369	1
Occupation history				
Pesticides	Yes	29	18	6.1 (3.3, 11.2)
	No	359	1365	1
Cotton dust	Yes	5	67	0.2 (0.1 0.6)*
	No	385	1316	1

*P<0.01

Table 3. Odds-Ratio (Adjusted) and 95% Confidence Interval for Life-Style Factors

Factor	Characteristics	Cases	Controls	Adj. OR**	95%CI (Lower,Upper)
Cigarette Smoking	Smokers	162	412	1.7 *	(1.4, 2.2)
	Non – Smokers	228	971	1.0 (Ref)	
Bidi Smoking	Smokers	84	145	2.0*	(1.5, 2.7)
	Non – Smokers	306	1238	1.0 (Ref)	
Pan Tobacco Chewing	Chewers	61	297	0.5	(0.5, 1.2)
	Non-Chewers	329	1086	1.0 (Ref)	
Tobacco Lime Chewing	Chewers	20	38	1.9*	(1.1, 3.2)
	Non-Chewers	370	1345	1.0 (Ref)	
Betel Nut Chewing	Chewers	4	63	0.2	(0.1, 1.4)
	Non-Chewers	386	1320	1.0 (Ref)	
Alcohol Drinking	Drinkers	26	63	1.6*	(0.9, 2.5)
	Non Drinker	364	1320	1.0 (Ref)	
Fish Consumption	Yes	312	884	2.2*	(1.7, 2.8)
	No	78	499	1.0 (Ref)	
Chicken Consumption	Yes	315	862	2.5*	(1.9, 3.2)
	No	75	521	1.0 (Ref)	
Red-Meat Consumption	Yes	314	820	3.8*	(2.8,5.2)
	No	55	562	1.0 (Ref)	
Eggs Consumption	Yes	320	895	2.4*	(1.8, 3.2)
	No	70	488	1.0 (Ref)	
Vegetable Consumption	No	20	8	0.1*	(0.1, 0.3)
	Yes	370	1375	1.0 (Ref)	
Chilly consumption	Yes	238	973	0.3*	(0.2, 0.3)
	No	152	410	1.0 (Ref)	
Milk consumption	Yes	297	523	9.4*	(6.9,13.0)
	No	51	855	1.0 (Ref)	
Coffee drinking	Yes	206	1166	0.26*	(0.2, 0.3)
	No	142	212	1.0 (Ref)	
Pesticides worker	Yes	29	18	5.7 *	(3.1,10.4)
	No	359	1365	1.0 (Ref)	
Cotton dust worker	Yes	5	67	0.3	(0.1, 0.7)
	No	385	1316	1.0 (Ref)	

*P<0.01, **adjusted for age and education

Table 4. Odds Ratio OR and 95%CI for Factors by Regression Method for Lymphoma Case-control Study

Factor	Characteristics	Adjusted OR**	95%Confidence Interval Lower	Upper
Cigarette Smoking	Smoker	2.0*	1.5	2.7
	Non - Smoker	1		
Bidi Smoking	Smoker	2.8*	1.9	4.1
	Non - Smoker	1		
Tobacco Lime Chewing	Yes	1.5	0.7	3.2
	No	1		
Milk Drinker	Yes	6.0*	4.1	8.8
	No	1		
Coffee Drinker	Yes	0.5*	0.3	0.7
	No	1		
Chicken Consumption	Yes	1.3	0.5	3.8
	No	1		
Red-Meat Consumption	Yes	7.3	2.2	24.6
	No	1		
Eggs Consumption	Yes	0.3	0.1	1.1
	No	1		
Fish Consumption	Yes	0.6	0.2	1.7
	No	1		
Chilly Consumption	Yes	0.8	0.5	1.1
	No	1		
Vegetable Consumption	Yes	0.3	0.1	1.5
	No	1		
Pesticides worker	Yes	3.1*	1.5	6.2
	No	1		
Cotton dust worker	Yes	0.3	0.4	1.2
	No	1		

*P< 0.01, **adjusted for each other

dust industry.

Table 2 describes the distribution and crude odds ratio (OR) for lifestyle habits, dietary habits and occupational factors. The categories considered were 'never' vs 'everexposed'. In the univariate analysis It can be seen that cigarette smokers had a 1.7 times excess risk and bidi smokers had a 2.3 times excess risk, compared to the non-smokers. Those who chewed tobacco with lime showed excess risk while chewed pan-tobacco or betel-nut chewers showed reduction in risk (crude risk), compared to non-chewers. Alcohol drinkers had a 1.5-fold risk but not significant compared to non-drinkers. With regard to the dietary items, it was observed that those who ate fish (OR=2.3), chicken (OR=2.5), mutton (OR=3.9) and egg (OR=2.4) eaters all had excess significant risk compared to non-eaters. Those who consumed vegetable, fruits or chilly showed a 90%, 70% and 70% reduction in risk respectively. Consumption of milk showed 9.5-fold excess risk, while coffee consumption showed 70% reduction in risk; history of hematopoietic malignancies in the family didn't show any difference between the cases and controls. Exposure to pesticides showed 6-fold excess risk for lymphoma while cotton-dust workers didn't show any excess risk.

Table 3 elucidates the adjusted-odds ratio, adjusted for age and literacy status, and their 95% confidence limits, for different factors under study. It is observed that after adjustment, cigarette smokers (OR=1.7) and bidi smokers (OR=2.0), continued to show enhanced risk compared to non-smokers, tobacco-lime chewers showed near 2-fold excess risk for lymphoma. After adjusting for age and literacy, those that continued to show excess significant risk were those who consumed fish (OR=2.2), chicken (OR=2.5), mutton (OR=3.8) and egg (OR=2.4) compared to non-eaters. Those who consumed vegetable or chilly continued to show a 90%, and 70% reduction in risk respectively. Consumption of milk showed 9.4-fold excess risk while coffee consumption continued to show 70% reduction in risk. Exposure to pesticides-workers showed 5.7-fold excess risk for lymphoma.

Odds ratio and confidence limits obtained by applying regression method, wherein all the factors that emerged as significant earlier were included into the regression model are shown in Table 4. Cigarette smokers showed a 2-fold risk and bidi-smokers 2.8-fold significant enhanced risk for lymphoma, compared to non-smokers. Among the dietary items, only mutton-eaters showed 7-fold excess risk while milk drinkers had an 6-fold excess risk compared to the non-drinkers; however coffee drinkers showed a 50% reduction in risk. Among the occupational exposure, only Pesticide-workers showed a 3-fold excess risk for NHL.

Discussion

NHL is not so common a cancer and the rates vary across the globe; the incidence rates are as low as 3.5 per 100,00 in less developed countries compared to 8.6 per 100,000 in more developed countries (Ferlay et al 2010).

The risk factors include tobacco smoking, alcohol abuse, diet, body mass index, occupational exposure etc. The present study is an hospital-based case-control study on association of life-style factors, occupational exposure, dietary items, and beverages, on lymphoma There are many studies across the world reporting the association of risk factors with lymphoma. In the present study, a total of 390 lymphoma cases and 1383 normal controls were analyzed. Due to unforeseen circumstances, the study results could not be reported earlier; nonetheless the study is of importance since it addresses the possible association of tobacco, dietary habits and occupational exposure with NHL. However, no significance was observed for those having a family history for hematopoietic cancers.

Smoking is a known risk factor for several cancers; Epidemiologic evidence of an association between tobacco smoking and non-Hodgkin's lymphoma has been conflicting. In an nationwide Danish-Swedish population-based case-control study consisting , it was found that cigarette smoking was not associated with the risk of non-Hodgkin's lymphoma overall (OR, 0.97; 95%CI, 0.87-1.08) nor with the major subgroups such as diffuse large B-cell lymphoma (OR, 0.94; 95%CI, 0.79-1.10), chronic lymphocytic leukemia (OR, 0.86; 95%CI, 0.72-1.02), or follicular lymphoma (OR, 1.03; 95%CI, 0.85-1.24) (Schöllkopf et al., 2005).Men who had ever smoked had a significantly increased risk of T-cell lymphoma (OR, 1.67; 95%CI, 1.11-2.51) and no dose-response association with cigarette smoking could be established for any lymphoma subgroup. Cigarette smoking slightly (OR=1.07) increased the risk of developing follicular lymphoma but did not seem to affect risk of the other non-Hodgkin lymphoma subtypes (Morton et al., 2005). Population-based case-control interview studies from Iowa and Minnesota showed that the risks were significantly elevated for all lymphoma [odds ratio (OR) =1.4], high-grade lymphoma (OR=2.3), and unclassified lymphoma (OR=2.8) for cigarette smokers and provided some support for an association between tobacco use and certain subtypes of non-Hodgkin's lymphoma (Brown et al., 1992).

The present study re-iterated the overall risk for cigarette smokers was two-fold and for bidi smokers it was almost three-fold (all subtypes included) which is in agreement with studies mentioned here. However there are studies which have shown 'no association' between smoking and risk of NHL (Adami et al., 1997)

Findings from literature on association of alcohol drinking and leukemia have not been consistent and there has been conflicting reports. A large hospital-based case-control study in Japan, showed that for any alcohol intake versus nondrinking, point estimates of odds ratio were less than unity for all four malignant lymphoma subtypes; they found that alcohol had an inverse association with malignant lymphoma risk across all malignant lymphoma subtypes in our Japanese subjects (Kanda et al., 2009). In a prospective National Institutes of Health-former American Association of Retired Persons (NIH-AARP) Diet and Health Study (Lim et al., 2007), the authors assessed the above lifestyle factors reported that compared with nondrinkers, alcohol consumers had a lower risk for non-Hodgkin's lymphoma overall (for >28 drinks/week: adjusted relative risk (RR)=0.77, 95% confidence interval (CI):0.59, 1.00; p-trend among drinkers=0.02) and for its main subtypes.

In a recent systematic review of 21 case-control and 8 cohort studies, including a total of 18,759 NHL cases, meta-analysis was done estimates taking into account correlation between estimates to study the association of alcohol drinking and NHL risk and observed that the overall relative risk (RR) of NHL for drinkers versus non-drinkers was 0.85 (Tramacere et al., 2012); the meta-analysis provided quantitative evidence of a favourable role of alcohol drinking on NHL risk, though the lack of a biological explanation suggests caution in the interpretation of results. In a pooled analysis of 9 case-control studies from USA, UK and Sweden, Morton et al. (2005) concluded that People who drink alcoholic beverages might have a lower risk of NHL than those who do not, and this risk might vary by NHL subtype and further study designs are needed to determine whether confounding lifestyle factors or immune-modulatory effects of alcohol explain this association.

In the present study as well, alcohol drinking did not emerge as a significant risk factor for NHL, though the risk was enhanced by 50% compared to non-drinkers. In India, type of alcohol is consumed varies, from processed to country liquor and yet there was no association of alcohol with NHL.

It has been estimated that 30-40 percent of all cancers can be prevented by lifestyle and dietary measures alone. Study on diet has always been difficult for various reasons. There are few studies reported from India on association of diet with cancer. The dietary items in the present study has been classified as vegetarians and non-vegetarians; non-vegetarian diet included red- meat (mutton, pork), chicken, fish; vegetarian diet such as vegetables (both raw and cooked), fruits (citrus and fresh-fruit) and consumption of chilly.

In the present study, eggs consumption did not show any association with NHL, although Purdue et al. (2004) showed increased risk for egg eaters. There are studies that suggest that a diet high in fish may be protective against lympho-hematopoietic cancers and confirm the reduced risk among fish eaters (Fritschi et al., 2004) Fish and chicken eating were not significant risk factors for NHL in the present study which has been shown by other studies as well.

A large study (Hu et al., 2008), reported the association between meat and fish intake and the risk of NHL and concluded that total meat and processed meat were directly related to the risk of NHL; no consistent excess risk emerged for fish and poultry and fish and poultry appear to be favorable diet indicators (Hu et al., 2008)

The consumption of meat and other foods of animal origin is a risk factor for several types of cancer, but the results for lymphomas are inconclusive. In a large study,overall, the consumption of foods of animal origin was not associated with an increased risk of NHLS or HL, but the associations with specific subgroups of NHL entities were noted (Rohrmann et al., 2011). High consumption of dairy products and fried red meat was

associated with increased risk of NHL (Ellen et al., 2005). The present study did show a very high enhanced seven-fold risk for red-meat eaters which has been reported earlier by several studies.

In contrast, high consumption of fruits and vegetables was associated with reduced risk of NHL, particularly follicular lymphoma, among women but not men. The positive associations of NHL risk with dairy products and fried red meat and the inverse association with fruits and vegetables suggest that diet affects NHL risk and could explain the increase of some histopathologic subtypes (Ellen et al., 2005).

Consumption of vegetables has been shown to be protective for many cancers, but the present study, did not show any association with NHL; however there are many studies showing a protective effect (Ellen et al., 2005). NHL risk was inversely associated with intakes of vegetables, lutein and zeaxanthin, and zinc. A higher intake of flavonoids, dietary components with several putative anti-carcinogenic activities, may be associated with lower NHL risk which has been shown by Frankenfeld et al. (2008). Flavonoids are polyphenolic compounds, found primarily in fruit and vegetables, that have been proposed to be anti-carcinogenic. Consumption of vegetable showed a reduction of 70% in risk, though not significant and Chilli eating didn't either emerge as a risk factor in the present study.

Association of coffee with NHL are not consistent. Tavani et al. (1994) found no association between non-Hodgkin's lymphoma and consumption of regular or decaffeinated coffee and tea. In another study, consumption of milk, coffee and tea, was positively related with non-Hodgkin's lymphoma risk; the consumption of whole-grain bread and pasta showed a protective effect (Franceschi et al., 1989). Although tea drinking is more common in India, it did not show any additional or excess risk for NHL in the present study. Another beverage not so common as tea drinking in India, Coffee drinking , showed reduction in risk in our study compared to non-drinkers; in the present study, coffee drinkers had a 50% reduction in risk compared to non-drinkers for NHL, which has been shown earlier in some studies.

International correlation studies show a positive association between consumption of the non-fat portion of milk and NHL mortality, consistent with reports of increased lymphoma risk associated with milk consumption in studies from Norway, the US. and Italy (Franceschi et al, 1989; Ward et al, 1994; Zheng et al, 2004; Tavani et al, 2005).

In the present study, milk consumption enhanced the risk six-fold for NHL after adjusting for life-style factors which is agreement with the studies in US, Norway and Italy. However, the Canadian, Swedish and another US. study found no association with milk consumption (Chiu et al., 1996). Dairy fat contains significant levels of organochlorines such as dioxins and polychlorinated biphenyls, known human carcinogens and immunotoxins that can alter normal B-cell responses. Positive associations between organochlorines and NHL suggest a role of dairy fat in lymphoma-genesis.

There has been considerable interest in the question of whether exposure to pesticides causes non-Hodgkin's lymphoma, with recent reviews highlighting pesticide exposure as one of the likely occupational risk factors for this cancer. There are several studies on various occupational exposure risk for NHL. Subjects with substantial exposure to organo-chlorines, organophosphates, and "other pesticides" (all other pesticides excluding herbicides) and herbicides other than phenoxy herbicides had similarly increased risks in an Australian study (Fritschi et al., 2005) among others (McDuffie et al., 2001).

Data from an in-person interview study of 622 white men with newly diagnosed non-Hodgkin's lymphoma and 1245 population-based controls in Iowa and Minnesota studied to measure the risk associated with farming occupation and specific agricultural exposures (Kenneth et al., 1992); they found Men who ever farmed were at slightly elevated risk of non-Hodgkin's lymphoma (odds ratio=1.2) that was not linked to specific crops or particular animals. Elevated risks were found, with odds ratio generally 1.5-fold or greater, for personal handling, mixing, or application of several pesticide groups and for individual insecticides, including carbaryl, chlordane, dichlorodiphenyltrichloroethane, diazinon, dichlorvos, lindane, maialinoli, nicotine, and toxaphene. This suggested an important role for several insecticides in theetiology of non-Hodgkin's lymphoma among farmers. A total of 291 incident cases of NHL (age 25-70 years) notified to the New Zealand Cancer Registry during 2003 and 2004, and 471 population controls, were interviewed face-to-face (Mannetje et al., 2008); after semi-Bayes adjustment the elevated risks for horticulture and fruit growing, metal product manufacturing and cleaners remained statistically significant, representing the most robust findings of this study. The study has confirmed that crop farmers and meat workers remain high risk occupations for NHL in New Zealand, and has identified several other occupations and industries of high NHL risk that merit further study.

In the present study, Occupational history as pesticide use, asbestos, cotton-dust, exhaust gas etc were recorded from subjects. Though the pesticide workers and cotton dust worker had increased crude risk (unadjusted for other factors), the risk for 'cotton-dust' workers was insignificant after adjustment for all background factors. A significant relationship (3-fold) was observed with exposure to pesticides. The relationship with pesticides remained significant even when confounding factors were taken into consideration.

In summary, in the present study, smoking emerged as high risk factor for NHL, while alcohol drinking didn't show any excess risk. Among the dietary items, red-meat eaters increased the risk seven-fold while fish, eggs and chicken didn't show any excess risk for NHL. Coffee drinking showed a 50% reduction in risk for NHL, probably coffee may help protect against cancer through the activity of its anti-carcinogenic constituents (Cavin et al., 2002). Consumption of milk increased the risk six-fold compared to non-drinkers; this could be further investigated on the type of milk consumed in a larger study. Pesticide workers had an excess risk of three-fold for NHL and the type of pesticide used may be worthwhile

investigating in a larger setting.

Based on these findings it may be concluded that prevention of tobacco use, limited use of certain dietary items could prove to be beneficial in prevention of NHL. The study is of importance, especially in the context that no other case-control study has been reported from the Indian subcontinent so far.

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