RESEARCH COMMUNICATION

Personal Use of Hair Dyes - Increased Risk of Non-Hodgkin's Lymphoma in Thailand

Suleeporn Sangrajrang[1]*, Helene Renard[2], Thiravud Kuhaprema[3], Pattarapong Pornsopone[3], Wichit Arpornwirat[3], Paul Brennan[2]

Abstract

The use of hair dyes has been inconsistently associated with an increased risk of lymphomas. To further evaluate this possibility, we examined hair dye use and lymphoma risk in a case-control study in the Thai population. A total of 390 histologically confirmed incident non-Hodgkin's lymphoma (NHL) cases and 422 controls were included. Information on hair dye use was obtained through a personal interview together with information on other known risk factors of lymphoma. Analysis was performed using logistic regression; odds ratios (ORs) estimates and 95% confidence intervals (CI) were calculated. Ever use of hair dyes was not associated with an increase risk of NHL both overall (OR=1.1, 95%CI 0.8-1.5) and in women (OR=1.4, 95%CI 0.9-2.3). However, NHL was significantly higher among persons who began using hair dyes before 1980 (OR=2.1, 95%CI 1.0-4.1). An increased risk was also observed among women who reported use of permanent hair dye product (OR=1.8, 95% CI 1.0-3.1). Analyses by NHL subtype showed an increased risk for diffuse large B-cell lymphoma among users of permanent hair dyes (OR=1.6, 95%CI 1.0-2.5) while follicular lymphoma was associated with the use of dark-colored dyes (OR=3.7, 95%CI 1.1-12.8). No association was observed with duration of use, nor total lifetime applications. These results indicate that personal hair dye use may play role in risks of NHL among person who used hair dyes before 1980.

Keywords: Case-control study - lymphoma - hair dyes - risk factors

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Introduction

In the past decades, the incidence of non-Hodgkin's lymphoma (NHL) has doubled in most Westernized countries from 1970 to the mid 1990s (Baris and Zahm, 2000; Fisher and Fisher, 2004). Although considerable efforts have been made, little is know about the etiology and the risk factors responsible for this increasing incidence. Personal use of hair dyes has been suggested as a risk factor of NHL. The fact that almost all hair dyes on the market contain small amounts of aromatic amines and that aromatic amines are carcinogenic in animals has generated interest in studying the association between hair dye use and cancer risk (Ames et al., 1975; Sontag, 1981).

Although the chemical constituents of hair dyes have changed since the 1980s, including the removal of some known carcinogens such as 2,4-diaminoanisole, some recent products may still contain 4-aminobiphenyl (4-ABP) which is known to be a bladder carcinogen but has not been linked to lymphoma risk (Turesky et al., 2003). Epidemiologic studies have been conducted to investigate the relation between hair dye use and human cancer risk including risk of NHL but the results have been inconclusive (Cantor et al., 1988; Zahm et al., 1992; Thun et al., 1994; Tavani et al., 2005). As a modifiable exposure, the role of hair dyes in NHL is of particular interest because of the potential opportunity for prevention. In Thailand, the number of people dying or coloring their hair has been increasing steadily. In this study, we evaluated for the first time in a Thai population, the association between personal use of hair-coloring products and risk of lymphoid neoplasms.

Materials and Methods

Study population

Cases were all new incident NHL patients histologically diagnosed at the National Cancer Institute in Bangkok and at 3 regional cancer centers during the period of 2007- 2009, cases were recruited at their first visit to the center. The regional cancer centers consist of two centers in the North-Eastern part of the country and one center from central part. Controls were randomly selected from healthy person who visited patients admitted to the same center. 389 of 390 identified cases (99.7%) and 422 of 425 controls (99.2%) participated in the study in the

*[1]Molecular Epidemiology Unit, Research Division, [3]Medical Oncology Department, National Cancer Institute, Bangkok, Thailand [2]Genetic Epidemiology Group, International Agency for Research on Cancer (IARC), Lyon, France *For correspondence: sulee@health.moph.go.th*

Table 1. Selected Characteristics of the Study Population

Characteristics		Cases (390)	Controls (422)	p value
Sex	Male	221	238	0.939
	Female	169	184	
Age	≤35	43	64	0.042
	36-55	146	175	
	>55	201	183	
(mean ± SD)		54.3±14.9	51.1±14.2	
Tobacco	No	218	293	<0.001
smoking	Yes	172	129	
Alcohol	No	198	247	0.026
consumption	Yes	192	175	
Education	≤ 9 years	314	241	<0.001
	> 9 years	76	181	
Family history	No	385	420	0.213
lymphoma	Yes	5	2	

same study period. The distribution of the 390 cases by major histologic type was as follows: diffuse large B cell (DLBCL) =189 (52.3%); follicular =33 (9.1%); T-cell = 20 (5.5%); other types of NHL=65; and unclassified NHL =83. The study was approved by the ethical review committee for research in human subjects, National Cancer Institute, Thailand.

Data collection

Face to face interviews were done by trained nurse interviewers. Informed consent was obtained from all subjects prior to enrollment. Identical questionnaires were used for both case and controls. Information was collected about demographic variables, tobacco smoking, alcohol intake, eating habits, past history of disease, family history of lymphoma in first degree relatives and a life time history of all jobs that were held for one year and longer. Ever smokers of tobacco were defined as those who smoked at least 100 cigarettes over a 6 month period. Similarly, alcohol consumption was defined as having consumed alcoholic beverages at least once a week for at least 6 months. Information on chemical hair dye use included question on ages of first and last use for each product, how often they used each product, what type (permanent, semipermanent and temporary), and color (dark color, including black, brown and red or light color, including blonds) of product they used.

Data analysis

Multivariate unconditional logistic regression was used to calculate odds ratios (OR) while adjusting for the confounding effects of age (≤35, 36-55, >55), sex, smoking, alcohol, education and study area. Risk of NHL subtype was estimated only for the two most common subtypes, diffuse large B cell (DLBCL) lymphoma and follicular lymphoma. All statistical tests were two sided with a type I error rate at 5%. Statistical analyses were done with the SPSS version 18.0.

Results

Table 1 presents the distribution of selected characteristics for cases and controls. The mean age at entry was 51 years among controls (age range 17-80) and 54 years among cases (age range 19-81). The cases has a significantly higher percentage of cigarette smoking and alcohol drinking than controls. Controls, on the other hand, had a higher level of education than cases. The distribution of other factors (such as sex, family history of lymphoma and study area) was quite similar between cases and controls. Among women, 122 (72.2%) lymphoma cases and 122 (66.3%) controls reported use of hair dyes. Among men, 75 (33.9%) cases and 85 (35.7%) controls reported use of any hair coloring product.

As shown in Table 2, there is no significant association between hair dyes use and risk of NHL for overall users (OR= 1.1, 95%CI 0.8-1.5) or among women (OR=1.4, 95%CI 0.9-2.3). However, stratification by time period of use showed an increased risk of NHL among ever users who started using hair dyes before or at 1980 as compared with nonusers (OR=2.1, 95%CI 1.0-4.1). An increased risk of NHL was also observed among women who used permanent products (OR=1.8, 95%CI 1.0-3.1). No changes in risk were observed related to the number of years used or total lifetime applications.

Evaluation of the association between use of hair dyes and NHL subtype revealed that risk of follicular

Table 2. Personal Hair Dye Use and Lymphoma Risk in the Study Population and in Women

Variable		Overall			Women		
		No.cases	No.controls	OR (95%CI)*	No. cases	No. controls	OR (95%CI)*
Use of hair dye	Never	193	215	1	47	62	1
	Ever	197	207	1.1 (0.8-1.5	122	122	1.4 (0.9-2.3)
Dye color	Light	20	28	1.0 (0.5-1.9)	18	19	1.6 (0.7-3.6)
	Dark	176	173	1.1 (0.8-1.5)	104	100	1.4 (0.9-2.3)
Dye type	Permanent	109	97	1.3 (0.9-1.8)	72	56	1.8 (1.0-3.1)
	Semi perm	56	82	0.7(0.5-1.1)	29	49	0.8 (0.4-1.5)
	Temporary	31	27	1.5 (0.8-2.7)	20	17	2.1 (0.9-4.5)
Duration of use (years)	≤ 10	119	129	1.1 (0.7-1.5)	69	66	1.6 (0.9-2.7)
	11–24	52	62	0.9 (0.6-1.5)	35	46	1.0 (0.5-1.9)
	≥ 25	24	15	1.7 (0.9-3.6)	16	10	1.9 (0.8-4.8)
Lifetime applications	≤ 20	118	113	1.1 (0.8-1.6)	71	65	1.5 (0.9-2.6)
	21 – 40	32	31	1.3 (0.8-2.4)	19	19	1.5 (0.7-3.3)
	> 40	44	62	0.8 (0.5-1.3)	29	38	1.1 (0.6-2.1)
Year first used	≤ 1980	30	15	2.1 (1.0-4.1)	16	8	2.2 (0.8-5.9)
	> 1980	163	192	1.0 (0.7-1.3)	102	114	1.3 (0.8-2.1)

*Adjusted for smoking, alcohol, education, sex, age (≤35, 35-55, > 55) and study area

Table 3. Personal Hair Dye Use and Lymphoma Risk by DLBCL and Follicular Lymphoma Subtype

Variable		DLBCL			Follicular	
		No.controls	No.cases	OR (95%CI)*	No. cases	OR (95%CI)*
Use of hair dye	Never use	215	84	1	17	1
	Ever use	207	105	1.3 (0.9-1.9)	16	1.1 (0.5-2.2)
Dye color	Light	28	10	1.1 (0.4-2.5)	5	0.8 (0.4-1.9)
	Dark	173	94	1.3 (0.9-2.0)	11	3.7 (1.1-12.8)
Dye type	Permanent	97	60	1.6 (1.0-2.5)	11	1.7 (0.7-4.1)
	Semi perm	82	29	0.9 (0.5-1.5)	4	0.6 (0.2-2.0)
	Temporary	27	16	1.7 (0.8-3.6)	1	0.6 (0.1-4.7)
Duration of use (years)	≤ 10	129	68	1.4 (0.9-2.1)	6	0.6 (0.2-1.6)
	11 – 24	62	23	0.9 (0.5-1.6)	7	2.1 (0.7-5.8)
	≥ 25	15	12	2.1 (0.9-5.1)	3	3.3 (0.8-14.1)
Lifetime applications	≤ 20	113	63	1.3 (0.9-2.1)	9	1.0 (0.4-2.5)
	21 – 40	31	13	1.3 (0.6-2.7)	5	2.4 (0.8-7.6)
	> 40	62	26	1.2 (0.7-2.0)	2	0.5 (0.1-2.3)
Year first used	≤ 1980	15	14	2.2 (1.0-5.2)	3	3.2 (0.8-13.4)
	> 1980	192	88	1.2 (0.8-1.8)	13	0.9 (0.5-2.0)

*Adjusted for smoking, alcohol, education, sex, age (≤35, 35-55, > 55) and study area

lymphoma was increased among those who had used dark-colored dyes (OR=3.7, 95%CI 1.1-12.8) (Table 3). For DLBCL, use of permanent hair dyes was associated with an increased risk (OR=1.6, 95%CI 1.0-2.5) and a nonsignificant risk was also observed among people who start using hair dyes before or at 1980 (OR=2.2, 95%CI 1.0-5.2).

Discussion

In this study, we found no increased risk of non-Hodgkin's lymphoma among personal use of hair dyes. However, we did find an increased risk of lymphoma among people who started using hair coloring products before 1980 (OR=2.1, 95%CI 1.0-4.1). A case control study by Zhang et al. (2004) reported an increased risk among women who used hair dyes before 1980 and for those who use dark permanent dyes for 25 years or more, similar findings of increased NHL risk associated with hair dye use prior to 1980 were recently reported by de Sanjose et al. (2006). The different association for the two time periods appears to be consistent with the change in carcinogen contents in hair dye product during the past two decades, however it is also possible that women who started using the product after 1980 have not yet reached the minimum induction and latency period. In this study, the proportion of people who used hair dyes before 1980 was less than of that used after 1980 since Thai people tended to use natural dyes from herbs for a long time before changed to chemical hair dyes.

Hair coloring products include permanent, semipermanent, and temporary dyes that vary by chemical formulation and are distinguished mainly by how long they last and whether they penetrate the hair shaft. Carcinogenic compounds can be found in both permanent and semipermanent products and in most color formulations, but they usually occur in greater concentration in dark color products than in light color products Zahm et al., 1992). Compound useds in the formulation of permanent dyes may be used in semipermanent dyes, with the addition of an oxidizing agents. Ames et al. (1975) reported that some hair dye components become strongly mutagenic after oxidization by hydrogen peroxide. Thus, it is plausible that personal use of permanent or dark-color hair dyes may result in higher risks of lymphoma compare to never use or use other type of hair dyes.

NHL has been associated with use of hair coloring products, particularly long-term use of dark permanent dyes, in several previous epidemiologic studies (Cantor et al., 1988; Zahm et al., 1992; Altekruse et al., 1999; Zhang et al., 2004; Benavente et al., 2005; Sanjosé et al., 2006). However, other investigators have not reported positive associations between ever use of permanent hair dye and lymphoma (Grodstein et al., 1994; Tavani et al., 2005) or NHL (Thun et al., 1994; Holly et al., 1998). There are a few studies in Asian population, including 2 case-control studies (Xu et al., 2003; Wong et al., 2010) and one cohort study (Mendelsohn et al., 2009) from China showed no association between personal hair dye use and lymphoma. In this study, an increased risk of lymphoma was seen among women who used permanent products (OR=1.8, 95%CI 1.0-3.1). The large pooled analysis from the International Lymphoma Epidemiology Consortium (Interlymph) revealed that personal hair-dye use may play a role in a risk of NHL, particularly follicular lymphoma and CLL/SLC (Zhang et al., 2008). In addition, Milligi et al. (2005) suggested an association between permanent hair dyes and follicular NHL. Geographic variations in the relative frequency of various histologic subtypes of NHL are well recognized. Approximately 30 percent of NHL in north America is follicular lymphoma and 40 percent is diffuse large B-cell lymphoma (Jaffe et al., 2001). In our study, where follicular lymphoma accounts for 9% and DLBCL for 52% of the patients, permanent and dark color of hair dyes were associated with increased risk of both sutypes,

The underlying mechanisms that may explain an association between hair dye use and lymphoma are unknown. The results of this study should be interpreted with caution as risk did not increase consistently with duration or total lifetime applications. The study may also have an error in recall bias, however the error of hair dye use are likely to be small for ever versus never use, color

and tone, but may be greater for reporting age started and stopped, and frequency of use.

One additional limitation of the present study is that the accuracy of self-report of past use of hair dyes could differ by case/control status which may bias the risk estimates. However, most subjects in our study were unaware of this association. Another potential limitation is that of the small sample size, the statistical power to examine the relation by histologic subtype, by color and type of hair-coloring products used, and by time period of use was limited

In summary, in this case-control study, we found for the first time an increased risk of NHL among Thai people who started using hair-coloring products before 1980 and among women who use permanent dyes. Use of dark color hair dyes also showed an increased risk of follicular lymphoma.

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