Use of hair colouring products and risk of multiple myeloma among US women

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ABSTRACT

Objective: To evaluate the association between personal hair dye use and risk of multiple myeloma among women.

Methods: A population-based case–control study of 175 cases of multiple myeloma and 679 controls. Cases and controls were interviewed regarding the type and colour of hair colouring product used, age at first use, age use stopped, duration, and the frequency of use per year. Odds ratios (ORs) and 95% confidence intervals (CI) were estimated using unconditional logistic regression to compare never users with four exposure groups: all users, ever semi-permanent dye users, ever permanent dye users and dark permanent dye users (most frequent use).

Results: No association was found between ever reporting hair colouring product use and myeloma risk among all users (OR 0.8; 95% CI 0.5 to 1.1), semi-permanent dye users (OR 0.7; 95% CI 0.4 to 1.2), permanent dye users (OR 0.8; 95% CI 0.5 to 1.1) or dark permanent dye users (OR 0.8; 95% CI 0.5 to 1.3). There were no significant associations among women who used hair dyes before 30 years of age, started use before 1980, had ⩾240 lifetime applications, or had used dark permanent dye for 28 or more years.

Conclusion: No evidence of an association between hair colouring product use and myeloma risk was found. However, given the conflicting body of literature on hair colouring product use and risk of multiple myeloma, this question should be further evaluated in larger studies or consortia, and in high risk groups.

Multiple myeloma is a form of cancer in which malignant plasma cells accumulate in the bone marrow and whose aetiology is not well understood.[1] Elevated risks have been linked with increasing age, male gender, African heritage and several other postulated factors such as lower education, lower income/socioeconomic status (SES), medication use, radiation, pesticides and other occupational exposures.[2] Early reports of an excess risk of myeloma among women working as cosmetologists or hairdressers[3 4] led to further investigations of an association between personal use of hair colouring products and myeloma risk.[5–9] Hair dye ingredients, which vary by colour and product type, have been shown to have carcinogenic properties.[10] Although the chemical constituents of hair dyes have changed since the 1980s and known carcinogens have been removed, some recent products may still contain cancer causing agents.[11] The impact of these changes, however, has not sufficiently been evaluated in epidemiological studies. Thus, we conducted a population-based case–control study among US women in the state of Connecticut to evaluate the association between personal hair dye use and risk of multiple myeloma.

METHODS

Study population

A detailed description of the study population has been given elsewhere.[12] Briefly, cases consisted of female residents of Connecticut aged 21–84, diagnosed with multiple myeloma between 1 January 1996 and 31 December 2002 and identified through the Connecticut Tumor Registry. A total of 186 cases completed in-person interviews, which corresponded to a response rate of 57%. Population-based controls were the same controls selected for a parallel study of non-Hodgkin lymphoma (NHL)[13] and were identified using random digit dialling (RDD) and the Centers for Medicare and Medicaid Services (CMS). Controls were frequency matched to the NHL cases by age within 5-year age groups. A total of 717 controls completed in-person interviews; the response rate was 69% for RDD controls and 47% for CMS controls. After exclusions for missing data, our analyses were based on 175 cases and 679 controls.

Hair dye assessment

Cases and controls were interviewed in-person by trained interviewers. Study subjects were provided with a list of hair colouring processes and products, and were asked whether they had used any of the items on the list at any time in their lives. Pictures of hair product labels were shown to study participants to facilitate their recall. If the subjects reported any of these products, they were then asked to report the time period in which they had used the corresponding hair colouring product. For each time period, subjects were asked to report the type and colour of the hair colouring product used, age at first use, age use stopped, duration, and the frequency of use per year. Separate time periods were determined for each change in either product or colour.

Statistical analysis

Odds ratios (ORs) and 95% confidence intervals (CI) were estimated using unconditional logistic regression with adjustments for age (<50, 50–59, 60–69, 70+) and race (white, black). Other variables including drinking, smoking, education, body mass index (BMI) and SES were evaluated as potential confounders but were ultimately excluded from models because they did not change OR estimates by more than 10%. ORs and 95% CIs were obtained for ever use of hair colouring products

Table 1 Risk of multiple myeloma associated with hair colouring products by use characteristics* †

	All users		Semi-permanent dye users		Permanent dye users		Dark permanent‡ dye users	
	Cases/ controls	OR (95% CI)	Cases/ controls	OR (95% CI)	Cases/ controls	OR (95% CI)	Cases/ controls	OR (95% CI)
Total	175/679		90/313		135/524		101/343	
Hair colouring product use								
Never	59/179	1.0		–		–		–
Ever	116/500	0.8 (0.5 to 1.1)	31/134	0.7 (0.4 to 1.2)	76/345	0.8 (0.5 to 1.1)	42/164	0.8 (0.5 to 1.3)
Dye colour used most frequently								
Light blonde	30/150	0.8 (0.5 to 1.3)	3/12	0.8 (0.2 to 3.0)	27/133	0.8 (0.5 to 1.4)		–
Dark blonde	11/62	0.6 (0.3 to 1.3)	3/14	0.7 (0.2 to 2.5)	7/48	0.5 (0.2 to 1.2)		–
Red	6/50	0.4 (0.2 to 1.0)	2/10	0.8 (0.2 to 3.7)	4/39	0.4 (0.1 to 1.0)	4/39	0.3 (0.1 to 1.0)
Light brown	19/49	1.3 (0.7 to 2.5)	8/19	1.5 (0.6 to 3.6)	9/28	1.1 (0.5 to 2.5)	9/28	1.1 (0.5 to 2.5)
Medium brown	24/85	0.9 (0.5 to 1.6)	4/36	0.3 (0.1 to 1.0)	17/43	1.4 (0.7 to 2.6)	17/43	1.4 (0.6 to 3.7)
Dark brown/black	23/104	0.6 (0.3 to 1.1)	11/43	0.7 (0.3 to 1.6)	12/54	0.6 (0.3 to 1.2)	12/54	0.6 (0.3 to 1.3)
Age at first use								
⩾48 years	29/131	0.6 (0.4 to 1.0)	13/46	0.7 (0.3 to 1.3)	13/75	0.5 (0.2 to 0.9)	8/40	0.5 (0.2 to 1.2)
38–<48 years	31/124	0.8 (0.5 to 1.4)	8/36	0.8 (0.3 to 1.8)	23/82	0.9 (0.5 to 1.7)	17/50	1.2 (0.6 to 2.2)
30–<38 years	27/100	1.0 (0.6 to 1.8)	5/22	1.0 (0.3 to 2.7)	19/76	0.9 (0.5 to 1.7)	10/34	1.0 (0.5 to 2.3)
<30 years	27/145	0.7 (0.4 to 1.3)	5/30	0.6 (0.2 to 1.8)	21/112	0.7 (0.4 to 1.4)	7/40	0.5 (0.2 to 1.2)
Year first used								
⩾1980	38/210	0.7 (0.4 to 1.1)	16/64	0.7 (0.4 to 1.4)	55/209	0.6 (0.5 to 1.3)	30/97	0.7 (0.3 to 1.4)
<1980	76/290	0.8 (0.6 to 1.2)	15/70	0.8 (0.4 to 1.5)	21/136	0.8 (0.3 to 1.1)	12/67	0.9 (0.5 to 1.5)
Duration of use								
<7 years	26/134	0.7 (0.4 to 1.2)	12/59	0.6 (0.3 to 1.3)	12/70	0.7 (0.3 to 1.4)	6/30	0.7 (0.3 to 1.7)
7–<15 years	28/122	0.8 (0.5 to 1.4)	9/31	1.0 (0.4 to 2.2)	18/85	0.8 (0.4 to 1.6)	10/48	0.8 (0.4 to 1.6)
15–<28 years	27/131	0.6 (0.4 to 1.1)	6/25	0.8 (0.3 to 2.0)	17/98	0.6 (0.3 to 1.0)	12/50	0.8 (0.4 to 1.5)
⩾28 years	30/112	0.8 (0.5 to 1.3)	2/19	0.3 (0.1 to 1.4)	28/91	0.9 (0.5 to 1.6)	14/35	1.1 (0.5 to 2.2)
Number of lifetime applications								
<52	22/146	0.5 (0.3 to 0.9)	10/57	0.6 (0.3 to 1.2)	10/82	0.5 (0.2 to 1.0)	4/38	0.4 (0.1 to 1.1)
52–<130	23/82	1.0 (0.6 to 1.7)	6/19	1.1 (0.4 to 2.9)	16/61	0.9 (0.5 to 1.8)	10/36	0.9 (0.4 to 2.0)
130–<240	22/88	0.8 (0.4 to 1.4)	1/21	–	20/65	1.0 (0.5 to 1.8)	16/34	1.5 (0.8 to 3.0)
⩾240	24/79	0.9 (0.5 to 1.6)	6/11	1.5 (0.5 to 4.4)	17/62	0.8 (0.4 to 1.6)	9/27	1.0 (0.4 to 2.3)

*ORs adjusted for age and race; never users used as referent group for all comparisons; †sums may not add up to total due to missing responses for some questions; ‡dark permanent dye users include the use of red, light brown, medium brown and dark brown/black colours. OR, odds ratio.

(never/ever) and for dye colour used most frequently (light blonde, dark blonde, red, light brown, medium brown, dark brown/black). Factors such as age at first use, year of first use, duration and number of applications were also considered. Age, duration and frequency categories are based on quartiles of the distribution among the cases due to small numbers. Analyses compared never users to four exposure groups: all users, ever semi-permanent dye users, ever permanent dye users and dark permanent dye users (most frequent use). Separation of these usage groups is indicated due to several findings that implicate dark permanent dye use as more deleterious.[5 9 14] All statistical analyses were conducted using SAS software v 8 (SAS Institute, Cary, NC).

RESULTS

The demographic characteristics of the study subjects were explored. A higher proportion of controls (21%) than cases (7%) were under 50 years of age because the controls had been frequency-matched to the NHL case series; however, all analyses were age adjusted. The majority of subjects were white, with a higher proportion of cases (13%) than controls (4%) being black. Cases tended to have less formal education, higher BMI, and smoke and drink alcohol less than controls.

We did not find any association between ever reporting hair colouring product use and myeloma risk (OR 0.8; 95% CI 0.5 to 1.1) (table 1). Risks by hair dye colour ranged from 0.4 (95% CI 0.2 to 1.0) for users of red colour to 1.3 (95% CI 0.7 to 2.5) for users of light brown colour. However, there were no consistent patterns among all users, semi-permanent dye users, permanent dye users, or women who used dark permanent dyes most frequently. There were no significant associations among women who used hair dyes before 30 years of age, who started use before 1980 or had ⩾240 lifetime applications. Similarly, no association was observed for dark permanent dye users with 28 or more years of use (OR 1.1; 95% CI 0.5 to 2.2) or among any other user type.

DISCUSSION

Hair colouring products are known to contain several chemical compounds including aromatic amines which have been found to be mutagenic and carcinogenic in several experimental studies.[10] The parallel analysis of NHL found an increased risk among women who used hair dyes before 1980 and for those who use dark permanent dyes for 25 years or more.[13] This population-based case–control study showed no association between use of hair colouring products and risk of multiple myeloma. Our study is consistent with null associations reported in three case–control studies[7 8 15] and two cohort studies.[6 16] Two case–control studies and one cohort study, however, have reported hair colour use as a risk factor for myeloma especially among those reporting use of dark hair dyes for long periods of time[5 9 14]; we did not observe this association here. Only one case–control study evaluated the product type,[9] only two studies examined the frequency of use,[5 9] and several of these previous reports are based on smaller numbers than those presented here.

Main messages

- We did not find any association between ever reporting hair colouring product use and myeloma risk among all users, users of semi-permanent products, permanent products or dark permanent products.
- There were no significant associations among women who used hair dyes before 30 years of age, who started use before 1980, who had ⩾240 lifetime applications, or for dark permanent product users with 28 or more years of use.

Policy implications

- Multiple myeloma is a deadly disease but few risk factors have been identified.
- Further evaluation of hair dye constituents is warranted in relation to this and other cancer types among large subsets of study subjects so that we can rule out any deleterious consequences on human health.

Several strengths and potential limitations of the study design should be considered in interpreting our null findings. In this study, we collected lifetime histories of hair colouring product use with detailed questions on type, shade, duration of use, age at first use, and number of applications. This allowed us to calculate risk for various levels and categories of exposure, including time period of use. As with previous studies, our ability to evaluate hair dye use and myeloma risk was limited by a small sample size (number exposed: cases = 116; controls = 500) that prevented us from fully evaluating hair dye use and any subsequent risk overall and within well-known high risk groups, such as black subjects and dark permanent dye users. The differing participation rates between cases and controls and potential selection bias due to low response rates are also a concern. Although no information was available on the characteristics of non-participants, we used vital statistics data to compare the demographic profile of participating controls with that of the Connecticut population from which they were drawn. In terms of demographic characteristics, controls were similar to the general population.[17] Therefore, it seems unlikely that controls were misrepresented in our study regarding exposure-related characteristics.

In summary, we did not find any evidence of an association between hair colouring product use and myeloma risk. However, given the conflicting body of literature on hair colouring product use and risk of multiple myeloma, this question should be further evaluated in larger studies or consortia, using well characterised hair dye information and particularly among high risk groups.

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Competing interests: None.

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