Hair Dye Use and Risk of Leukemia and Lymphoma

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Abstract: Data from a population-based case-control study of incident leukemia and non-Hodgkin's lymphoma among adult men in Iowa and Minnesota were used to evaluate risk associated with hair dye use. The relative risk for ever using hair dyes was 1.8 (95% confidence interval [CI] = 1.1–2.7) among leukemia patients, and 2.0 (CI = 1.3–3.0) among cases with non-Hodgkin's lymphoma. There was a suggestion of increased risk with extent of hair dye use. Given the widespread use of hair coloring products, these observations deserve more detailed evaluation in populations where the exposure is relatively common. (*Am J Public Health* 1988; 78:570–571.)

Introduction

Hairdressers, beauticians, and cosmetologists with potential for occupational exposure to hair dyes appear to be at excess risk of several hematopoietic malignancies.[1-7] A case-control study of acute non-lymphocytic leukemia also suggested that personal hair dye use may be a risk factor.[8] In view of these findings, as well as laboratory investigations showing the mutagenicity[9,10] and carcinogenicity of hair dye components,[11,12] we evaluated interview responses on hair dye exposures from a case-control study of leukemia and non-Hodgkin's lymphoma (NHL).

Methods

We conducted a population-based case-control interview study of incident leukemia and non-Hodgkin's lymphoma among men aged 30+ in Iowa and Minnesota (excepting Minneapolis, Duluth, and Rochester) in the years 1980–83. Personal or proxy interviews were completed for 578 leukemia patients and 622 NHL patients. Morphologic subclassification of all cases was performed by an experienced review panel of pathologists. NHL was subclassified using the Working Formulation.[13] We interviewed 1,245 controls selected from the general population, frequency matched to cases on state of residence, five-year age category, and vital status. The living controls less than 65 years old were selected using a random digit dialing method.[14] The living controls 65 or older were identified from a 1 per cent random listing provided by the Federal Health Care Financing Administration. Deceased controls were randomly selected from state mortality listings.

Structured interviewers (45–60 minutes) were administered by trained interviewers. The questionnaire covered socio-demographic characteristics, medical history, a detailed farming and occupational history, familial history of cancer, and other known or suspected risk factors. We asked two questions about use of hair dyes in the interview. One question asked, "have you ever used hair tints or any hair coloring product?" Later in the interview, we listed 45 materials, and asked for each. "Have you handled (Did he

handle or was he exposed to) any of the following materials at least once a month for a year or more during your (his) lifetime?" "Hair dyes" was the 24th item listed. If the response to any material was "yes," the period(s) of use for that item was requested as: "past 10 years," "10–20 years ago," and "more than 20 years ago." No respondent reported using hair dyes more than 20 years prior to the interview. A negative response to this question, combined with a "yes" to the former query, implied hair dye use either less frequent than once per month or use that endured for less than a year (or both).

The effect of hair dyes on leukemia or NHL risk was measured by the maximum likelihood estimate of the relative risk, adjusted for state of residence and age (<65, 65+ years) using stratification into multiple contingency tables.[15] Results were confirmed using polychotomus logistic regression models.[16]

Results

The overall odds ratio for ever/never use of hair tints, coloring products, or dyes was 1.8 (CI = 1.1–2.7) for leukemia and 2.0 (CI = 1.3–3.0) for NHL. There was a suggestion of increased risk for both malignancies with frequency and duration of exposure to hair dyes (Table 1). Among men who had used or handled hair dyes at least once a month for a year, and had started more than 10 years prior to interview, the relative risk was 2.2 (CI = 0.4–13.5) for leukemia and 4.1 (CI = 0.9–20.9) for NHL. Ten respondents (one leukemia case, five NHL cases, and four controls) said "yes" to our query of handling or exposure to hair dyes "at least once per month for a year or more", but "no" to ever/having used hair tints or coloring products. Five of these handled or were exposed to hair dyes in occupational settings (one barber, two theater assistants, one hair product manufacturing worker, one truck driver); two subjects mentioned exposure at home when spouses dyed their hair; and the remaining three provided no further information. The point estimates of relative risk in Table 1 were not substantially changed when these 10 subjects were excluded. Elevated

TABLE 1—Odds Ratios for Hair Dye Use, by Frequency of Use and Time Period of First Use

Hair Dye Use	Controls N	Cases			
		Leukemia		Non-Hodgkin's Lymphoma	
		N	OR (95% CI)	N	OR (95% CI)
Never Used Hair Dyes:	1190	534	1.0 —	569	1.0 —
But not 1 time/mo for at least a year	39	29	1.7(1.0–2.8)	37	2.0(1.2–3.2)
1+ times/mo for at least a year, starting within the last 10 years	13	11	1.9(0.8–4.6)	10	1.6(0.6–3.9)
1+ times/mo for a year or more, starting 10+ years ago	3	3	2.2(0.4–13.5)	6	4.1(0.9–20.9)

risks for both leukemia and NHL were found among younger and older respondents (<65, 65+ years) from each state. When separate analyses were restricted to either direct or proxy interviewers, relative risks were consistently elevated. Relative risks were not confounded by reported pesticide or solvent exposures, farming occupation, having had a first degree relative with cancer, or cigarette smoking habit. Finer control for age did not alter relative risk estimates.

Most morphologic subtypes showed elevated relative risks (Table 2). Among the leukemias, ORs above 2.0 were found for dysmyelopoietic syndrome, chronic myelogenous leukemia, acute lymphocytic leukemia, and "other" leukemias. Of the lymphomas, elevation of risk was greatest for follicular lymphoma.

Discussion

In this population-based case-control study, we found excess risk of several types of leukemia (OR = 1.8) and NHL (OR = 2.0) among male users of hair dyes, relative to non-users. There was no evidence of confounding by other risk factors. Although detailed information on the timing and type of exposure was limited, and numbers of exposed men were small, there was a suggestion of increased risk with extent of hair coloring use.

Evidence of an association between exposure to hair dyes and risk of hematopoietic cancer is found in occupational studies where small excesses of lymphoma and/or leukemia have been observed among hairdressers, beauticians, and cosmetologists[1-5,7] with relative risk estimates ranging from 1.2 to 2.0. Excess risk for multiple myeloma has also been reported among female cosmetologists from Los Angeles (PIR = 467) and British Columbia (PMR = 619).[6,7] Risks in these studies were measured for occupational groups, and risks associated with hair dyes or any other specific exposure were not evaluated. In contrast with our finding of no association with acute non-lymphocytic leukemia, a study of 101 incident cases and matched controls of both sexes from Baltimore reported a positive association with non-occupational, personal exposure to hair dyes.[8] It is not known to what extent histologic distinctions of clinical importance are relevant to etiology, and differences in risk elevation among the diagnostic sub-types in the current study could be due to random fluctuation. Cases of aplastic anemia following hair dye use have been reported.[9]

Caution is warranted in interpreting these findings. Information on exposure to hair dyes was limited. For example, we were unable to distinguish between permanent dyes, differently colored tints, or various brands. Information on frequency of use was limited and years of use were defined in broad 10-year categories. The study location was selected to maximize the potential for agricultural exposures, and hair dye use was rare among the study population of mostly middle-aged and elderly males (4.4 per cent of controls were ever exposed). Small numbers of exposed subjects limited the statistical stability of risk estimates. The same control population was used to evaluate risk in each case group, raising a multiple comparison issue. However, elevated risk for ever having used hair dyes was found for both leukemia and NHL in each of four age/state-of-residence categories, and there was no indication of confounding.

In summary, use of hair dyes in this case-control study was associated with elevated risk of leukemia and lymphoma, and risk increased with extent of exposure. If these results are not spurious and the association is regarded as causal, the proportion of NHL or leukemia cases attributable to hair dye use is on the order of 4 per cent. These findings pertain to an uncommon exposure and relatively rare diseases, and do not in themselves signal a major public health concern within the study population. However, the association deserves more detailed study in more urbanized male populations and among females where use of hair coloring products is more widespread.

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TABLE 2—Odds Ratios for Ever Use of Hair Dyes, by Type of Leukemia or Non-Hodgkin's Lymphoma

Case/Control type	Ever used (Number)	Never used (Number)	OR (95% CI)
Control	55	1190	1.0 —
Leukemia (all cell types)	43	534	1.8 (1.1–2.7)
Acute non-lymphocytic	7	136	1.1 (0.5–2.6)
Dysmyelopoietic syndrome	7	56	2.9 (1.2–7.1)
Chronic lymphocytic	14	229	1.4 (0.7–2.6)
Chronic myelogenous	5	46	2.2 (0.7–6.2)
Acute lymphocytic	2	14	2.9 (0.4–13.8)
Other types	8	53	3.3 (1.4–7.6)
Non-Hodgkin's lymphoma*	53	569	2.0 (1.3–3.0)
Follicular	23	172	2.8 (1.6–4.8)
Diffuse	16	182	1.9 (1.0–3.6)
Small lymphocytic	4	81	1.1 (0.3–3.3)
Other and unclassified	10	134	1.6 (0.8–3.4)

*Follicular subtypes included small cleaved, mixed small cleaved and large cell, and large cell. Diffuse subtypes included small cleaved, mixed small and large cell, and large cell. Other included large cell immunoblastic, small noncleaved cell, and lymphoblastic.