Tattoos and Hematologic Malignancies in British Columbia, Canada

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ABSTRACT

Background: Tattoos may cause a variety of adverse reactions in the body, including immune reactions and infections. However, it is unknown whether tattoos may increase the risk of lymphatic cancers such as non-Hodgkin lymphoma (NHL) and multiple myeloma.

Methods: Participants from two population-based case–control studies were included in logistic regression models to examine the association between tattoos and risk of NHL and multiple myeloma.

Results: A total of 1,518 participants from the NHL study (737 cases) and 742 participants from the multiple myeloma study (373 cases) were included in the analyses. No statistically significant associations were found between tattoos and risk of NHL or multiple myeloma after adjusting for age, sex, ethnicity, education, body mass index, and family history.

Conclusions: We did not identify any significant associations between tattoos and risk of multiple myeloma, NHL, or NHL subtypes in these studies.

Impact: Though biologically plausible, tattoos were not associated with increased risk of NHL or multiple myeloma in this study. Future studies with greater detail regarding tattoo exposure may provide further insights.

Introduction

Tattoos are the result of the application of exogenous substances causing permanent pigmentation of the skin (1). These pigments may include more traditional inks involving metals or more modern-day organic dyes, which may still contain contaminants such as metals or other carcinogenic compounds (2, 3). Although rare, complications, which have been linked to the occurrence of cancer such as inflammation and infections, can arise from tattoos (2). These adverse reactions to tattoos can vary by ink color chemistry, with red having the greatest association with adverse reactions (4).

Whether there is an association between tattoos and long-term cancer risk remains unclear (3, 4). When tattoo pigments are deposited into the dermis, there is an attempt to clear the pigments, and in doing so, transport them to the lymphatic vessels and regional lymph nodes, where pigment has reportedly been found (4, 5). This process occurs acutely after the tattooing process, but can continue over time through tattoo decomposition (e.g., solar exposure). Cases of tattoo pigment–induced lymphadenopathy in regional lymph nodes mimicking the clinical and radiologic features of lymphoma have been reported (6). As such, it is biologically plausible that tattoos may increase risk of lymphatic cancers. The objective of this study is to examine the association between tattoo history and non-Hodgkin lymphoma (NHL) and multiple myeloma.

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Materials and Methods

The participants included in this study were taken from two population-based case–control studies in British Columbia, Canada, with cases ascertained from the BC Cancer Registry, and controls ascertained from the Provincial Health Insurance Plan. The study of NHL study was conducted from 2000 to 2004 (7), while the multiple myeloma study was conducted from 2009 to 2013 (8). NHL cases were further identified by their subtypes (follicular, diffuse large B cell, T cell, and other B cell). The studies obtained written informed consent from each participant and were approved by the BC Cancer/University of British Columbia Research Ethics Board. Further study details can be found elsewhere (7, 8).

Tattoo exposure was assessed via self-reported questionnaire in four ways: ever received a tattoo (Y/N), the number of reported tattoos, age at first tattoo, and years since first tattoo (relative to date of diagnosis among cases or enrollment date among controls). Using logistic regression, ORs and 95% confidence intervals (95% CI) for the risk of multiple myeloma and NHL were calculated for each tattoo exposure variable. Tattoos reported within 1 year of the diagnosis date (cases) or enrollment date (controls) were omitted. Each model was adjusted for age (<50, 50–59, 60–69, 70+), sex, family history of lymphohematopoietic cancers, ethnicity (white, other), education, and BMI (<25, 25+). Participants were excluded if they were missing information on tattoo exposures or any of the covariates. All analyses were performed in RStudio version 1.2.5001.

Results

The original NHL and multiple myeloma studies had 1,676 and 773 participants, respectively. Of these, 1,518 participants from the NHL study (737 cases) and 742 participants from the multiple myeloma study (373 cases) were included in this analysis. The distributions of study-related variables are provided in **Table 1**. Results from the adjusted logistic regression models of tattoo exposure are provided

Table 1. Distribution of study-related variables.

	NHL		Multiple myeloma	
	Cases (%)	Controls (%)	Cases (%)	Controls (%)
Row counts	737	781	373	369
Histology				
Follicular	204	—	—	—
Diffuse large B cell	198	—	—	—
T cell	72	—	—	—
Other B cell	263	—	—	—
Age (years)				
20–49	144 (19.5)	211 (27.0)	26 (7.0)	11 (3.0)
50–59	181 (24.6)	166 (21.3)	87 (23.3)	70 (19.0)
60–69	197 (26.7)	200 (25.6)	154 (41.3)	159 (43.1)
70+	215 (29.2)	204 (26.1)	106 (28.4)	129 (35.0)
Sex				
Male	431 (58.5)	421 (53.9)	223 (59.8)	211 (57.2)
Female	306 (41.5)	360 (46.1)	150 (40.2)	158 (42.8)
Education				
<High school	140 (19.0)	112 (14.3)	62 (16.6)	50 (13.6)
High school graduate	384 (52.1)	435 (55.7)	196 (52.5)	190 (51.5)
Postsecondary graduate	234 (28.9)	234 (30.0)	115 (30.8)	129 (35.0)
Ethnicity				
European	603 (81.8)	622 (79.6)	304 (81.5)	327 (88.6)
Other	134 (18.2)	159 (20.4)	69 (18.5)	42 (11.4)
Body mass index				
<25	375 (50.9)	413 (52.9)	123 (33.0)	123 (33.3)
25+	362 (49.1)	368 (47.1)	250 (67.0)	246 (66.7)
Family history				
Yes	67 (9.1)	51 (6.5)	21 (5.6)	16 (4.3)
No	670 (90.9)	730 (93.5)	352 (94.4)	353 (95.7)
Tattoo				
Yes	42 (5.7)	46 (5.9)	37 (9.9)	35 (9.5)
No	695 (94.3)	735 (94.1)	336 (90.1)	334 (90.5)
Age at first tattoo (years)[a]				
No tattoos	695 (94.3)	735 (94.1)	336 (91.6)	334 (91.8)
<35	36 (4.9)	35 (4.5)	19 (5.2)	12 (3.3)
≥35	6 (0.8)	11 (1.4)	12 (3.3)	18 (4.9)
Years since first tattoo				
No tattoos	695 (94.3)	735 (94.1)	336 (91.6)	334 (91.8)
<25	18 (2.4)	27 (3.4)	13 (3.5)	17 (4.7)
≥25	24 (3.3)	19 (2.4)	18 (4.9)	13 (3.6)
Number of tattoos[a]				
None	695 (94.4)	735 (94.1)	336 (90.6)	334 (91.0)
Few (1–2)	30 (4.1)	34 (4.4)	31 (8.3)	27 (7.4)
Many (3+)	11 (1.4)	12 (1.5)	<5	6 (1.6)

[a]Counts less than 5 and related percentages are omitted. Some subjects who reported tattoos did not provide the number or age at first tattoo.

in **Table 2**. Because of small numbers, NHL subtype analyses were only conducted for tattoos (Y/N) but not for the number of tattoos, age at first tattoo or years since first tattoo. Overall, no statistically significant associations were observed.

Discussion

We did not find any significant associations between tattoos and the risk NHL, its specific subtypes, or multiple myeloma in these studies. There were several important limitations with regards to the data available for analysis. Firstly, the exact details regarding the dye ingredients used in tattoos (i.e., organic dyes vs. heavy metals) were unavailable, so we were unable to examine associations with specific ingredient types that may be particularly carcinogenic. Similarly, we did not have access to information on ink colors used, which may be related to risk due to their varying chemistries (4). We were also not able to assess the effect of the surface area covered by ink (indicating the amount of exposure). Although we used number of tattoos as a proxy, given the small number of study participants reporting multiple tattoos, our power to detect associations in this group was limited. This study examined the broader association of tattoos and hematologic cancers and found no significant associations. Given the increasing prevalence of tattoos, particularly among young people, future studies with detailed tattoo exposure data are needed to better elucidate specific effects.

Table 2. Risk of NHL and multiple myeloma in association with tattoo exposure.

Outcome	Exposure	Category	OR (95% CI)	*P*
NHL (all)	Tattoos (Y/N)[a]		1.04 (0.66–1.62)	0.88
NHL (follicular)			0.95 (0.45–1.84)	0.89
NHL (diffuse large cell)			0.71 (0.32–1.44)	0.37
NHL (T cell)			1.47 (0.49–3.66)	0.44
NHL (other B cell)			1.27 (0.68–2.30)	0.43
Multiple myeloma			1.08 (0.66–1.80)	0.75
NHL (all)	Number of tattoos[a]	No tattoos	Ref	Ref
		Few (1–2)	1.00 (0.59–1.67)	0.99
		Many (3+)	1.03 (0.44–4.42)	0.94
Multiple myeloma		No tattoos	Ref	Ref
		Few (1–2)	1.01 (0.58–1.75)	0.98
		Many (3+)	0.55 (0.14–2.01)	0.37
NHL (all)	Age at first tattoo[a]	No tattoos	Ref	Ref
		Young (<35)	1.14 (0.70–1.88)	0.59
		Mature (≥35)	0.68 (0.23–1.83)	0.46
Multiple myeloma		No tattoos	Ref	Ref
		Young (<35)	1.39 (0.65–3.05)	0.40
		Mature (≥35)	0.60 (0.27–1.26)	0.18
NHL (all)	Years since first tattoo	No tattoos	Ref	Ref
		<25 years	0.92 (0.48–1.71)	0.79
		≥25 years	1.17 (0.63–2.20)	0.63
Multiple myeloma		No tattoos	Ref	Ref
		<25 years	0.64 (0.30–1.37)	0.26
		≥25 years	1.27 (0.60–2.75)	0.53

[a]All models were adjusted for age, sex, education, ethnicity, body mass index, and family history.

Disclosure of Potential Conflicts of Interest

A.S. Lai reports grants from National Cancer Institute of Canada and Canadian Institute of Health Research during the conduct of the study. No potential conflicts of interest were disclosed by the other authors.

Authors' Contributions

F.M. Warner: Conceptualization, formal analysis, investigation, methodology, writing–original draft, project administration, writing–review and editing. **M. Darvishian:** Formal analysis, methodology, project administration, writing–review and editing. **T. Boyle:** Formal analysis, methodology, project administration, writing–review and editing. **A.R. Brooks-Wilson:** Data curation, writing–review and editing. **J.M. Connors:** Project administration, writing–review and editing. **A.S. Lai:** Data curation, project administration, writing–review and editing. **N.D. Le:** Writing–review and editing. **K. Song:** Data curation, writing–review and editing. **H. Sutherland:** Data curation, writing–review and editing. **R.R. Woods:** Formal analysis, methodology, writing–review and editing. **P. Bhatti:** Formal analysis, supervision, methodology, project administration, writing–review and editing. **J.J. Spinelli:** Conceptualization, data curation, formal analysis, supervision, investigation, methodology, writing–original draft, project administration, writing–review and editing.

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