

Reviews

Hair dye: an occupational risk factor for bladder cancer among beauty industry workers

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Abstract

Introduction: A new area of research has highlighted a possible link between the use of hair dyes and an increased risk of bladder cancer in people working in the beauty industry.

Materials and methods: The present study is a systematic review, the data being collected from PubMed database and selected according to predetermined eligibility criteria.

Results and discussion: The results show that in the period prior to 1980 the incidence of bladder cancer was increased in male barbers, while after 1980 the risk was higher in female hairdressers.

Conclusion: At this moment, the research seems to reveal that hair dyes represent a possible occupational risk factor for bladder cancer, but further research is needed in order to confirm this conclusion.

Keywords: bladder cancer, hairdressers, hair dye, occupational exposure, systematic review

Introduction

Bladder cancer is a type of cancer that develops from the innermost lining of the urinary bladder. It is a significant global health concern due to its prevalence and potential for morbidity and mortality. Bladder cancer is one of the top ten most frequently

diagnosed cancers worldwide and affects more males than females. This disease can present with a range of symptoms, from early-stage asymptomatic cases to advanced forms that are marked by hematuria, pain and systemic symptoms. As the cancer progresses through the layers of the bladder wall, it becomes increasingly difficult to treat.

It is crucial to understand the various factors that lead to bladder cancer so that effective preventive measures and management strategies can be developed. Although smoking is the most well-known risk factor, accounting for up to 50% of bladder cancer cases, recent studies have revealed that genetics, environmental exposure, and occupational hazards also play a significant role in causing bladder cancer.

Hair coloring can significantly adjust one's physical appearance and improve self-confidence. However, there is a hidden health concern that often goes unnoticed, especially for the hardworking individuals in the beauty industry.

This article calls for awareness and action within the beauty industry and beyond, on chemical exposure.

Occupational exposure to chemicals is, after smoking, the most important risk factor for bladder cancer. Workers in the beauty industry are chronically exposed to potentially carcinogenic products contained in hair dyes.

This article aims to study the connection between using hair dyes and greater risk of bladder cancer, especially among workers in beauty salons.

Hair dyes often contain aromatic amines, including 4-aminobiphenyl and benzidine, which have been classified as Group 1 carcinogens by the International Agency for Research on Cancer (IARC). These substances can undergo metabolic activation in the body, potentially leading to DNA damage and the initiation of bladder cancer [1]. Anilines are chemical compounds used as intermediaries in hair dye manufacturing. Prolonged exposure to anilines has been associated with an increased risk of bladder cancer, with occupational settings presenting heightened hazards [2]. Some hair dyes contain direct and oxidative dye intermediates, which have been scrutinized for their potential carcinogenicity. Their association with bladder cancer warrants attention in the context of occupational health [3].

Bladder cancer does exhibit some gender-based differences in terms of incidence, risk factors, and outcomes, being more common in men than in women. According to the American Cancer Society (ACS), the estimated new cases of bladder cancer in 2023 were 62,420 in men and 19,870 in women and about 16,710 deaths from bladder cancer (about 12,160 in men and 4,550 in women). The rates of both new bladder cancers and deaths from bladder cancer have been dropping in recent years. Bladder cancer is the fourth most common cancer in men, but it is less common in women. This discrepancy in incidence rates has been observed for many years [4]; also, men are more likely to be diagnosed with bladder

cancer at an older age compared to women. The risk of bladder cancer increases with age for both genders, but men tend to be diagnosed at a slightly older age [5]. Smoking is a major risk factor for bladder cancer in both men and women, but men historically have had higher smoking rates, which may partially explain the gender difference in bladder cancer incidence [6].

Material and method

This paper aims to be a systematic review on the occupational risk factors for bladder cancer among beauty industry workers, especially for the ones working with hair dyes and as hairdressers and barbers.

A systematic search was performed in the electronic PubMed database for studies published until March 2023 with the following keywords: "Bladder cancer AND hair dye AND occupation"; "Bladder cancer AND hairdressers AND occupation"; "Bladder cancer AND hairdressers AND hair dye", resulting a total of 90 studies (Figure 1).

The inclusion criteria that the studies had to meet were the following:

- The population for this study is represented by the beauty industry staff who worked with hair dye;
- The condition of interest was developing bladder cancer;
- Studies that assessed the incidence of bladder cancer in beauty industry workers;
- Articles published only in English that can be accessed in full, online, for free;
- Cohort or case-control studies.

The exclusion criteria that the studies were not selected by, were as follows:

- Studies on animals;
- Abstract publications;
- Articles published in another language besides English;
- Duplicate studies;
- Qualitative analysis studies and systematic reviews;
- Studies in which the number of participants was not specified;
- Personal hair dye use;
- Studies not backed up by exposure data;
- Sample < 10 cases.

The studies were selected according to predetermined eligibility criteria and each potentially eligible study was reviewed and an extraction formula was used for studies that met the inclusion criteria. The extraction formula used is shown below: location and time interval studied, study type, article title, age of participants, method, and the main result of the study

(Table 1).

From the total of 90 studies found on PUBMED, after applying the inclusion and exclusion criteria, a

total of 9 eligible studies were included in this review (Figure 2).

Figure 1. This image shows the initial PubMed search that generated a total of 90 studies, using the specific keywords: “bladder cancer”, “hairdressers”, “hair dye” and “occupation”.

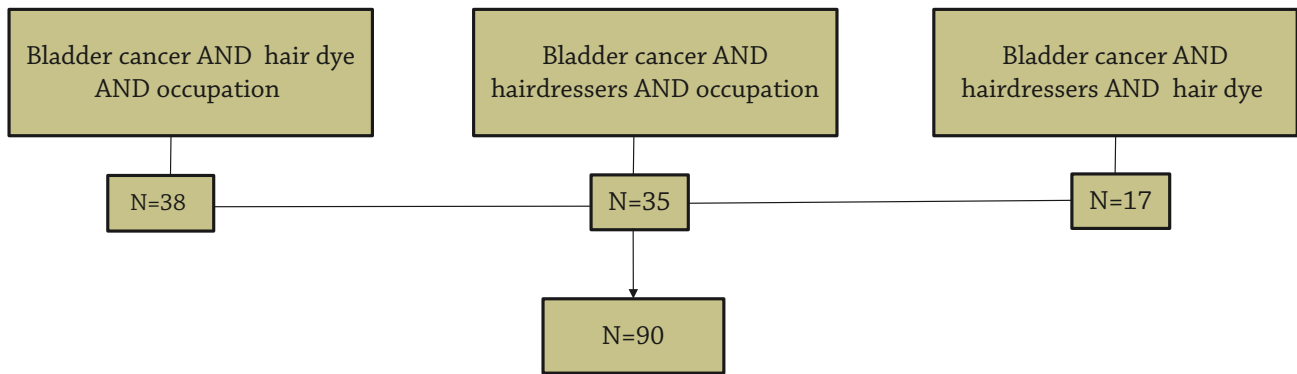
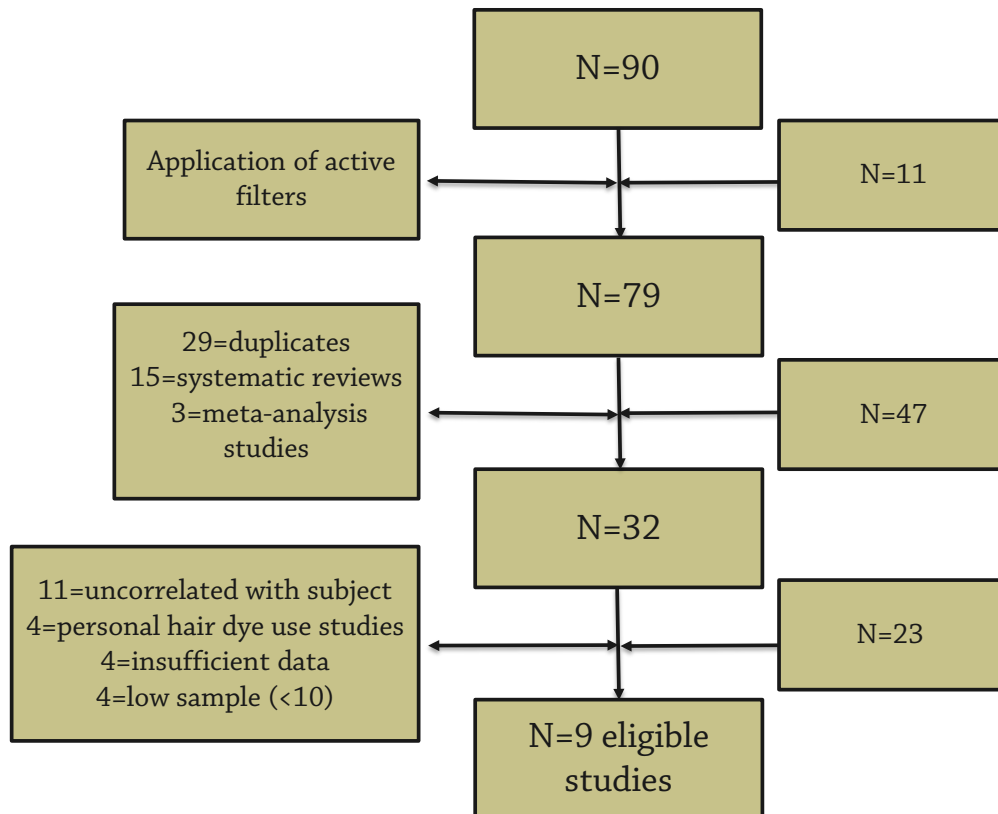


Figure 2. The following flow chart details the process of including studies in the review.



Results

The selected articles presented the exposure period for at least one year. The time period studied was divided before and after 1980 (Figure 3).
An increase in the incidence of bladder cancer was observed before 1980 in 5 articles. According to the Geneva study, there was an increase in mortality with $SMR = 208$, 90%, $CI = 116-344$, but there is also a higher incidence of bladder cancer in male barbers ($RR=2.05$, 95%; $CI 1.5-2.8$) compared to hairdressing women ($RR= 1.76$, 95%; $CI 0.7-3.6$) according to the study from Denmark (Figure 4).
This could be mainly because in barbering and

hairdressing occupations before 1980, there was exposure to various types of substances containing harmful compounds such as brilliantine, aromatic amines, formaldehyde, ammonia and paraphenylenediamine (PPD).
After the mid-1980s, the use of these dangerous products was stopped (legislative measures) and a decrease in the incidence of bladder cancer was highlighted in 6 articles.
According to a study carried out in California, a limitation to the female gender was highlighted (Figure 5), with an increased risk of bladder cancer when exposed to hair dyes ($OR = 1.8$ in women and 0.9 in men).

Figure 3. This image shows the divided time period studied, before and after 1980 and the increase and decrease of the bladder cancer incidence of the beauty industry workers.

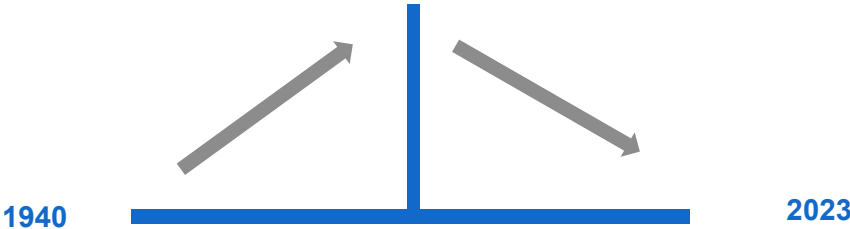


Figure 4. This image shows the morality and the incidence gender based, of the bladder cancer before 1980.

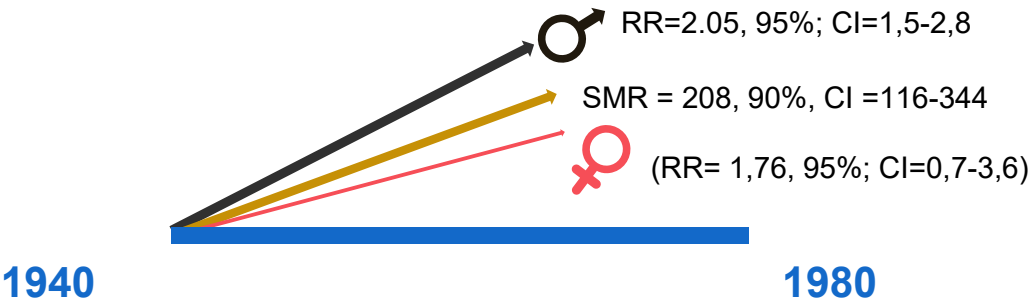


Figure 5. This image shows the incidence of bladder cancer in beauty industry workers, after 1980.

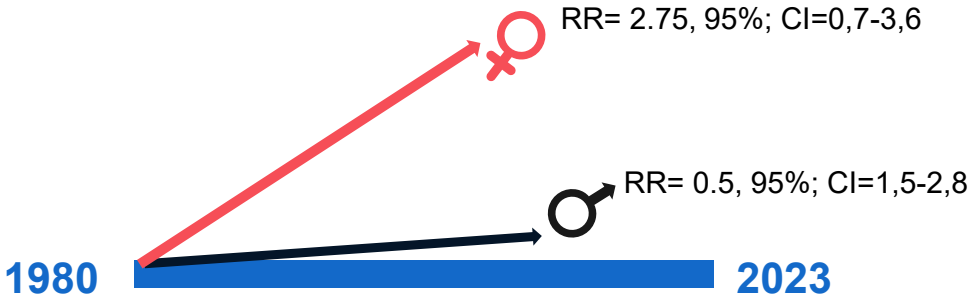


Table 1. Eligible studies included in the review

Study location, period	Study design	Article title	Age	Method	Results
Canada 1994-1997	Case-control study	A case-control study of occupational risk factors for bladder cancer in Canada [7]	20-74 years	A population of 887 individuals with incident, histologically confirmed bladder cancer.	This study found a statistically significant excess risk of bladder cancer, with a duration-response trend, among male primary metal workers and auto mechanics, and female office workers engaged in general clerical duties.
USA 1984-1995	Retrospective study	Cancer Mortality Patterns Among Hairdressers and Barbers in 24 US States, 1984 to 1995 [8]	20 years of age and older	Analyzing 7.2 million death certificates in 24 states from 1984 to 1995.	Mortality from all malignant neoplasms combined was significantly elevated among female hairdressers of both races.
Sweden 1958-1998	Cohort study	Cancer risks in hairdressers: assessment of carcinogenicity of hair dyes and gels [9]	15– 60 years	Economically active individuals from the Database covers 3.3 million men and 2.8 million women born between 1900 and 1974.	During the entire follow-up period of 39 years, the risk for bladder cancer was 1.51 (95% CI 1.10 –2.00) in hairdressers older than 45 years at the beginning of the follow-up in 1960.
Geneva 1900-1964 and was followed up to the end of 1982.	Cohort study	Increased Risk for Male Bladder Cancer among a Cohort of Males and Female Hairdressers from Geneva [10]	Mean age at diagnosis cases from bladder cancer found among male hairdressers were 68.6 years	703 male and 677 female hairdressers born from 1880 onwards, who started to run salons in Geneva between 1900 and 1964 followed by the end of 1982.	Significant excess mortality from bladder cancer (observed deaths = 10, expected deaths = 3.9) was found among males 5.3). Among female hairdressers, a significant increase in mortality or in cancer incidence was found.
Denmark, Finland, Iceland, Norway, Sweden 1960-1990 and a follow-up until about 2005.	Cohort study	Occupation and cancer follow-up of 15 million people in five Nordic countries [11]	People aged 30-64 years	Self-administered questionnaires.	The incidence of bladder cancer in the Nordic countries is several times higher in males than in females. There was an increasing incidence over time until the 1980s.

Table 1 (continued). Eligible studies included in the review

Study location, period	Study design	Article title	Age	Method	Results
Nordic countries = 1991-2005; Canada= 1991-2010	Cohort study	Occupational variation in the incidence of bladder cancer: a comparison of population-representative cohorts from Nordic countries and Canada [12]	People aged 30-75+ years	All the patients had bladder cancer at the age of diagnosis. The census records include questionnaire-based information on economic activity, occupation and industry.	MALE = no statistically significant excess risks of bladder cancer;
Denmark, Finland, Norway, and Sweden, 1990	Observational cross-sectional study	Risk for Cancer of the Urinary Bladder Among Hairdressers in the Nordic Countries [13]	15-69 years	Cross-sectionally registered census populations have been followed up for cancer incidence by individual record linkage.	Statistically significant increased risks for both bladder and lung cancer were found among male hairdressers in both Norway and Sweden
Los Angeles County 1992	Case-control study	Use of permanent hair dyes and bladder-cancer risk [14]	25-64 years	Structured interviews were conducted in the subjects' homes—1,514 incident cases of bladder cancer. Information on personal use of hair dyes was obtained from 897 cases and their matched controls.	Occupational exposure to hair dyes was associated with an increased risk of bladder cancer in this study. Subjects who worked for 10 or more years as hairdressers or barbers experienced a 5-fold (95% CI = 1.3-19.2) increase in risk compared to individuals not exposed.
Denmark 1970-1979 follow-up for about 10 years.	Case-control study	Use of Surveillance Systems for Occupational Cancer: Data from the Danish National System [15]	20-64 years	1970-1979 population has been followed up for deaths, emigrations, and cancer cases.	An excess risk of bladder cancer in hairdressers, RR = 2.05

Discussion

Analysis of the relevant data shows an incidence of bladder cancer in male barbers in the period prior to 1980, but with a higher risk, which was predominantly associated with the male gender, that could be attributed to Brilliantine.

After 1980, an increase in the risk of bladder cancer was observed in coiffed women and this trend may be associated with changes in professional practices, exposure to harmful chemicals in hair dyes and other cosmetics, and changes in their composition.

An effect on individual telomere length was found in barbers, they had shorter telomeres compared to other occupations and even if this is not specific for bladder cancer, it shows a carcinogenic risk that cannot be neglected. Some gene-specific DNA methylation changes were observed, but in a less clear pattern, and therefore, further studies are warranted to clarify the genetic effects of hair dye chemicals.

The observed difference in mortality between men and women in this field could be due to the differences in gender-based exposure and susceptibility to toxins in the workplace. Anatomical and physiological differences between the sexes can influence metabolism, as well as pulmonary, cardiovascular, gastrointestinal and renal structure and function. These differences can result in variations in exposures, target doses in tissues, quantities and, consequently, in the different responses of the sexes to the workplace and environmental chemicals.

Current exposure to hair dye components differs from that of the past. Over the past 20 years, many of the chemicals identified as mutagenic and carcinogenic in hair dyes and other hair products have been banned in the United States and Europe.

A recent systematic review conducting a comprehensive evaluation of recent epidemiological studies that have explored the carcinogenic or reprotoxic effects on hairdressers, a group that appears to face a higher risk of experiencing systemic adverse effects resulting from chemical exposure in hair care products when compared to consumers suggested that only a small fraction of the latest epidemiological investigations involving hairdressers have identified a statistically significant elevation in the risk of carcinogenic effects, particularly in relation to bladder cancer [16].

Furthermore, three separate meta-analyses have indicated a notably increased risk, ranging from 20% to 30%, of bladder cancer among hairdressers when compared to the general population or individuals in non-exposed occupational fields [17, 18, 19].

Conclusion

Hair dyes are a possible occupational risk factor for bladder cancer, however, further detailed studies focusing on exposure assessment in hairdressing facilities with a more representative sample are needed.

The implications of these medical studies urge us to pay attention to occupational health in the case of hairdressers and barbers, promoting good prevention practices, awareness and information about the risks associated with the occupation and improving working conditions in these industries.

Limitations

One restraint of the current review is the limited availability of publications addressing bladder cancer identified from 1900 onwards.

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