



## Consumption of hair dye products by the French women population: Usage pattern and exposure assessment



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### ABSTRACT

Only few published data are available in the literature about consumption and exposure, for hair dye products. The aim of this study was to assess the use of 10 different hair dye products in French Women with a focus on consumption of hair dye in different places of use (at home and at the hairdressers) in order to assess the corresponding dermal exposures. The assessment was performed on a total of 4237 women older than 15 years old, thanks to three national web surveys. The percentage of hair dye users among the French women population was about 64%. The mean frequency of use ranged between 2.23 and 14.22 times per year depending on the studied product and age category of women. This study provided the first data available for exposure to hair dye products with mean exposures ranging between 1.48 and 6.49 mg/kg bw/day depending on the product studied and age category of women. Moreover, consumption data obtained in this study might be useful to perform safety assessment of hair dye products thanks to the knowledge of the age categories of the population having the highest percentage of users and/or frequency of use.

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### 1. Introduction

Nowadays, in industrialised countries, it is generally recognised that physical appearance is important and as a consequence, cosmetic products are now widely used. Draelos proposed an estimation of 70% of hair dye users among women in developed countries with an important proportion of regular users (Draelos, 2010). Hair dyeing belongs to the hair care branch of cosmetic products and can be defined as “products that alter the color appearance of hair temporarily or permanently, by removing some of the existing color and/or adding new color” (Draelos, 2010). Hair dyeing cosmetics gather a great diversity of products, these products being generally divided in three categories: vegetal, mineral or metallic and synthetic hair dyes. The last one can be also considered as the grouping of four subtypes of products which differ in their degree of permanence or attending effects: temporary, semi-permanent and permanent hair dye, as well as hair bleaches

(Guerra-Tapia and Gonzalez-Guerra, 2014). Hair dye can be split as well in other categories: oxidative dye (permanent), direct (temporary and semi-permanent) dyes, metal salts and natural dyes (Nohynek et al., 2004). This wide variety of products with different application modes can cause uncertainty about the exposure.

France is a member of the European Union (EU) and is by this way subject to the European cosmetic regulation. As cosmetic products, hair dyes are regulated in the European Union by the Regulation (EC) No 1223/2009, which defines cosmetics as « any substance or mixture intended to be placed in contact with the external parts of the human body (epidermis, hair system, nails, lips and external genital organs) or with the teeth and the mucous membranes of the oral cavity with a view exclusively or mainly to cleaning them, perfuming them, changing their appearance, protecting them, keeping them in good condition or correcting body odours » (EU, 2009). This regulation specifies that before its placement on the EU market, the achievement of a safety evaluation for the cosmetic product is required in order to provide evidence that under the defined condition of use, the cosmetic will not cause human health adverse effect.

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To assess cosmetic products safety in consumers, toxicological and exposure data are needed. As the exposure assessment is depending on use habits, collecting quantity data and frequency of use data is necessary. The Scientific Committee on Consumer Safety (SCCS) provided a single amount of 35 mL of semi-permanent hair dyes and 100 mL of oxidative/permanent hair dyes used by application and a retention factor of 0.1, but no exposure values were given due to the low frequency of exposure (SCCS, 2012a). One study included hair dye in its cosmetics' usage analysis and so determined the percentage of hair dye users in a representative sample of the Dutch population. This study indicated that 3.3% of men and 55.6% of women used hair dye. However, no information on the quantity applied per use and on the frequency of use of hair dye was provided (Biesterbos et al., 2013). In 2005, Søsted et al. published data on hair dye usage patterns among Danish adults. The results gave a percentage of users in the last 12 month of 49.7% among women, with a mean frequency of use of 3.7 times per year (Søsted et al., 2005). However, if these two studies gave interesting usage data, no exposure data were provided.

The first aim of the current study was to assess the use of hair dye in French women. A particular attention was paid to the use of 10 hair dye products and to places of their use: at home or at the hairdressers. Moreover, usages of two different product lines at home were taken into account: at home using professional products or using supermarket products. This study provided data on the percentage of hair dye users, frequency of use and quantity use per application. All of these data enabled to achieve the second objective of this study which was to assess external dermal chronic exposure to hair dye for each age class in mg/kg bw/day.

## 2. Materials and methods

### 2.1. Surveys' design, population studied and data analysis

Data were collected thanks to three different Computer Assisted Web Interview (CAWI), called CAWI 1, CAWI 2 and CAWI 3 and performed between September 2013 and April 2015 in collaboration with a French private survey company. More information is available in the [supplementary material](#).

#### 2.1.1. CAWI 1

The aim of the first survey was to establish the percentage of users and the frequency of use of 139 cosmetics products, by a representative sample of the French general population, at home (Ficheux et al., 2015). The cosmetics studied included four different hair dyes types (hair colour, hair bleach, highlighter and henna). For the frequency of hair dye use, respondents indicated their corresponding annual frequency of use:  $\geq$  once a month, 6–10 times per year, 3–5 times per year, less often.

In this survey, quotas were used in order to obtain a representative panel of the French general population. Quotas used for the selection were: sex, age (0–3, 4–9, 10–14, 15–24, 25–39, 40–49, 50–59, 60–70 years old), socio-professional category, geographical area (northwest, northeast, southwest, southeast and Ile-de-France) and degree of urbanization (<2000 inhabitants, 2000–20,000 inhabitants, 20,000–100,000 inhabitants, Paris metropolitan area). The CAWI 1 was conducted among 7131 people, from which 2715 corresponded to the target population of this study: women between 15 and 70 years old.

The percentage of users as well as the frequency of use per year were determined by age group, 15–24, 25–39, 40–49, 50–59 and 60–70 years old. For the frequency of use, the scale of:  $\geq$  once a month, 6–10 times per year, 3–5 times per year, less often, considered as insufficiently precise, was replaced for calculation by three scales:

- Minimum scale: 1, 3, 6 and 12 times per year.
- Medium scale: 1, 4, 8 and 18 times per year.
- Maximum scale: 2, 5, 10 and 24 times per year.

#### 2.1.2. CAWI 2

The second web questionnaire was performed to complement data obtained by the CAWI 1, especially to provide information about the amount of use and to clarify the frequency of use data obtained in the CAWI 1. A representative sample of the general French population of 1200 adults between 15 and 70 years old was surveyed in this CAWI by using the same quotas as for the CAWI 1, thus resulting in a population of interest of 583 French women. The respondents were asked about the place of use, i.e. if they made their hair dye at home, at the hairdressers or both. Women using hair dyes at home were asked if they used the quantity of 0.5; 1; 1.5; 2 or more than 2 hair dye kits by application. Concerning the frequency, all women users were asked about the number of hair dye made per year. The frequencies of use were determined by age group like in the first survey, and the respondent had to give directly the number of use per year. The percentages of users for each place of use were determined among the hair dye users population.

#### 2.1.3. CAWI 3

This survey was developed to provide information focussing on French women hair dyes usage patterns. The questionnaire contained questions to take into account different place of use and product line: hair dyeing at the hairdressers, at home using professional product or at home using supermarket product. Participants were also asked about the type of hair dye used: hair bleach, lightener, permanent dye, semi-permanent dye, temporary dye, or vegetal dye. A particular kind of hair dye product is bleach plus other hair dye, this combined group was created because before making a hair dye with the aim of a colour change, a part of the consumer's population previously bleach their hair for better results.

Information given by the respondents on the usage pattern and the product use referred to the last use of hair dye. For each usage pattern, the frequency of use was asked with different possible responses: twice a month; once a month; every two months; every three months; every four months; every six months; once a year; less than once a year; or don't know. Information about quantity used by application, 0.5; 1; 1.5; 2 hair dye kits or other, were collected for women using supermarket hair dye product at home.

A different method of quotas was applied here. Given that 5–10% of men use hair colorants at one time (EC, 2006) and that only 6% of men in the CAWI 1 survey used hair dye, only women were taken into account. Moreover, it was chosen to have about 75 percent of hair dye users in the panel in order to obtain more information about users' consumption. The age quota applied was: 15–17, 18–24, 25–34, 35–49, 50–64, 65 and more, years old. Quotas for socio-professional category, geographical area and degree of urbanization were the same as in the two previous surveys. A representative sample of 1257 French women (with users over-represented) took part in this survey, from which 939 women used a hair dyeing product during the past 12 months.

As a quota was used for hair dye users and non-users in the third survey, it was not possible to evaluate the percentage of users in the general population. Thus, the percentage of users was determined among users, for the different place of use and product line: hair dyeing at hairdressing salon, at home using professional or supermarket products, and for the different type of hair dyeing for each age group (15–24, 25–34, 35–49, 50–64, 65 and more, years old). The frequency of use per year was calculated for each usage pattern

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