



# Use-patterns of personal care and household cleaning products in Switzerland



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## ARTICLE INFO

### Article history:

Received 25 August 2016

Received in revised form

7 October 2016

Accepted 25 October 2016

Available online 3 November 2016

### Keywords:

Use frequency  
Consumer product  
Use frequency  
Co-use  
Exposure factors  
Amount

## ABSTRACT

Reliable consumer use data are needed to determine health risks posed by chemicals contained in household cleaning and personal care products. Essential information includes the amount of product applied, the frequency of use, and the site of application. To obtain such data, a survey was conducted in Switzerland to assess consumer usage patterns. The use-patterns of 12 household care products, 5 laundry products, and 22 personal care products were collected among the Swiss population (N = 759; ages 0–91) by postal questionnaire, providing for the first time in Europe comprehensive information regarding use of household cleaning and personal care products for the same study population. Apart from the investigation of use frequency, quantity, duration, and habits, also co-use analysis was performed separately for household and personal care products. Use-patterns are presented for both genders and all age groups, including children below the age of 12, who may be more vulnerable to adverse effects attributed to certain chemicals. Also, the currently missing use factors for cosmetic/baby wet wipes were assessed. Stratification of the data by gender, age and other socio-demographic factors, such as region affiliation, allowed us to identify differences between population sub-groups, emphasizing the need for region-specific exposure factors.

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## 1. Introduction

Consumers regularly use household cleaning and personal care products (HC&PCPs) which contain a plethora of chemicals. Some of these chemicals are known to cause skin rashes, allergies, eye irritation, and respiratory irritation (Wolkoff et al., 1998) in adults as well as in children (Mendell, 2007; Nickmilder et al., 2007). Also health effects resulting from internal exposure to chemicals in personal care products (PCPs) have been suspected, e.g. endocrine disruption (Witorsch and Thomas, 2010; Darbre and Harvey, 2008), cancer (Mandriota et al., 2016; Darbre and Harvey, 2008), birth defects (Polanska et al., 2016; Lyche et al., 2009), and allergic

dermatitis (Uter et al., 2012; Van Oosten et al., 2009). To determine the chemical risks for consumers which are associated with the use of HC&PCPs, it is necessary to estimate consumer exposure (van Leeuwen et al., 1996). Since a specific chemical is often contained in different product categories, the exposure of an individual to such a chemical is the result of the simultaneous use of different products by the same person (Biesterbos et al., 2013; Manova et al., 2013). For this reason, it is necessary to calculate the aggregate exposure (Manova et al., 2013; Lorenz et al., 2011; von Goetz et al., 2010). For such a calculation, exposure data describing (1) the frequency of use, (2) typical amounts (quantity per application) used for single products (Van Engelen et al., 2007), (3) co-use patterns (Cowan-Ellsberry and Robison, 2009), (4) the duration of exposure, (5) the site of contact, (6) the type of products (e.g. aerosol, spray), and (7) the way the product is used (e.g. wiping, diluting) are needed (Weegels et al., 2001).

PCP use-patterns have been assessed for only few countries, i.e. France, The Netherlands, Switzerland, the United States of America, and EU-15 (Ficheux et al., 2015; Biesterbos et al., 2013; Manova et al., 2013; Bennett et al., 2011; Wu et al., 2010; Sathyanarayana et al., 2008; Loretz et al., 2008, 2006, 2005; Weegels et al., 2001; Hall et al. 2007, 2011), and there is very limited knowledge

*Abbreviations:* HC&PCP, Household cleaning and personal care products; HCP, Household cleaning products; PCP, Personal care products; ChAd, Children and adolescents; A.I.-S.E, Association for Soaps Detergents and Maintenance Products; HERA, Human and environmental risk assessment on ingredients of household cleaning products; EPHECT, Emissions, exposure patterns and health effects of consumer products in the EU; SCCS, Scientific committee on consumer safety.

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regarding the use of household cleaning products (HCPs): in fact, there are only four published reports that have described the cleaning product habits and practices for laundry, dishwashing, and hard surface cleaners: two for North America (Sanderson et al., 2006; Weegels et al., 2001) and two for Europe (EPHECT, 2012; HERA, 2005). Moreover, these data limitations are even more pronounced for children: PCP use-patterns of children are only available from four studies (Ficheux et al., 2015; Manova et al., 2013; Sathyanarayana et al., 2008; Wu et al., 2010). It is important to bear in mind that children might be more sensitive than adults to chemical exposure, because their central nervous, immune, reproductive, and digestive systems are still under development: At certain early stages of development, exposure to chemicals may lead to irreversible damage (Grandjean et al., 2008). Therefore, for many chemicals it is especially important to include children in the risk assessment.

There are various methods to obtain data on human habits and practices. Commonly questionnaires (i.e. web-based or paper-and-pencil), interviews (by telephone or face-to-face), and daily diaries are being used, which sometimes are combined. Although web-based questionnaires may have advantages compared to the traditional paper-and-pencil questionnaires (time, costs, data digitalization, and data management), they should not be used as the only method, because results obtained exclusively from Internet users may be biased (participants need to have Internet-related skills to access and complete the survey; Kongsved et al., 2007). Moreover, the response rates in web-based questionnaires are normally lower compared to postal questionnaires (van Gelder et al., 2010). Therefore, postal questionnaires are considered to be the best methodology for a national-scale study across all ages.

The aim of this project was to assess the use-patterns of HC&PCPs in Switzerland, in order to provide population-based exposure factors for calculating internal and external consumer exposure. Special emphasis was placed on the assessment of the main Swiss language regions (which have cultural differences), to include children, and, in response to a related project, to include the product categories that are likely to contain the chemical class of isothiazolinones. Thus, the main focus in this study is on water-based rinse-off and cleaning products, but some leave-on products were included in order to give a more complete overview on the use-patterns of HC&PCPs in Switzerland.

## 2. Materials and methods

### 2.1. Study population

A total of 4500 households were randomly selected from the Swiss phone book: 2500 in the German, 1300 in the French, and 700 in the Italian speaking region of Switzerland (the regions represent approx. 64%, 23%, 8% of the Swiss population, respectively (SFSO, 2015)) and provided by mail with paper questionnaires in the respective regional language. The response rates were calculated by dividing the number of returned questionnaires by the total number of questionnaires, excluding those sent to invalid addresses. After the exclusion of incomplete, ineligible and contradictory answers, the final database included 759 participants (647 adults and 112 children and adolescents (ChAd)). If a participant decided not to respond to specific questions, the answers were coded as missing values. For each variable, the percentage was calculated based on the total number of respondents for that specific question.

### 2.2. Data collection

A paper questionnaire with both open and closed questions was

sent in May 2015, including a pre-paid reply envelope. In early June 2015, a reminder was sent. To ensure a within-household random selection of the target respondent, we asked the household member whose birthday was next to complete the questionnaire if no children were present in the household. Since for children ( $\leq 14$  years of age) narrower age groups should be used, they might be easily underrepresented in this study. Therefore, children were prioritized over adults, and parents were asked not to complete the questionnaires for themselves, but for the child whose birthday was next. To increase the motivation of the participants, the possibility to receive a feedback with the study results was offered, but no further incentives. The questionnaire contained general questions regarding demographics, body characteristics, education, and allergic reaction experiences (see SI). Further, specific questions were contained regarding the use of HCPs, PCPs, and other water-based consumer product categories (selected for their likelihood of containing isothiazolinones in response to the overarching research project). The list of investigated product categories is shown in Table 1.

Questions regarding cleaning products included use of HCPs at different places in the home (i.e. floor, windows, etc.), and frequency and duration of the cleaning task at each place, because this format facilitates recall (Bearth et al., 2016). For each HCP the use of protective gloves was investigated. Hand washing duration and frequency depending on the product used (bar soap, dishwashing detergent, liquid hand soap, and disinfectant) were investigated as well. The PCP use-patterns were estimated using questions regarding the frequency of use, the application site for some selected products, and the amount of product used per application. Photographs were used to visualize the amount of some PCP categories selected on the basis of their high use prevalence. These included hand cream, body lotion, toothpaste, face cream, make-up remover, facial cleanser, foundation, shampoo, conditioner, shower gel, bubble bath, and liquid hand soap. An increasing amount of product was displayed with four photographs (see Fig. 1). As reference we used a Swiss coin (5 Swiss francs). With three different brands for each product category, the amount displayed in the photographs was reproduced and weighed in triplicate. This information was used to transform the categorical respondent answers into numerical data. For the other HC&PCPs, this visualization method with images was considered not meaningful. Apart from the use frequency and quantity, also most frequently used product brand names were inquired.

For more detailed information about the questions and the questionnaire structure, see the questionnaire in the Supplementary Section 1.

### 2.3. Data analysis

To summarize the demographic and body characteristics of the studied population, basic descriptive statistics were used. The same data analysis was done for all HC&PCPs with some minor adjustments. To calculate the use duration per day of HCPs, for each product used to clean a specific part of the house the total cleaning frequency was multiplied by the total cleaning duration of that specific part of the house (but not divided by the number of products: representing a worst-case approach if more than one product used). For graphical presentation the results of this calculation were regrouped in 7 bins (0 min/day, 1–10 min/day, 11–20 min/day, 21–30 min/day, 31–40 min/day, 41–50 min/day, 51–60 min/day, more than 60 min/day). For such calculation, values for frequencies were assigned using the following criteria: For answers like 'X–Y times per day' the frequency was replaced by the highest number, i.e. Y; for answers like 'more than Z' the frequency was replaced by Z. For hand washing products (other than

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