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The attitude of patients with $p$-phenylenediamine or 2,5-toluenediamine contact allergy to hair dyeing

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Key words: 2,5-toluenediamine; behaviour; contact allergy; hair dye; $p$-phenylenediamine; self-esteem.

Adverse skin reactions resulting from the use of hair dye are reported in 6% of individuals using hair dye products in the European general population (1, 2). Even though allergic contact dermatitis provokes unpleasant symptoms, such as itching and scaling, many patients with a hair dye allergy seem to continue dyeing their hair (3). This phenomenon is influenced by the severity of the allergic reaction, as 73% of patients with a weak positive reaction upon patch testing continued dyeing their hair, 49% of the patients who had strong positive reactions, and none of the patients with an extreme positive reaction (4).

Although this phenomenon has often been observed and reported, the underlying reason has not yet been elucidated. In this study, we aimed to investigate this phenomenon, which seems to parallel addictive behaviour.

Patients and Methods

A total of 124 patients with a relevant positive patch test reaction to either $p$-phenylenediamine (PPD) or toluene-2,5-diamine (TDA) were selected from our patch test database between January 1994 and March 2015. All included individuals completed a questionnaire consisting of 68 questions. This questionnaire included questions regarding socio-demographics, exposure to hair dye products, including the length and frequency of hair dye use, and original hair colour. The second part of the questionnaire focused on motivations for either stopping or continuing to dye hair. Furthermore, the satisfaction of individuals regarding their lives and appearance, called grade of life and grade of looks, respectively, were measured by use of a 10-point scale. Only individuals who completed the questionnaire were included in further analyses.
Data were analysed with IBM SPSS® Statistics version 22 for Windows®. Owing to the explorative character of this study, we decided that an unadjusted $p$-value of $< 0.05$ represented a significant difference (File S1).

**Results**

**Socio-demographic characteristics of the investigated population**

In the 10-year period, 124 individuals with a relevant positive patch test reaction to PPD or TDA were identified. Of these, 48% ($n = 60$) completed the questionnaire, and were included in further analyses. Of these, 27 still dyed their hair and 33 stopped. No remarkable differences between groups with respect to the socio-demographic factors were found (Table S1 in File S1). Factors influencing hair-dyeing habits are shown in Table 1.

Regarding the severity of the expected symptoms after dyeing of hair, both groups expected mild symptoms, redness, and itch, although those who stopped dyeing expected these more often ($p = 0.001; \eta^2_p = 0.21$). Of all investigated individuals, those who continued to dye their hair were less afraid of dyspnoea ($p = 0.05; \eta^2_p = 0.07$). These ‘continuers’ did not expect crusts, erosions, or facial oedema, whereas those who stopped did expect them (respectively: $p < 0.001$ and $\eta^2_p = 0.42$; and $p = 0.002$ and $\eta^2_p = 0.18$).

Almost half of the individuals who continued to dye their hair thought that itching or redness was an acceptable symptom after dyeing their hair, whereas significantly fewer of the individuals who stopped dyeing agreed with this (44.4% and 9.7%, respectively; $p < 0.01$; $\eta^2_p = 0.16$).

Both groups were similarly satisfied with their lives and content with their appearance (respectively: $p = 0.41$ and $p = 0.34$). Individuals who continued to dye their hair stated that they were not influenced by the opinion of others regarding their hair colour ($p = 0.40$), and suspected that their happiness would decrease if they discontinued ($p = 0.04$). Furthermore, they would have given their lives a significantly lower grade if they stopped dyeing than those who actually stopped dyeing ($p = 0.002$). Nevertheless, no differences were observed in the present grade of life and grade of looks between the groups, although it is remarkable that 42% of the ‘stoppers’ wished to dye again.

Concerning the reasons for hair dyeing, two important differences between the groups were found. Individuals who continued to dye their hair gave, on average, higher points to ‘the coloured hair looks nicer’ ($p = 0.02; \eta^2_p = 0.10$) and ‘it is important to look good at your work’ ($p = 0.02; \eta^2_p = 0.10$). Individuals who stopped dyeing their hair agreed significantly more often with the statement that people with grey hair are not different ($p = 0.02; \eta^2_p = 0.104$).

The Rosenberg self-esteem score was used to calculate the self-confidence of both groups. The mean score of the group of individuals who stopped dyeing their hair was 33.7/40, and did not differ from that of the ‘continuers’, which was 33.3/40 ($p = 0.73$).

**Discussion**

The individuals who stopped dyeing their hair expected statistically significant more adverse reactions and more severe reactions if they dyed their hair, with the most pronounced, strong association being that between stopping hair dye use and the presumed appearance of crusts and erosions on the scalp. It is remarkable that the acceptance of adverse reactions and the expected adverse reactions after dyeing of hair among the current hair dye users are not similar; current hair dye users accept fewer adverse reactions than they expect. It is possible that threatening information regarding someone’s self-image if hair dying is stopped enables the individual to ignore or reduce the significance of this threat, and that a person’s thoughts and outcomes of these thoughts are influenced by a preferred conclusion (5, 6).

The reasons for dyeing hair, namely because ‘the colour was nicer’ or ‘it was required by the occupation’, had a large effect on the decision concerning current hair dye use. In contrast, the opinions of others and the behaviour of others were not marked as an important reason in either of the groups. In our opinion, the individuals included in the present study could have provided us with a socially acceptable answer, as peer comparisons can be a very strong indicator of body dissatisfaction (7).

Factors that may influence one’s decision to continue dyeing hair are thoughts and opinions regarding both grey and dyed hair. These factors are often related to the individual’s beliefs on attractiveness and beauty, although the opinion regarding grey hair did not differ between the groups. This is in line with the fact that both groups agreed that covering grey hair is not a reason to dye hair, and that dyed hair does not make one look younger. These differences between the groups indicate that ‘grey hair’ might not be a reason for continuing to use hair dye.

Apart from motivations and opinions, the self-esteem of an individual can contribute to the continued use of hair dye products, despite contact allergy. However, in the current study, no difference between the groups was found. There were also no differences between the grades of life and looks between the groups. However, the individuals...
Table 1. Attitude of patients to hair dyeing

<table>
<thead>
<tr>
<th>Expected symptoms after dyeing</th>
<th>Stopped dyeing (n = 33) Mean</th>
<th>Continued dyeing (n = 27) Mean</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Redness, itching</td>
<td>4.54</td>
<td>3.46</td>
<td>0.001* (ƞ²_p = 0.209)</td>
</tr>
<tr>
<td>Crusts, erosions</td>
<td>4.36</td>
<td>2.42</td>
<td>0.000* (ƞ²_p = 0.416)</td>
</tr>
<tr>
<td>Oedema on the face</td>
<td>3.50</td>
<td>2.25</td>
<td>0.002* (ƞ²_p = 0.181)</td>
</tr>
<tr>
<td>Dyspnoea</td>
<td>2.64</td>
<td>1.96</td>
<td>0.050* (ƞ²_p = 0.074)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Acceptable symptoms after dyeing</th>
<th>Stopped dyeing (n = 33) Mean</th>
<th>Continued dyeing (n = 27) Mean</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Redness, itching</td>
<td>1.71</td>
<td>2.73</td>
<td>0.002* (ƞ²_p = 0.156)</td>
</tr>
<tr>
<td>Crusts, erosions</td>
<td>1.32</td>
<td>1.65</td>
<td>0.11*</td>
</tr>
<tr>
<td>Oedema on the face</td>
<td>1.29</td>
<td>1.31</td>
<td>0.91*</td>
</tr>
<tr>
<td>Dyspnoea</td>
<td>1.26</td>
<td>1.35</td>
<td>0.60*</td>
</tr>
</tbody>
</table>

Others think I should dye my hair†          | 3.75                         | 3.47                          | 0.43*            |

Happiness would improve without allergy       | 2.59                         | 3.00                          | 0.18*            |

Happiness would improve if dyeing were possible† | 3.66                         | 3.11                          | 0.044**          |

Number of loved ones who dye their hair‡      | 8.60                         | 7.24                          | 0.54*            |

Wish to dye hair again‡, n (%)                | 11 (42.3)                    | NA                            | NA              |

Grade of life‡                                 | 7.39                         | 7.80                          | 0.19p            Mean difference: 0.41 (95%CI: –0.21 to 1.03) |

Grade of look‡                                 | 7.16                         | 7.13                          | 0.95p            Mean difference: –0.02 (95%CI: –0.70 to 0.66) |

Grade of life when dyeing has stopped‡        | 8.02                         | 6.00                          | 0.002**b         Mean difference: –2.02 (95%CI: –3.24 to –0.81) |

Reasons for dyeing hair                       |                             |                               |                 |

Covering grey hair                            | 2.94                         | 3.29                          | 0.53            |

Nicer colour                                  | 3.38                         | 4.04                          | 0.021*          (ƞ²_p = 0.100) |

Required at work                              | 3.10                         | 3.92                          | 0.020*          (ƞ²_p = 0.101) |

Others like it                                | 3.56                         | 3.54                          | 0.86            |

Looks better                                  | 2.81                         | 3.08                          | 0.26            |

Partner likes it                              | 2.63                         | 3.00                          | 0.29            |

More shine                                    | 3.06                         | 3.39                          | 0.30            |

Others dye as well                            | 2.19                         | 2.54                          | 0.31            |

Younger look                                  | 3.13                         | 3.40                          | 0.68            |

Opinion on grey hair                          |                             |                               |                 |

Old                                          | 2.03                         | 2.44                          | 0.31            |

Smart                                        | 2.36                         | 2.25                          | 0.62            |

Shabby                                       | 1.84                         | 2.04                          | 0.42            |

Unattractive                                  | 1.90                         | 2.12                          | 0.46            |

Life-experienced                              | 2.97                         | 2.62                          | 0.12            |

Not different                                 | 4.31                         | 3.68                          | 0.02* (ƞ²_p = 0.104) |

Lazy                                         | 1.66                         | 1.65                          | 0.52            |

Reputable                                     | 3.07                         | 3.04                          | 0.90            |

Piteous                                       | 1.59                         | 1.60                          | 0.84            |

Not afraid of being herself                   | 3.47                         | 3.08                          | 0.30            |

Artistic                                      | 2.74                         | 2.35                          | 0.13            |

Rosenberg self-esteem scale                   | 33.7                         | 33.3                          | 0.73            |

NA, not applicable. Questions were answered according to a five-point scale (often the Likert scale). Likert scales went from 1 (totally disagree) to 5 (totally agree), or vice versa, in which case they are marked with †. Statistically significant differences were calculated with: aANOVA, or bStudent’s t-test.

†‘Grade of life’ and ‘Grade of looks’ are terms referring to the satisfaction of individuals regarding their lives and appearance.
If no individual p-values are shown, they were not statistically significant. Statistically significant differences and the effect size (ƞ²_p) are shown.
The answers under ‘Opinion on grey hair’ and ‘Reasons for dyeing hair’ were calculated with a MANOVA. When a statistically significant difference was measured, a separate ANOVA test was performed and the effect size (ƞ²_p) was calculated.

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who continued to dye their hair would have graded their lives lower if they stopped dyeing than those who had already stopped dyeing. In our opinion, the lack of differences between self-esteem, grade of life and grade of looks are attributable to the continued use of hair dye products. Similar observations have been made regarding cosmetic surgery in individuals with lower self-ratings of physical attractiveness (8).

In conclusion, this study confirms that many patients with hair dye allergy continue to dye their hair, often for reasons other than ‘covering grey hair’. For this reason, research regarding alternative hair dye molecules seems important.

**Acknowledgements**

We would like to acknowledge W. A. Christoffers for her contributions to the questionnaire.

**Supporting Information**

Additional Supporting Information may be found in the online version of this article:

**File S1.** Methods and Table S1 (Fixed factors influencing continuous hair dye use).

**References**