Ann Dermatol Vol. 24, No. 3, 2012 http://dx.doi.org/10.5021/ad.2012.24.3.274

ORIGINAL ARTICLE

# A Survey of the Awareness, Knowledge and Behavior of Hair Dye Use in a Korean Population with Gray Hair

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**Background:** Gray hair naturally develops in the process of human aging. Many people with gray hair periodically dye their hair. Hair dyeing products are widely used and they can cause adverse effects. Therefore, the user's knowledge and recognition about hair dyeing and related side effects are important. **Objective:** The goal of this study was to lay the foundation for understanding, preventing and treating side effects caused by hair coloring products. **Methods:** We conducted a questionnaire survey for adult males and females aged over 20 who had gray hair. A total of 500 subjects were included in this study and statistical analysis was performed. **Results:** Large numbers of the people who had experience with hair dye (233 out of 319 people, 73.0%) did not know about the exact brand name of the hair dye product that they were using. Of 319 hair dye users, 23.8% (76 out of 319) people stated that they experienced side effects. Despite the occurrence of side effects from hair dyeing products, it seems they did not realize the seriousness of the side effects or the need for treatment. **Conclusion:** It is advisable to introduce a system that enables users to become aware of the ingredients and side effects of hair coloring products and give opportunities for users to become aware of the side effects of hair coloring through education, publicity and publication of an informational booklet. **(Ann Dermatol 24(3) 274～279, 2012)**

**-Keywords-**
Gray hair, Hair dyes, Side effects

Received April 5, 2011, Revised August 5, 2011, Accepted for publication August 19, 2011

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## INTRODUCTION

Gray hair (white hair) develops naturally or prematurely in the process of human aging as a result of progressive and eventual total loss of melanocytes in the hair follicle[1]. All people have gray scalp hair as they grow old. It is reported that over 50% of the population experiences gray scalp hair by their late fifties. Kim et al.[2] reported that 54.4% of Koreans have gray hair in their early forties.

For beauty and to look younger, people with gray hair tend to periodically dye their hair. There are over 60 kinds of hair coloring products in Korea. Despite that use of hair dye has been implicated in a variety of side effects, there has been no survey about the awareness, knowledge, and behavior of hair dye use.

Therefore, we conducted a survey to lay the foundation for understanding, preventing and treating the side effects from hair coloring products. We want to increase awareness and change the thinking of the people using hair dye.

## MATERIALS AND METHODS

### Subjects

A questionnaire survey was conducted for adult males and females aged over 20 and who had gray hair regardless of the use of hair coloring products for about 12 months, from November 2009 until October 2010. The survey subjects were patients and the patients' guardians who had visited the dermatology clinic at St. Paul's Hospital, College of Medicine, The Catholic University of Korea and people who belong to churches, senior citizens' community centers and nonprofit organizations in the immediate area of the St. Paul's Hospital. A total of 521

people participated in the questionnaire survey. Among the 521 people who participated in survey questionnaire, the responses of 21 people were excluded from analysis because they did not complete over 50% of the items. The responses of 500 survey subjects were used for analysis.

### Methods

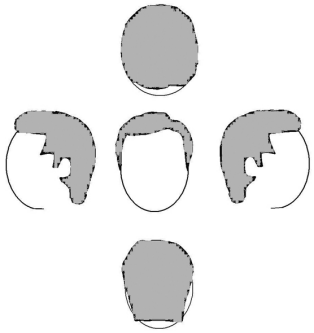
The questionnaire was composed of 26 questions and list of 68 kinds of hair coloring products on the Korean market. The questionnaire asked for basic information including gender and age, clinical findings of gray hair and the related information, use or non-use of hair coloring products and the status of use, hair dyeing-related side effects and recognition of side effects (Table 1). Some question items were designed so that the survey subjects could make multiple choices.

### Statistical analysis

Chi- square tests and independent sample t-tests were conducted for analyzing the associations among items. *p*-values $< 0.05$ were deemed significant. The survey items that had no significant implications were excluded from

**Table 1.** A questionnaire about the awareness, knowledge and behavior of hair dye use

1. Demographics and the basic information of the surveyed subjects
   1) What is your gender? (female, male)
   2) How old are you?
   3) Have you ever had or do you have a systemic disease (yes, no)?
   4) If "yes" to No.3, write down the name of disease.
   5) Have you ever had or do you currently have a skin disease (yes, no)?
   6) If "yes" to No.5, write down the name of disease.
2. Clinical findings of gray hair and the related information
   1) When did you detect your gray hair for the first time
   2) Have you ever been stressed out because of your gray hair (yes, no)?
   3) What is your hair graying pattern (partial, overall)?
   4) If it is partial, mark the location of your gray hair on the figure.



3. Use or non-use of hair coloring products and the status of use
   1) Have you ever colored your hair because of gray hair (yes, no)? If you do not color your hair, please quit the survey.
   2) If yes, what was the reason (to look younger, by strong recommendation of the people around me, to keep good impression, other)?
   3) How old were you when you colored your graying hair for the first time?
   4) How often do you color your graying hair?
   5) Write down the brand name of the hair dyeing products you use most frequently. If you don't know the brand, choose it on the annexed paper.
4. Hair dyeing related side effects and the status of recognizing side effects
   1) Have you ever experienced side effects after coloring your gray hair (yes, no)?
   2) If yes, what kind of symptoms did you have Choose all answers (itching, erythema, scales, vesicles and/or woozing, eye irritation, eyelid and/or facial swelling, other)?
   3) Have you ever had medical treatment at the hospital for side effects of hair dyeing (yes, no)?
   4) If "no" to No. 3, why?
   5) Do you still color your hair even after experiencing side effects (yes, sometimes, never, use a different method, other)?
   6) If you still color your hair even after experiencing side effects, why (side effects are minor, Side effects are serious but I don't want gray hair, It's ok to do it occasionally, I like this way best, other)?
   7) Have you ever changed your tint because of side effects (yes, no)?
   8) If "yes" to No. 7, write down the brand before and after changing your tint.
   9) Have you had side effects even after changing the hair dyeing products (yes, no)?
   10) If "yes" to No. 9, what kind of symptoms did you have (pruritus, erythema, scales, vesicle and/or oozing, eye irritation, eyelid and/or facial swelling, other)?
   11) Are you going keep coloring your hair in the future (yes, no)?

further statistical analysis and interpretation.

## RESULTS

### Demographic and medical description

Medical history report included 116 people reporting systemic disease, in which 37 people (7.4%) with hypertension and 21 (4.2%) with diabetes mellitus. A total of 48 people responded that they had previous skin disease; 9 (1.8%) had atopic dermatitis, 7 (1.4%) had skin allergy, and 6 (1.2%) had tinea.

### Clinical findings of gray hair

The highest proportion of subjects reported 40～49 years of age (194 people, 38.8%) as age of onset of gray hair, followed by 50～59 years of age (112 people, 22.4%), 30～39 years of age (103 people, 20.6%), over 60 years of age (54 people, 10.8%), 20～29 years of age (25 people, 5.0%), and 10～19 years of age (12 people, 2.4%) (Table 2). Two hundred thirty four people (46.8%) indicated that they had experienced stress due to their gray hair. Independent sample t-tests demonstrated the older the subjects were, the greater the stress level reported because of gray hair ($p<0.01$), and a higher proportion of females reported stress ($p<0.05$). According to the results of the distribution of gray hair, the number of cases of focal distribution (320 people, 64%) was greater than the number of cases of diffuse distribution (180 people, 36.0%). However, no statistical difference in age was shown for the distribution of gray hair. For site of focal distribution of gray hair, the frontal area and temporal area showed the high distribution (Table 3).

### Use of hair coloring products

Three hundred nineteen people (63.8%) had experience with dyeing their hair. Principle reasons were "to look younger" (169 people, 53%) and "to maintain a good impression" (117 people, 36.7%) replied 'to maintain a good impression' (Fig. 1). Most subjects started dyeing after 40 years of age (Table 2), usually monthly. On the brand of hair dye, the majority of the subjects (233 people, 73.0%) did not reply accurately even when an appendix with more than 60 types of hair dye was provided.

### Hair dyeing related side effects and recognition of side effects

Side effects were reported by 76 subjects (23.8%). Most reported pruritus (69 people, 90.8%), a sensation of eye tingling (36 people, 47.4%), and erythema (24 people,

**Table 2.** Age distribution of the participants, onset age of gray hair and age at starting hair dyeing

| Age | Number of subjects (%) | | |
|---|---|---|---|
| | Age distribution of the participants | Onset age of gray hair | Age at starting hair dyeing (n=319, no response=15) |
| 10～19 | 0 (0) | 12 (2.4) | 4 (1.3) |
| 20～29 | 5 (1.0) | 25 (5.0) | 7 (2.2) |
| 30～39 | 33 (6.6) | 103 (20.6) | 32 (10.0) |
| 40～49 | 71 (14.2) | 194 (38.8) | 111 (34.8) |
| 50～59 | 139 (27.8) | 112 (22.4) | 105 (32.9) |
| 60～ | 252 (50.4) | 54 (10.8) | 45 (14.1) |
| Total | 500 (100.0) | 500 (100.0) | 304 (95.3) |

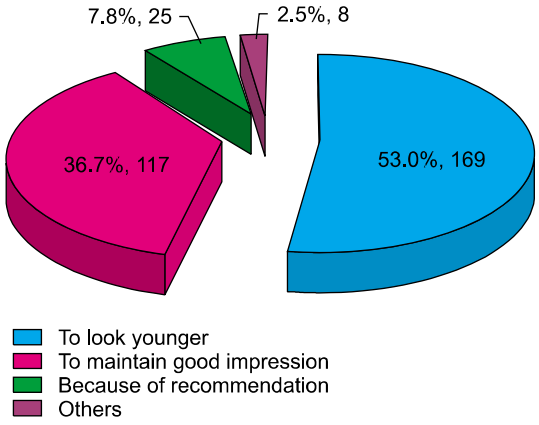



**Fig. 1.** Purpose for hair dyeing (n=319).

**Table 3.** Site of focally distributed gray hair (n=320)

| Age | Number of subjects (%) | | | | |
|---|---|---|---|---|---|
| | Vertex | Frontal | Right temporal | Left temporal | Occipital |
| 20～29 | 0 (0.0) | 1 (0.8) | 1 (1.8) | 0 (0.0) | 1 (11.1) |
| 30～39 | 9 (18.0) | 8 (6.3) | 3 (5.5) | 7 (7.9) | 0 (0.0) |
| 40～49 | 6 (12.0) | 18 (14.2) | 7 (12.7) | 14 (15.7) | 0 (0.0) |
| 50～59 | 12 (24.0) | 30 (23.6) | 13 (23.6) | 30 (33.7) | 3 (33.3) |
| 60～ | 23 (46.0) | 70 (55.1) | 31 (56.4) | 38 (42.7) | 5 (55.6) |
| Total | 50 (100.0) | 127 (100.0) | 55 (100.0) | 89 (100.0) | 9 (100.0) |

**Table 4.** Adverse effects of hair dyeing and adverse effects after changing the hair dye product

| Adverse effets | Number of subjects (%) | |
|---|---|---|
| | Adverse effects of hair dyeing (n=76) | Adverse effects after changing the hair dye product (n=26) |
| Pruritus | 69 (90.8) | 26 (100) |
| Eye tingling sensation | 36 (47.4) | 3 (11.5) |
| Erythema | 24 (31.6) | 3 (11.5) |
| Scale | 11 (14.5) | 1 (3.8) |
| Vesicle, oozing | 9 (11.8) | 1 (3.8) |
| Edema or swelling of the eyelid and/or face | 2 (2.6) | 1 (3.8) |

**Table 5.** Reasons for not visiting hospital despite having side effects of hair dyeing (n=56)

| Reasons | Number of subjects (%) |
|---|---|
| Because the symptoms were not severe | 25 (44.6) |
| Regarded the adverse effect as a natural symptom of hair dyeing | 22 (39.3) |
| Because it is too much bother | 6 (10.7) |
| Self-healing after some period | 2 (3.6) |
| Self treatment | 1 (1.8) |
| Total | 56 (100) |

31.6%) (Table 4). From the 76 respondents who experienced side effects, 20 people (26.3%) visited a medical provider for treatment.

For the reasons for not visiting a medical provider, most people (25 people, 44.6%) answered that the side effects were not severe and 22 people (39.3%) regarded side effects as a normal part of hair dyeing (Table 5). Despite the side effects, a large portion of the survey subjects (68 out of 76 people, 89.5%) continue to dye their hair (Fig. 2), and most of them (36 out of 68 people, 53%) said it was because the side effect was bearable. Sixteen out of 68 people (23.5%) said they did not like gray hair even though the side effect was severe. Fourteen out of 68 people (20.6%) think severe side effects are bearable if they use dye only occasionally, and 2 out of 68 people (2.9%) said that they kept dyeing their hair because it's the best way to hide their gray hair. Fifty five people (72.4%) changed hair dye products due to side effects, and of them, 47.3% (26 out of 55 people) experienced side effects even after they changed the product, most often pruritus (26 people, 100%) (Table 4). For the question on whether they would continue with the hair dye, 256 people (80.2%) gave a positive answer

In the analysis of the differences of knowing which hair dyeing product they were using between the two groups

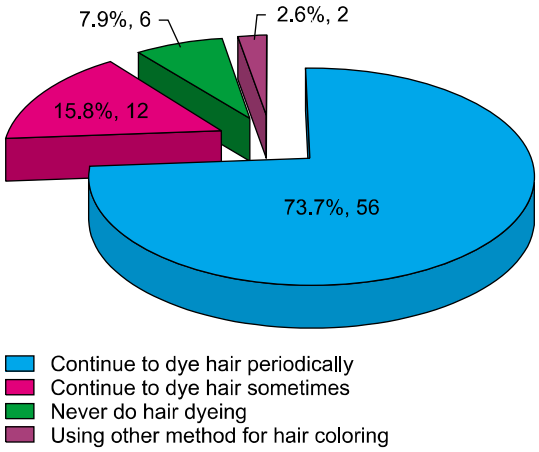



**Fig. 2.** The patterns of continuing hair dyeing despite the experience of adverse effects (n=76).

who experienced side effects and did not experience side effects, the percentage of knowing the exact hair dyeing brand name was higher in the group with side effects (39.5% vs. 23.0%), but this did not differ statistically.

## DISCUSSION

Graying of the scalp hair is an inevitable physiologic process in human aging. It is caused by the loss of the pigmented-forming melanocytes from the hair follicles, which reflects loss of the melanocyte stem cell population in the aging hair follicles[1,3,4].

We surveyed clinical findings of gray hair. Forty to 49 years of age was the most frequent onset age of gray hair (194 out of 500 people). In the focal distribution of gray hair, the frontal area and temporal area revealed the high distribution. However, as this result was a personal report rather than the objective assessment, it suggests that the site of focal distribution that was visible to the subjects was the most commonly reported.

In current culture, the desire to look younger and the interest in beauty are widespread. Hair color has an important role in this. Many people do not want graying hair and they seek hair dyeing products to cover it. This is supported by our survey responses that most subjects said they dye their hair to look younger. Numerous hair dye products are being produced and sold according to such social needs. However, even though 68 types of commercially available hair dye products were arranged for them to choose in this survey, large number of the people who had experience with hair dye (233 out of 319 people, 73.0%) did not know which hair dye product they were using. Even if they experienced side effects due to hair dyeing, many people did not know exact brand name.

The results reflect that many people did not have great interest about the type of hair dye used.

Hair dyeing products can cause various adverse effects, including allergic contact dermatitis[5,6]. Additionally, an association with cancer and other systemic disease has also been suggested[7-14]. Among the composition of hair dye, para-phenylenediamine, m-aminophenol, p-methyl-aminophenol and prophylenglycol are known as the primary substances[15] that cause allergic contact dermatitis, but it is not easy to determine the other substances that cause side effects as many different types of products contain various additives such as henna or squid ink color[16-21]. In most previous studies, the prevalence of the side effects due to hair dye has been obtained through patch testing with para-phenylenediamine. However, the prevalence of positive patch test result is not equivalent to prevalence of hair dye allergy[22]. The prevalence of the side effects from hair dye has not been established in Korean people. In this study, the prevalence of the side effects due to hair dye is 23.8% (76 out of 319 people). The result that 47.2% (26 out of 55) people experienced side effects even after they changed the product suggests that the mild symptoms induced by hair dyeing, such as a tingling sensation of the eye and pruritus, may be under-recognized. Despite the experience of side effects, most (68 of 76 people, 89.5%) continue hair dyeing. Furthermore, a small portion of the subjects (20 out of 76 people) who experienced side effects visited the hospital for treatment. People do not realize typically the seriousness of the side effects or the need for treatment. Also, even if the patients recognize the side effects, they considering them normal symptoms that can appear with dyeing rather than recognizing them as adverse effects, and these are results in the people continuing to dye their hair because there are no other alternatives.

In this study, many people did not know the exact brand name of the hair dye product that they were using, and continued hair dyeing in spite of side effects. Also, a large portion of the people who experienced side effects of hair dyeing did not receive any treatment. The results suggest that most of the people who had experienced hair dyeing have insufficient knowledge of hair dye products. This study was conducted to determine the public's perception on hair dye products and the side effects, and as a result, it was confirmed that the level of awareness was fairly low.

Therefore, it is necessary for people to fully know the ingredients of hair coloring products and to properly use them, such as conducting a patch test for the causative agents of contact dermatitis before use, in order to decrease the side effect caused by hair coloring products. Directions and included literature of hair dye products must be improved to inform people about the ingredients, the side effects and patch test method. It is advisable to introduce a system that will enables users to become aware of the ingredients of hair coloring products and the side effects of hair coloring products. We should give broad opportunities for users to become aware of the side effects of hair coloring through education, publicity and publication of an informational booklet so that people can appropriately use hair coloring products. Additionally, for the people who experience side effects of hair dye products, a patch test for the main substances that cause contact dermatitis may be helpful to select hair dye products and to decrease the side effects of them.

## ACKNOWLEDGMENT

The authors wish to acknowledge the financial support of the Catholic Medical Center Research Foundation made in the program year of 2009.

## REFERENCES

1. Park HY, Pongpudpunth M, Lee J, Yaar M. Biology of melanocytes. In: Wolff K, Goldsmith LA, Katz SI, Gilchrest BA, Paller AS, Leffell DJ, editors. Fitzpatrick's dermatology in general medicine. 7th ed. New York: McGraw-Hill, 2008: 591-608.
2. Kim DW, Shin DJ, Lee SJ, Chung SL, Kim JC. Statistical and clinical study of gray hair. Korean J Dermatol 1999;37: 1567-1575.
3. Gibbs OS. The graying of hair. Science 1942;95:576.
4. Yaar M, Gilchrest BA. Aging of skin. In: Wolff K, Goldsmith LA, Katz SI, Gilchrest BA, Paller AS, Leffell DJ, editors. Fitzpatrick's dermatology in general medicine. 7th ed. New York: McGraw-Hil, 2008:963-973.
5. Chey WY, Kim KL, Yoo TY, Lee AY. Allergic contact dermatitis from hair dye and development of lichen simplex chronicus. Contact Dermatitis 2004;51:5-8.
6. Duarte I, Fusaro M, Lazzarini R. Etiology of para-phenylenediamine sensitization: hair dye and other products. Dermatitis 2008;19:342.
7. Mendelsohn JB, Li QZ, Ji BT, Shu XO, Yang G, Li HL, et al. Personal use of hair dye and cancer risk in a prospective cohort of Chinese women. Cancer Sci 2009;100:1088-1091.
8. Thun MJ, Altekruse SF, Namboodiri MM, Calle EE, Myers DG, Heath CW Jr. Hair dye use and risk of fatal cancers in U.S. women. J Natl Cancer Inst 1994;86:210-215.
9. Abdelraheem MB, El-Tigani MA, Hassan EG, Ali MA, Mohamed IA, Nazik AE. Acute renal failure owing to para-phenylene diamine hair dye poisoning in Sudanese children. Ann Trop Paediatr 2009;29:191-196.
10. El-Ansary EH, Ahmed ME, Clague HW. Systemic toxicity of para-phenylenediamine. Lancet 1983;1:1341.
11. Andrew AS, Schned AR, Heaney JA, Karagas MR. Bladder cancer risk and personal hair dye use. Int J Cancer 2004;

109:581-586.
12. Grodstein F, Hennekens CH, Colditz GA, Hunter DJ, Stampfer MJ. A prospective study of permanent hair dye use and hematopoietic cancer. J Natl Cancer Inst 1994;86:1466-1470.
13. Rauscher GH, Shore D, Sandler DP. Hair dye use and risk of adult acute leukemia. Am J Epidemiol 2004;160:19-25.
14. Zhang Y, Sanjose SD, Bracci PM, Morton LM, Wang R, Brennan P, et al. Personal use of hair dye and the risk of certain subtypes of non-Hodgkin lymphoma. Am J Epidemiol 2008;167:1321-1331.
15. Schwartz L, Barban C. Paraphenylenediamine hair dyes. AMA Arch Derm Syphilol 1952;66:233-239.
16. Carrascosa JM, Domingo H, Soria X, Ferrándiz C. Allergic contact dermatitis due to benzyl alcohol in a hair dye. Contact Dermatitis 2006;55:124-125.
17. Edwards EK Jr, Edwards EK. Allergic contact dermatitis to lead acetate in a hair dye. Cutis 1982;30:629-630.
18. Eskelinen A, Molitor C, Kanerva L. Allergic contact dermatitis from 2,7-dihydroxynaphthalene in hair dye. Contact Dermatitis 1997;36:312-313.
19. Dejobert Y, Piette F, Thomas P. Contact dermatitis to 2-hydroxyethylamino-5-nitroanisole and 3-nitro-p-hydroxyethyl aminophenol in a hair dye. Contact Dermatitis 2006;54: 217-218.
20. Belhadjali H, Ghannouchi N, Amri Ch, Youssef M, Amri M, Zili J. Contact dermatitis to henna used as a hair dye. Contact Dermatitis 2008;58:182.
21. Bowling JC, Scarisbrick J, Warin AP, Downs AM. Allergic contact dermatitis from trideceth-2-carboxamide monoethanolamine (MEA) in a hair dye. Contact Dermatitis 2002; 47:116-117.
22. Krasteva M, Bons B, Ryan C, Gerberick GF. Consumer allergy to oxidative hair coloring products: epidemiologic data in the literature. Dermatitis 2009;20:123-141.