



Is it safe to use hair dyes during pregnancy? An update

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Possible adverse impacts such as congenital malformations and childhood cancers of fetuses that may be caused by hair dye use during pregnancy have been debated for long years. Ames et al. found in 1975 for the first time that some hair dye contents created mutagenic impact on *Salmonella typhimurium* mutant Ta 1538 strain.^[1] Also, in many studies performed in these years, it was shown that chromosome and chromatid aberrations occurred in the mammalian cell culture exposed to hair dyes.^[2-4] Teratology studies carried out on the rats followed these studies in 1976 and 1977.

The study titled as "Teratology and percutaneous toxicity studies on hair dyes" was conducted in 1976, and the study titled as "Dominant lethal mutagenicity study on hair dyes" was conducted in 1977. In vivo effects of hair dyes which were presented to be active mutagenically by in vitro tests were investigated in these studies.^[5,6] In the first study, 12 different hair dyes were applied to 12 white New Zealand rabbits for investigating the systemic toxicity of dyes and to 20 pregnant Charles River CD rats for investigating teratological effects on 1, 4, 7, 10, 13, 16 and 19 days of gestation. Hair dyes were applied topically 2 times a week for 13 weeks as described.^[4] Three of hair dyes were applied directly and other 9 of them were applied in the rate of 1:1 as usual by mixing with 6% hydrogen peroxide just before the use. In the teratology study, it was observed that a no change occurred in any significant soft tissue or skeletal system. In the percutaneous toxicity study, 25 tissue samples taken from each subject were analyzed

and no histomorphological change was observed. Also urine samples were analyzed and no staining was observed in the urine. In the dominant lethal mutagenicity study, 11 different types of hair dye were applied intraperitoneally to male Charles River CD rats 3 times a week for 8 weeks in 20 mg/kg doses.^[6] Then, within 2 weeks, they were copulated with female rats.^[6] At the end of this study, no increase was seen in fetal loss after implantation.

These studies were followed by many other studies carried out on animals. In the study of Picciano et al. carried out in 1983 and 1984, analyzed 4-chlororesorcinol, m-phenylenediamine, pyrogallol, 6-chloro-4-nitro-2-aminophenol, o-chloro-paraphenylen-diamine and N-phenyl-paraphenylen-diamine were analyzed teratologically and no embryotoxic/fetal toxic impact was found.^[7,8] The dose and frequency of hair dye applied in these studies are incredibly higher than the dose of hair dye applied in human topically once a month. However, based on the animal studies, it may be an assertive approach to a degree claiming that hair dyes have no teratogenic impact in human pregnancy. Prospectively investigating the potential teratogenic impact of hair dyes on human may cause some ethic problems.

Therefore, in order to investigate the fetal impacts of exposure to hair dye, case-controlled retrospective studies based on interview method were conducted. In order to shed some light on this matter, reproductive results of hairdressers were analyzed as the profession group which expose to the hair dyes most. In 2002, Rylander et

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al. followed up 3706 hairdressers, who were living in Sweden, for 25 years (1973-1994) and compared their 6960 babies with 3462 women and their 6629 babies.^[9] When compared with the control group of hairdressers, the authors found that they only delivered SGA (*small for gestational age*) babies (OR: 1.5, $p=0.004$). The term SGA used in this study was defined according to the standard table, where birth records in Sweden between 1985 and 1989 were investigated and birth weights were reported according to the weeks of gestation, and it was used to describe the fetuses with intrauterine growth restriction. Also the newborns with low birth weights (< 2500 g) and preterm labor rates (<37 weeks) were compared between the groups. While there was no difference between the groups in terms of preterm labor rates, the incidence of the babies with low birth weight in hairdresser group was higher although it was not statistically significant (4.5% vs. 4.1%, OR:1.2, 95% CI: 1.0-1.05, $p>0.05$). It was reported that major malformations were observed more in the babies of hairdressers (2.8% vs. 2.1%, OR:1.3, $p=0.01$). However, no major anomaly was found specific to the case group. Although the risk to deliver SGA baby was higher in the group which had perm and hair spray more, this difference was not statistically significant. By this study, it is brought to the mind that hair dye may cause fetal impacts not only by being absorbed through the scalp and hair cuticle but also inhalation. Therefore, many respected authorities recommend following precautions when dyeing hairs: If possible, it should be waited for the second trimester for dyeing hair; it should be done in a well-ventilated environment; if individual applies the hair, then she should use gloves; the dye should not be kept too long in the hair, and the hair should be rinsed well after dyeing. Also, it is recommended to use rather semi-permanent dyes or balayage-type superficial chemicals or henna which is completely herbal.^[10,11]

It has been proved that many substances in the hair dyes may pass to the systemic circulation from the skin in human and may exhibit carcinogen effects in laboratory animals.^[12-14] With the warnings by US Food and Drug Administration (FDA), 4-chloro-m-phenylenediamine, 2,4-toluenediamine, 2-nitro-p-phenylenediamine, 4-amino-2-nitrophenol (4-MMPD) were removed from the hair dyes especially after 1980s.^[15] Being effective as of December 1st, 2006, the European Union banned to use 22 chemical substances to use in

hair dyes. Hair dyes used today and the chemical substances included are shown in **Table 1**. The contents of hair dyes vary according to the dye type (**Table 1**).

The effects of temporary and semi-permanent dyes on hair are different than the effects of permanent dyes. The coloring molecule in temporary and semi-permanent dyes deposits on hair cuticle while it penetrates into the cortex of hair shaft in permanent dyes. Permanent hair dyes require to be used with an auxiliary substance such as hydrogen peroxide in order to reach the cortex. Hydrogen peroxide causes hair cuticle to expand, disrupts natural melanine pigment of the hair and enables dye to reach the cortex and causes pigmentation by oxidation.^[16] Therefore, oxidative damage occurring in hair is quite distinct in permanent dyes. The damage is higher especially when dark color (dark brown, black) hair dyes are used. As the indication of oxidative damage, scientific evidences have been seen reporting that the incidence of malignancies such as bladder cancer, breast cancer, some brain tumors and lymphoma increases in adults by using dark color hair dyes.^[16,17] The studies carried out on this matter are generally based on hospital records or patient interviews. On the other hand, these are the retrospective studies conducted on small populations. Therefore, no strong evidences are presented by study results sufficient to establish cause and effect relationship. The strongest evidence between hair dye use and malignancy was particularly found for the follicular sub-type of non-Hodgkin lymphoma (NHL). This risk especially becomes clear when the period for using dark color dyes increase (>15 years).^[18] Thus, it is recommended to those who personally have NHL history or who

Table 1. Hair dyes and chemical substances included.^[15]

Temporary dye	Azine derivatives Thiazine derivatives Indo amines Triphenylmethane Nitroanilines
Semi-permanent dye	Nitroanilines Nitrophenylenediamines Azo derivatives Anthraquinone
Permanent dye	Para-phenylenediamide Para-toluylenediamine Modified para-diamines Ortho- or para-aminophenol

have first degree relative with NHL history to be careful since using hair dye increases the cumulative risk. On the other hand, it is also recommended to apply petroleum-based cream to scalp before dye application and to reduce the period for keeping dye on hair about 25% in order to decrease the absorption of the hair dye.^[15] However, there has been no study carried out on the effects of such recommendations for decreasing NHL incidence.

After presenting the relationship between hair dyes and malignancy risk in adults, it has been investigated if there are any carcinogen effects during adulthood in terms of fetus when hair dyes are used during pregnancy. The studies carried out on this matter are the retrospective case-controlled studies and it has been presented in three out of four studies that there is an association between maternal hair dye use and childhood cancers. In the study of McCall et al. carried out in 2005, it was shown that there is a relationship between maternal hair dye use and neuroblastomas seen during childhood period. The authors showed that using hair dye during pregnancy including one month before the pregnancy has increased the neuroblastoma risk during childhood period (OR 1.6, 95% CI: 1.2–2.22).^[19] In another study, it was reported that the incidence rate for brain tumors increased in the children of women who used hair dyes manufactured after 1980.^[20] The authors in this study asserted that women should stay away hair dyes during pregnancy period due to the possible carcinogenic effects on fetus. Finally, Chen et al. reported in their case-controlled study that the incidence rate of tumors in male children of women who start to use hair dye one month before pregnancy increases, and hair dye use continued during breast-feeding increases the incidence rate of germ cell tumors in female children (OR 1.5, 95% CI:1.0–2.2).^[21] In their case-controlled study carried out in 1994, Bunin et al. found no relationship between maternal hair dye use and astrocytic glioma and primitive neuroectodermal brain tumors during childhood.^[22]

In brief, even though cause and effect relation has not been revealed clearly between hair dye use during pregnancy and childhood tumors, it is recommended in obstetric practice to share current scientific data with pregnant women.^[15]

Throughout the history, the hair has been considered as the symbol of beauty, attraction and femininity.

Particularly during recent years, the desire to keep the youngness for a long time has gained importance among the societies. On the other hand, maternal age has increased gradually due to widespread career-centered life styles of women. According to the studies, the rate of using hair dyes in women varies between 66 and 74%.^[23] Therefore, it is evident that the number of women who desire to dye their hairs during pregnancy will increase.

In light of the data provided above, it seems that the reliability of using hair dye during pregnancy has still been controversial in terms of both teratological and carcinogenic effects, and it will be a rational approach to recommend avoiding frequent and long applications as much as possible.

Conflicts of Interest: No conflicts declared.

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