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PREDICTORS OF BREAST CANCER RISK AMONG HAIR DYE USERS AT EL-MANIAL UNIVERSITY HOSPITAL, CAIRO UNIVERSITY, EGYPT

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ABSTRACT

Breast cancer is the most common cause of cancer related deaths among women worldwide. Concern has been highlighted by many authors that mutagenic substances and carcinogens were found in hair dye products. So the use of hair dyes may increase the risk of breast cancer. Therefore, the aim of the current study is to determine whether the use of hair dyes is associated with the risk of breast cancer. A descriptive correlational design was adopted in this study and a structured questionnaire was developed by the researchers to collect the data related to patients' characteristics, such as; age, level of education, health status and nature of hair dyes. Data was obtained from 250 patients at El- Manial University Hospital, Cairo University. The study findings revealed that (64.1%) of patients age ranged between 26- 36 years with Mean ± SD (36.8560 ± 8.24836). After adjusting the confounding variables such as age, family history and level of education, the study showed a positive association between using hair dyes and breast cancer. The risk of breast cancer increased with using semi-permanent as compared to permanent type (OR: 1.480, 95% CI 0.896 - 2.443). The risk increased with using a dark color of hair dyes (OR: 1.312, 95% CI 0.708 - 2.429). Therefore, Patients should be instructed to use natural substances such as henna and other suggested alternatives to color hair, instead of using chemical substances.

INTRODUCTION

The use of hair dyes can be dated back around 4000 years. In this respect, researchers analyzed the hair of Ramses II in Egypt and discovered that the use of henna to color the hair was common among the Pharaohs (Klimczak, 2016). Also using vinegar to darken graying hair was found in combs in the days of Roman Empire. In the end of 19th century, Oxidative hair dyes were introduced for coloring human hair. In the 1970 and 1980's, many types of hair dyes were introduced to the public (International Agency for Research on Cancer, 2010).

Hair dyes are divided into three types according to their color fastness. The first two types are temporary and semi-permanent hair dyes and are non-oxidative (non-permanent), do not penetrate into the hair shaft and lasts for 5 to 10 shampoos. The third type is permanent; oxidative hair dyes and are most commonly used worldwide (National Cancer Institute, 2017). Also, this type contains colorless substances such as aromatic amines (intermediates) and phenol. Whenever, adding hydrogen peroxide to the previous substances, chemical reactions happened to form the dye and cause chemical changes that lead to damage in the hair shaft and change its color until the hair is replaced by new growth. In addition, several studies reported that aromatic amines are strongly mutagenic and elevated levels of DNA-adducts of these amines have been detected from breast ductal epithelial cells of hair dye users (Turesky *et al.*, 2003; Baan *et al.*, 2008; Heikkinen *et al.*, 2015).

In relation to the color of hair dyes, Clausen *et al.*, (2006) were carried out study and showed that the use of dark-colored dyes (black, dark-brown) needs a higher concentration of intermediates and oxidative agents which accentuated the damage to the hair. A recent study conducted by (Llanos *et al.*, 2107) reported that the use of dark hair dye was associated with increase breast cancer risk. Other study conducted by

(Zhenga *et al.*, 2002) reported no significant association between breast cancer and other factors related to using hair dyes such as age at first use, duration of use and a total number of applications. The European Commission (2014) highlighted that 60% of women and 5–10% of men in Europe use hair dyes on an average of six to eight times per year. The use of hair dyes and its possible risk of breast cancer have been investigated in many countries from time to time; however, still the associations between the concerned variables yielding equivocal findings.

The association between using hair dyes and breast cancer has been explored in many meta-analysis studies such as study conducted by (Takkouche, *et.al*, 2005) reported no significant association between female breast cancer and any hair dye users. Other study conducted by (Green *et al.*, 1987; Zheng *et al.*, 2002; Bolt & Golka, 2007; Mendelsohn *et al.*, 2009) found no association between hair dye use and breast cancer risk. In contrary to those studies, a study carried out by (Ambrosone *et.al,* 2007) highlighted the positive association between the presence of carcinogenic adducts and using light colored hair dye. Another study conducted in USA by (Cook *et.al,* 1999) reported that among women who used hair coloring products, there was an association with a 30% borderline significantly increased risk of breast cancer as ever use of any hair coloring products was associated with a twofold increased risk and three fold among those who had a total number application of more than 90 episodes. However, still the results are inconclusive about the association between breast cancer and using hair dyes.

Considering the risk factors of breast cancer such as age, analysis by (Nasca *et al.*, 1980) revealed a significant association between hair dye use and breast cancer among women 40–49 years of age. Also Shore *et al.*, (1979) found a positive association between hair dye use and breast cancer was greatest among women over 50 years of age and. Regarding the family history, (Nasca *et al.*,1980) highlighted a statistically significant association between women with a history of benign breast cancer and use of hair dyes. In-addition, Saitta *et al.*, (2013) found that patients with a first-degree family history of cancer should be cautious in using hair dye because there may be a cumulative risk.

It has been observed in breast cancer cases admitted to El Manial University Hospital that most of the women were using hair dyes. In Egypt, few studies were conducted to determine whether the use of hair dyes is associated with the risk of breast cancer. Nurses working at surgical units have repeated frequent contact with breast cancer patients. So, in collaboration with the multidisciplinary team, nurses are in a strategic position to assess the association between breast cancer and chemical exposure such as hair dyes and help patients to develop strategies to manage its effects. This could be achieved through providing adequate information on breast cancer risk and how to use hair dyes safely and other alternatives. Therefore, the aim of the current study is to determine whether the use of hair dyes is associated with the risk of breast cancer.

The researchers carried out this study to alert the nursing professionals working in surgical units to educate patients to use natural substances such as henna. This research could provide health care providers with an in depth understanding related to this risk of breast cancer and how to minimize chemical exposure that could be reflected positively on patients care, decrease incidence of breast cancer and economic issues. It can be assumed that the findings of this study might establish evidence based data that can promote nursing practice and research as well. Moreover, this effort will generate attention and motivation for further nursing researches in this area.

Research hypothesis

H: Use of hair dyes may lead to breast cancer.

Subject and Methods

Research Design:

A descriptive correlation design was utilized to conduct the current study. The purpose of this design gives an indication of how use of hair dyes may predict breast cancer in the form of correlation without establishing causation of the research findings (Wood & Habber, 2015).

Setting:

The institution from which patients were recruited was breast surgery unit at El-Manial University Hospital, Cairo University. This unit aims to provide care for breast surgery patients to meet the highest international standards.

Sample:

A convenience sample consisting of 250 patients with breast cancer, representing patients accepted to participate in the current study. The inclusion criteria are age above 26 years, only female with breast cancer and the exclusion criteria includes patients using hair dyes less than 5 times and patients with impaired memory or cognitive functions were also excluded.

Data collection:

Face-to-face interview was done to collect socio-demographic data covering items related to age, level of education, occupation, marital status, residence and income. Also health assessment questionnaires were developed by the researchers and elicited information related to family history of and diagnosis of breast cancer either benign or malignant. In-addition, modified questionnaire of National Cancer Institute based on research conducted on hair dyes use and risk of cancer (Zheng *et al.*, 2002). It suggests that women generally are able to estimate the number of hair dyes application during life, age at first use, color of dyes (dark or light) as well as types of hair dyes used. Age at first dye used was categorized as: Under 25 years, 26-40years and 40 years or older. The different dye types were classified as: 'Semi-permanent' a color that removed after several washes, 'Permanent' a color that does not removed by wash and still until the hair replaced by new growth. The color of hair is categorized as light (blond, brown) and dark (brown, black).The number of application of hair dyes is divided into 2 categories as: less than 20 and more than 20 times in life.

Validity & Reliability of the tools

To ensure objectivity and clarity of the study tool a pilot study was conducted on 10% of the patients and necessary modifications were done. Content validity of the designed tool was reviewed by a panel of five experts in the field of medical surgical nursing, surgery and pharmacology.

Ethical Consideration

A written permission was obtained from the head of the department of surgery. Individual participation in the study was voluntary. The benefits and the purpose of the study were explained for each patient. Also informed consent was reviewed with all patients prior to the interview and signed accordingly. Confidentiality was assured by keeping privacy of patients' information.

Data Analysis

Collected data was analyzed using statistical package for the social science (SPSS) program, version 24. A descriptive statistics such as frequency, percentage, mean, standard deviation and range were utilized. Inferential statistics such as logistic regression analysis was carried out to estimate the association between breast cancer and using hair dyes and to eliminate the effect of confounding variables such as age, level of education, and family history of breast cancer. After adjusting the confounding variables, Odds ratios (OR) with 95% confidence intervals (CI) were reported. Also the (*P*-value) was calculated accordingly.

RESULTS

Table1: Frequency and percentage distribution of the patients' characteristics (N=250)

Variables	No	%
Age of participant :		
26-36	161	64.4
37-47	88	35.2
48-58	1	0.4
More than 58	0	0
Mean±SD 36.8560 ± 8.24836		
Marital status		
Single	148	59.2
Married	52	20.8
Divorced	50	20
Level of education		
Cannot read or write	14	5.6
Primary-preparatory	113	45.2
Secondary and above	123	49.2
Income		
Adequate	141	56.4
Inadequate	109	43.6
Occupation		
Employed	136	54.4
Unemployed	114	45.6
Place of residence		
Cairo	102	40.8
Outside Cairo	148	59.2

Table 1 showed the higher percentage (64.1%) of patients age ranged between 26 - 36 years with Mean ± SD (36.8560 ± 8.24836) and around half of them (45%) their level of education was primary and secondary while (59%) of them were living outside Cairo.

Table 2: Frequency and percentage distribution of the patients' health status (No=250)

Variables	No	%
Family history		
Yes	150	60
No	100	40
Diagnosis		
Benign	136	54.4
Malignant	114	45.6

Table 2 illustrated that the highest percentage (60%) of patients having family history of breast cancer. Also the above table showed that (54.4%) and (45.6%) of patients were diagnosed as benign and malignant breast cancer respectively.

Table 3: Association between characteristics of hair dyes use and breast cancer risk

Variables		Benign NO = 136	Malignant NO = 114	*P* Value	OR	95% CI	
						Lower	Upper
Type of Hair dyes	Permanent	80 (58.8%)	56 (49.1%)				
	Semi permanent	56 (41.2%)	58 (50.9%)	0.125	1.480	0.896	2.443
Years of using hair dyes	< 9 years	90 (66.2%)	59 (51.8%)				
	≥ 9 years	46 (33.8%)	55 (48.2%)	0.021*	1.824	1.094	3.040
Color of dyes	Light (blonde, light brown)	112 (82.4%)	87 (76.3%)				
	Dark (brown, black)	24 (17.6%)	27 (23.7%)	0.238	1.448	0.781	2.684
Number of Application (During life)	< 20	97 (71.3%)	66 (57.9%)				
	≥ 20	39 (28.7%)	48 (42.1%)	0.026*	1.809	1.069	3.060
Age at 1st Use	Mean±SD	32.60± 8.51	31.48 ± 8.50				
	Range	21 – 45	21 – 54	0.304	0.985	0.956	1.014

*OR: Odds ratios; CI: confidence interval; * Significant at P < 0.05*

Table 3 revealed positive association between types of hair dye and diagnosis of breast cancer as increase risk was apparent in semi-permanent as compared with permanent users (OR: 1.480, 95% CI 0.896 - 2.443).Also excess risks of breast cancer were apparent in with patients using hair dyes more than 9 years (OR : 1.824,95%CI 1.094 - 3.040). Also color of hair dyes and number of application were positively associated with breast cancer (OR : 1.448,CI 95% 0.781- 2.684).Also patients using hair dyes more than 20 times developed a higher risk of breast cancer than those who use it less than 20 times(OR:1.809, 95%CI 1.069-3.060) and *P* value (0.021) .

Table 4: Association of hair dyes use and breast cancer risk

		Permanent NO = 136	Semi permanent NO = 114	*P*-value	OR	95% CI	
						Lower	Upper
Ye2ars of using hair dyes	< 9 years	110 (80.9%)	39 (34.2%)	0.000			
	≥ 9 years	26 (19.1%)	75 (65.8%)		0.123	0.069	0.219
Color of dyes	Light (blonde, light brown)	111 (81.6%)	88 (77.2%)	0.387			
	Dark (brown, black)	25 (18.4%)	26 (22.8%)		1.312	0.708	2.429
Number of Application (During life)	< 20	99 (72.8%)	64 (56.1%)	0.006			
	≥ 20	37 (27.2%)	50 (43.9%)		0.478	0.282	0.812
Age at 1st Use	Mean ± SD	31.96 ± 8.30	32.24 ± 8.78	0.801			
	Range	22 – 54	21 – 44		0.996	0.967	1.026

*OR: Odds ratios; CI: confidence interval; * Significant at P < 0.05*

Table 4 showed that the risk increased with using dark color of hair dyes with those used permanent and semi-permanent hair dyes (OR: 1.312, 95% CI 0.708 - 2.429). Also the same table revealed no excess risks were observed with number of application and age at first use (OR: 0.478, 95%CI 0.282-0.812 and OR: 0.996, 95% CI 0.967-1.026) respectively.

Table 5: Association of hair dyes use and breast cancer risk

Variables		Dark NO = 51	Light NO = 199	*P*-value	OR	95% CI	
						Lower	Upper
Years of using hair dyes	< 9 years	37 (72.5%)	112 (56.3%)	0.035			
	≥ 9 years	14 (27.5%)	87 (43.7%)		0.487	0.248	0.957
Number of Application (During life)	< 20	38 (74.5%)	125 (62.8%)	0.118			
	≥ 20	13 (25.5%)	74 (37.2%)		0.578	0.289	1.155
Age at 1st Use	Mean ± SD	28.65 ± 8.06	32.97 ± 8.41	0.001			
	Range	21 – 54)	22 – 45		0.937	0.899	0.975

*OR: Odds ratios; CI: confidence interval; * Significant at P < 0.05*

Table 5 revealed that no excess risks of breast cancer were observed with years of using hair dyes, number of application and age at first use.

DISCUSSION

Over the past several years, concern has been raised in a number of studies that the potential risks associated with using hair dyes and development of breast cancer. In 2013, statistical figures in Egypt showed that breast represents 37% of all females' cancer Ismail, Abdel-Hamid & Abdel-Naby, 2013. This could be due to lack of patient's awareness regarding the risk factors of breast cancer such as chemical exposure and in this study the researchers are concerned with breast cancer patients who were using hair dyes. In Egypt, few researches were conducted to evaluate the association between using hair dyes and breast cancer risk .Therefore, it was important to carry out the current study. The findings of the current study showed that overall association was found between using hair dyes and breast cancer risk. This findings supported by (Cook *et al.*, 1999; Ambrosome *et al.*, 2007 & Heikkinen *et al.*, 2015) as they mentioned in their study that the use of hair dyes is associated with breast cancer incidence. The impact on public health may be substantial due to vast popularity of hair coloring in modern societies In-contrary a meta-analysis study conducted by (Tkkouche *et al.*, 2005) reported a contradicting result with the present study as the researchers concluded that the reviewed data from 14 studies on female breast cancer and hair dye use published between 1977 and 2002 found that hair dye users had no increase the risk of breast cancer compared with nonusers. Research on hair dye use and the risks of other cancers is more limited. Although some studies have shown associations between hair dye use and the risk of developing or dying from specific cancers, these associations had not been observed in other studies. Because of differences in the study design, it has not been possible to pool the findings of most cancer types in order to increase the power to detect associations with hair dye use. In addition, Zheng *et al.*, (2002) & Mendelsohn *et al.*, (2009) concluded no strong evidence of an association between hair dye use and risk of breast cancer. Moreover the association between hair dye and breast cancer was explored in the meta-analysis by (Saitta *et al.*, 2013) data pooled from 12 case-controlled studies and two cohort studies did not reveal a significant association between female breast cancer and any hair-dye users.

Regarding to the types of hair dyes, the present study found that increase risk was apparent in patients using semi-permanent hair dyes. This findings is consistent with (Zheng *et al.*, 2002) concluded that odds ratios were increased among patients using semi-permanent hair dyes. While Heikkinen *et al.*, (2015) indicated that increase risk of breast cancer among women using different types of hair dyes such as temporary, semi-permanent and permanent as compared to non users. This finding is incongruent with other studies conducted by Green *et al.*, 1987; Tkkouche *et al.*, 2005; Mendelsohn, 2009 and stated no association between using different types of hair dyes and breast cancer risks. Most interestingly, temporary and semi-permanent dyes seemed to have greatest impact in the risk of breast cancer. It has been also depicted that permanent hair dyes containing higher concentrations of intermediates and oxidative agents have previously been thought to possess the most potentially hazardous effects. Nevertheless, many of the modern semi-permanent dyes contain a peroxidizing agent and may thus be considered to act as permanent dyes with lower concentrations of oxidative agent. Also, semi-permanent colors may contain potentially carcinogenic substances, as many of them contain colorless substances that after cleavage may lead to the release of aromatic amines. In the present study, we excluded the temporary hair dyes from the data analysis because no patients reported using it.

In examining the variable related to the color either dark or light dyes, the current study estimates that using dark dye (dark brown, black) was associated with increased risk of breast cancer. This is similar to other study that was carried out on African American and White women and highlighted that the use of darker shades (dark brown and black) was associated with increased risk of breast cancer among women (Llanos *et al.*, 2017). In this regards, Bolt & Golka, (2007) cited that long-term use of dark color has been associated with increased cancer risk in a few studies. However, these studies have had limited power due to the low prevalence of long-term exposure to dark color of hair dyes.

As regards the duration of using hair dyes, the present study found no association between years of using hair dyes and risk of cancer. This findings is

supported by (Zheng *et al.*, 2002) who concluded no association between using hair dyes and increased risk of breast cancer. Moreover, Saitta *et al.*, (2013) added that with more than 200 lifetime exposures to hair dye was not associated with an increased risk of breast cancer.

Also the study conducted by (Wynder & Goodman, 1983; Bolt & Golka, 2007) found no association between using hair dye and increased risk of cancer. Based on the vast majority of studies toward the cancer risk of hair dye product, consumers can feel more confident of the safety of today's hair dye formulations. While the New York Post (2017) cited that Professor Kefah Mokbel, a breast cancer surgeon at the Princess Grace Hospital in London, reviewed studies on whether there is a link between hair dyes and breast cancer and found a fourteen percent increase in the disease among women who color their hair.

Since the safety of hair products has been debated for years many people regularly dye their hair, either through a professional hairdresser or at home, concerns have been raised regarding potential side effects from the chemical substances present in the product hair dyes, accordingly, the International Agency for Research on Cancer 2010 cited that hair coloring include the use of chemicals capable of removing, replacing, and/or covering up pigments naturally found inside the hair shaft, also use of these chemicals can result in a range of adverse effects, including temporary skin irritation and allergy, hair damage, skin discoloration and unexpected hair color results. In addition, in vitro and in vivo studies (in exposed human populations) have shown that some hair dyes and many chemicals used in the hair dyeing process can be considered mutagenic and carcinogenic. So, it is suggested by the researchers of the current study to use natural substances to color the hair instead of using product that contains chemical substances which cause complications and hazards to the skin. A variety of natural hair coloring can be simply made at home and alternative herbs can be used such as henna. In addition, the patients instructed to promote a certain color through using black tea leaves and hibiscus flowers as a natural method to color the hair. Furthermore, the pomegranate peel mixed with black tea can be used as a hair spray to promote the original hair color with no need to change it.

CONCLUSION AND RECOMMENDATION

Overall the findings of this study found a positive association between using hair dyes and breast cancer risk. With increasing the use of hair dyes day by day among male and female worldwide, so spreading awareness is necessary towards the potential effects of exposures to chemical ingredients and natural alternatives of hair dyes that can be used safely by any individual. Studying something like hair dyes can be even more complex because not all hair dyes are the similar and thousands of different chemicals substances are included. On top of this, the ingredients in hair dyes have changed over the years.

- To support the study findings, the current study needs to be replicated with large sample size in different settings.
- Pregnant women should be advised by nurses to avoid using hair dyes during pregnancy
- A multidisciplinary team in collaboration with Food and Drug Administration should develop guidelines and to be followed if any cosmetics are found to be harmful especially in developing countries.
- Certain precaution and warning signs inside the hair dye package should be explained to all users such as protecting skin by wearing gloves and shampoo scalp skin thoroughly with water.

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