

Effects of Holi colours in children's eyes: A cross sectional observational study**Bivas Bala^{1*}, Soumi Kanji², Viswanath Pratap³**¹*Assistant Professor, Dept. of Ophthalmology, RG Kar Medical College, Kolkata, West Bengal, India*²*Resident, Dept. of Ophthalmology, RG Kar Medical College, Kolkata, West Bengal, India*³*Resident, Dept. of Ophthalmology, RG Kar Medical College, Kolkata, West Bengal, India***Received: 09-09-2021 / Revised: 15-10-2021 / Accepted: 14-11-2021****Abstract**

Purpose: To determine the ocular surface toxicity due to Holi colors in paediatric population and to differentiate the toxic effects of organic Holi colors and chemical Holi colors on ocular surface. **Methods:** It was a prospective cross-sectional study, conducted over a period of 3 years done at a government medical college in Kolkata. Children between 5-15 years with history of chemical ocular injury due to holi colors were included as study population. Patient were divided into two groups according to nature of colours; chemical colours group and organic colours group. After taking meticulous history a comprehensive ophthalmological examination was done in each case including slit lamp biomicroscopy and fluorescein staining of ocular surface. Symptom and signs were recorded in an organized manner and compare about the nature and extent of ocular surface toxicity. **Results:** 76 eyes of 51 patients were included in this study. Boys were commonly affected than girls (63:37). Visual acuity did not affect much, 90.6% study population had a visual acuity of 6/18 or better during their initial presentation. Foreign body sensation was the commonest presenting symptom in both group and it was more commonly observed in chemical colour group (P=.0007). Others commonly observed symptom such as ocular pain, redness and watering did not show any statistically significant difference between the two groups. Conjunctival congestion was the most commonly observed clinical findings in this study. 65.2% child of chemical colour group and 40% child of organic colour group had this sign on presentation (P=.030). Other clinical sign such as conjunctival chemosis, stained conjunctiva, punctate epithelial erosion of cornea or large epithelial erosion observed in both groups and no statically significance observed here. No cases of corneal stromal involvement or anterior chamber involvement detected in any of the study population.

Keywords: Holi, Organic holi colour, Chemical holi colour.

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Introduction

Holi is a popular Hindu festival also known as "Festival of colors". This festival is originated and predominantly celebrated in India but has also spread to other regions of Asia and parts of Western World. During this festival people smear each other with colors and drench other. Water guns and water filled balloons are also used to play and color each other.

Health hazards from holi colours is a very common recurring health problem annually. The main component of holi colours are starch or flour. But synthetic holi colours often contains toxic malachite green, rhodamine, gentian violet and auramine O, proven by High performance liquid chromatography [1]. Other common adulterants include lead oxide, copper sulphate, mercury sulphate, chromium iodide, silica, mica dust etc. to impart attractive colours to carrier substances. Even fungal contamination of such powders has been proven [2]. Colors causes direct toxic effects and induced local inflammation and leads to toxicity from corneal epithelium or anterior stroma [2]. There is rampant availability of low-cost adulterated colors and essences during this festive season and very few marketed color packets have proper warning.

Unfortunately, there is lack of awareness regarding the dangers caused by adulterated compounds & no steps have been taken in India to control this issue. In ancient period organic Holi colors are made of mainly plant based products such as flower petals, fruits and leaves and these colors even can be made at home. Today a lot of colours in the market claim its organic in nature but in reality, it also contains artificial pigment to increase its shine [3]. This colours available in the market as so called herbal colour. This herbal colours are made in India as small-scale industries. It is available in Indian market during the time of holi without regulatory body surveillance. The content of this herbal colour not tested properly nor it is written over the packet of the colour. This type of herbal colour contains harmful lead and endotoxin. In one recent study at Kolkata, it was observed presence of lead twice and endotoxin 35 times more than approved permissible limit by FDA for dermatological cosmetics [4]. So, there is serious doubt about the organic colour available in the market about its purity regarding its organic nature.

There are few studies done in past about the ocular effects of holi colours upon exposure during the time of holi. It shows holi colors can cause ocular surface toxicity and patients can present with foreign body sensation, ocular pain, redness, watering [5]. Holi colors may cause chemical conjunctivitis, subconjunctival haemorrhage, conjunctival staining, corneal erosion, punctate epithelial erosion and corneal ulcer [6].

Holi colours related chemical conjunctivitis commonly affected young adults [7]. Children also participate in this colorful festival with great enthusiasm. They are very little concern about their ocular safety during participation and easily affected chemical injury by holi colours. Ocular hazards due to Holi colors specially in paediatric population are not well recognized or highlighted anywhere in literature. Also, there is little knowledge about effects of organic holi

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colours on ocular surface after exposure during the time of holi. This attracts us to do this study.

We report here a total of 51 children of paediatric age group from Eastern India who suffered from chemical ocular injury after exposure to holi colors in their eyes. The objective is to observe the pattern of the ocular surface toxicity due to Holi colors in a group of children and to differentiate any difference between the toxic effects of organic Holi colors and chemical Holi colors on ocular.

Methods

This was a prospective cross sectional observational study that has been conducted at Eye department of R G Kar medical college & hospital, Kolkata, India one of the largest tertiary care government medical college in West Bengal. Patients of both sexes aged between 5-15 years who came to Eye emergency room and eye out patient department on the of holi and next two days with complaints of chemical injury of eye due to Holi colors of both organic and chemical colours during the time of holi festivals in the year 2019-2021 comprised the study population. We are strictly following the Helsinki declaration while conducting this study. This study was approved by Institutional Ethics Committee.

Inclusion criteria

1. Patient attending Eye ER and OPD with history of having chemical injury to the eye due to Holi colors attending Eye ER and OPD.
2. Patients aged 5-15 years
3. Bilateral ocular affection.

Exclusion criteria

1. Age of patients below 5 years or above 15 years.
 2. Patients who have pre-existing ocular disease.
 3. Patients who have any other type of ocular injury.
 4. Patients who will not give consent to be the part of this study.
- After getting written informed consent from guardian from each patient, we had examined all the consenting children who came to Eye emergency room or eye OPD during the time of holi following chemical injury of due to holi colors. We also did a follow up eye examination for those patients, who came to Eye OPD for further checkup till 15 days after chemical injury.
- Nature of the examination was explained to the both patients and their guardians. We had collected demographic data such as name, age, sex, residential address, educational status of children from their accompanying guardian. Then we record history about ocular exposure by holi colours, especially nature of holi colours, how to happen, primary treatment specially irrigation with water and time

interval between primary treatment and ocular exposure by holi colours. The patient's visual acuity at presentation was recorded in a Snellen's chart. A detailed history was taken, type of color, whether rubbed at face or thrown, hours since exposure was asked.

Then we had recorded about patient current symptoms, which force them to seek medical attention. We asked questionnaires about presence of FB sensation, redness, ocular pain and about watering from the affected eyes.

Visual acuity of each eye was recorded separately with the help of a pin hole in an illuminated Snellen chart.

First the adnexal structure and anterior segment were examined by slit lamp biomicroscopy by diffuse illumination. During that time, we were given special emphasis to look for the presence of conjunctival congestion, chemosis and conjunctival staining. We were using direct focal illumination for examination of cornea to look for epithelial erosion, corneal stroma and endothelium. Then examination of anterior chamber, iris and anterior surface of lens was done to screen any abnormality related to colour induced chemical conjunctivitis. Special emphasis was given to exclude corneal limbal stem cell injury. One drop of 0.5% proparacaine hydrochloride eye drops put on the affected eye and stain the ocular surface with fluorescein strip. After that using cobalt blue filter we examine conjunctival and corneal epithelium in a slit lamp with high magnification for presence any epithelial defect specially at cornea like punctate epithelial erosion or large corneal erosion. Intra-ocular pressure was measured by non-contact tonometer and it was tested in both eyes irrespective of involvement. Then affected eye was dilated with a combination of 0.8 % tropicamide and 5% phenyl epinephrine eye drops (Tropicacyl Plus Eye Drops, Sunways India Pvt Ltd) and fundus examination done by slit lamp biomicroscopy with 90D lens and by indirect ophthalmoscope with a 20 D lens. All the data recorded in a pre-designed format by one of the authors and then compiled in a Microsoft excel spreadsheet. Then statistical analysis was performed with the help of GraphPad Prism version 9.1. 1 (GraphPad software Inc., San Diego; 2007) software. P value was determined by Fisher's exact test. P less than 0.05 was considered as significant.

Results and analysis

A total of 51 children whose age were between 5-15 years were examined during these three consecutive years from 2019 to 2021 with history chemical ocular injury by holi colours. We had divided them into four groups according to their age 5-7 years age group, 8-10 years, 11-13 years and 14-15 years age group (Table no 1). The average age of study population was 10.62 years (SD 3.10 and 95% CI limit 9.76-11.47).

Table 1: Distribution of study population in different age group

Age group	Number of patients		Percentage	
	Chemical color	Organic color	Chemical color	Organic color
5-7	7	3	13.72%	5.88%
8-10	11	5	21.56%	9.80%
11-13	9	5	17.64%	9.80%
14-15	7	4	13.72%	7.84%
Total	34	17		

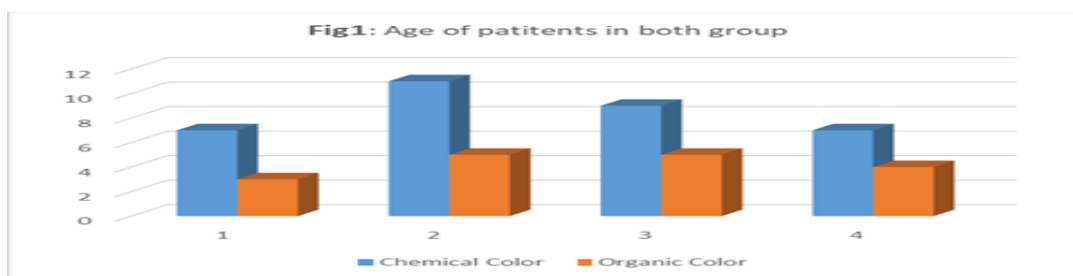


Fig 1:Age of patients in both groups

Table 1 show in 5-7 years age 7 (13.72%) patients had history of chemical colour contact while 3 (5.88%) patients had organic colour exposure. In 8-10 years, group 11 (21.56%) patients were suffered from chemical colour exposure while 5 (9.80%) had history of organic colour exposure. In 11-13 years, age 9 (17.64 %) patients had history of chemical colour contact while 9 (9.80 %) patients had organic colour exposure. Our last group was in the age range from 14-15 years. Here 7 (13.72%) patients were exposed in synthetic chemical colours and remaining 4 (7.84%) patients had history of organic holi colours contact.

Here total number of affected boys were 32 and girls were 19 with a male to female proportion was 63:37 (Figure 2).

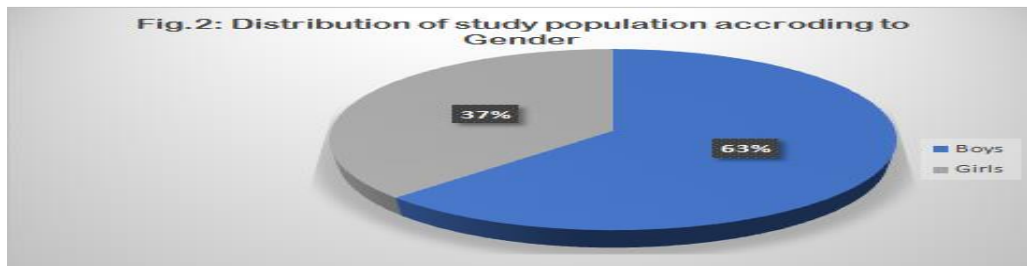


Fig 2: Distribution of study population according to gender

We were recorded each patient visual acuity with the help of a pin hole. Visual acuity was recorded as per Snellen chart. Total of 76 eyes were included in this present study.

Table 2: Distribution of study population according to visual acuity

Visual acuity	Number of eyes	Percentage
6/6	21	27.6
6/9	18	23.6
6/12	20	26.3
6/18	10	13.1
6/24	5	6.5
6/36	2	2.6
≥6/60	0	0
Total	76	100

Table 2 shows the distribution of patients according to visual acuity. 21 eyes (27.6%) had visual acuity of 6/6 followed by 18 eyes (23.6%) had 6/9, 20 eyes (26.3%) had visual acuity of 6/12 and 10 (13.1%) had a visual acuity of 6/18. Total 90.60% patients had either no vision loss or mild to moderate vision loss (upto 6/18 or less). None of them had profound vision loss of 6/60 or less.

Table 3: Distribution of Symptoms due to organic colours (30 eyes) and chemical colours (46 eyes)

Symptoms	Organic colors	Chemical colors	P value
	Number of eyes (n) with percentage (%)	Number of eyes (n)with percentage (%)	
FB sensation	12 (40.00%)	36 (78.26%)	0.0007
Ocular pain	4 (13.33%)	15 (32.60%)	0.0574
Redness	15 (50.00%)	30 (65.21%)	0.1868
Watering	20 (66.66%)	40 (86.95%)	0.0340
No symptoms	5 (16.66%)	6 (13.04%)	0.6599

Table 3 shows the prevalence of symptoms of the 15 patients (30 eyes) who used organic Holi colors. Foreign body sensation was seen in 12 (40%) eyes, ocular pain in 4 (13.33%) eyes, watering in 20 (66.66%) and redness in 15 (50%) eyes. In chemical colour group foreign body sensation was seen in 36 (78.26%) eyes, ocular pain in 15 (32.60%) eyes, watering in 40 (86.95%) and redness in 30 (65.21%) eyes. Here in both groups are Watering and FB sensation (78.26%) were the most common symptoms. But except foreign body sensation no statistically difference detected regarding symptom on these two groups.

Table 4: Distribution of signs due to organic colours (30 eyes) and chemical colours (46 eyes)

Signs	Organic colors	Chemical colors	P value
	Number of eyes (n) with percentage (5)	Number of eyes (n) with percentage (5)	
Conjunctiva	congestion	30 (65.21%)	0.3078
	chemosis	7 (15.21%)	0.8181
	stained	5 (10.86%)	0.4654
Cornea	epithelial punctate erosions	10 (21.73%)	0.5892
	epithelial large erosions	8 (17.39%)	0.1770
	stromal involvement	0 (0%)	-
	endothelial involvement	0 (0%)	-
Anterior chamber	0 (0%)	0 (0%)	-
No signs	5 (16.66%)	6 (13.04%)	0.6599

Out of 30 eyes who exposed to organic Holi colors, conjunctival congestion 12 (40%) eyes were the most common sign. In cornea punctate epithelial erosions seen in 5 eyes (16.66%) while 2 eyes

(06.66%) had large epithelial erosion. In chemical colours group conjunctival congestion was the commonest sign which was seen in 30 (65.21%) eyes. Punctate epithelial erosion of cornea seen in 10

(21.73%) eyes while large corneal epithelial erosion observed in 8 (17.39%) eyes. When we compare between these two groups only significant difference seen on prevalence of conjunctival congestion (P=0.03). Occurrence of others signs especially corneal erosion was statistically non-significant (P=0.58).

Discussion

Holi is an ancient Hindu festival also known as festival of colors or festival of Spring. It is celebrated all over the India, even abroad now. It was well observed that different cultural and religious practice has widespread impact on our health. Holi is such type of a festival. This is celebrated on the day after phalguni Purnima according to Hindu calendar. It is celebrated all over the India in different way according to their local custom and practice. In West Bengal it is celebrated as Dolyatra or Basontoutsav. In reality holi festival is a festival to celebrate harvest and fertility of land. It also celebrated to well come spring. The origin of holi yet not known but according to Hindu mythology Holika was the sister of demon king Hiranyakashipu. His son Prahlad was a devotee of lord Vishnu. But Demon king is not like it. So, he tries to kill his son but failed several times due to Vishnu. Holika had a special fire-resistant shawl given by Brama as a boon. Hiranyakashipu made a conspiracy with her sister to burn Prahalad. But when Holika attempted it, a strong wind was blowing with snatch her shawl from her and cover the body of Prahalad, as a result Holika instead of Prahalad become dead.

During the of day holi or immediate next day, often people consulted ophthalmologist with various ophthalmic complains arise as a result ocular contact with holi colours. During holi celebration ocular injuries like conjunctival hemorrhage/ tear, cornea epithelial defect, stromal haze, anterior chamber reaction, hyphaema very often seen [5]. Previously colours were made at home. From plants material but latter due to popularity and growing demand market are flooded with various chemical colours during the time of holi. Unfortunately, these chemical colours are often contains various toxic substance like malachite green [6]. During holi celebration ocular injuries like conjunctival hemorrhage/ tear, cornea epithelial defect, stromal haze, anterior chamber reaction, hyphaema very often seen [6]. In our study most of the children were boys with a male to female ratio was (1: .72). This result was almost similar to study done Pujari et al. where over 76% affected patients were male. Here in India, boys do outdoor activities more girls and also, they play holi aggressively. That might be reason behind such male dominance in study population.

In one previous study vision of patients were vary from 6/ to 6/24 [8]. In our study 77.5 % child visual acuity did not did not hamper much (better than 6/12). Only two eyes had a visual acuity of 6/36 who was suffered from severe toxic reaction. Similar type of result also observed by Garg A, Harsolia RS et al, where more than 70% study population had a visual acuity of better than 6/12.

Most common symptoms observed in our study were foreign body sensation, ocular pain, redness, and watering. In both groups these symptoms were present and except foreign body sensation no statistically significant difference observed between organic and chemical colour group.

Conjunctival congestion was the commonest sign in this present study. In chemical colours group 65.2% eyes suffered from conjunctival congestion where it was 40% in organic colors which was statistically significant (P= 0.030).

In this present study cornea epithelium is commonest affected parts at cornea. Punctate epithelial erosions as well as large sized epithelial erosion were seen in both organic and chemical colour groups. Although involvement of corneal epithelial was slightly more common in chemical colors group but this difference was not statistically significant (P=0.589). Out of 76 eyes no eye had anterior chamber involvement in our study. This result was almost similar to one previous study where anterior segment optical coherence tomography was done to assess the status of cornea of exposure to holi colors. This show that colour can penetrate only superficial 60 micron of corneal stroma, although in two patients color penetrate the cornea and stained anterior capsule of lens [8].

Conclusion

We have observed that chemical colours causes more sign and symptom than organic colors but Organic colours also causes significant ocular affection in children.

In our study organic colours also had adverse ocular effect, we suspect organic colours that is available ready made in the in the market is also contaminated with toxic substances, as there is no proper regulatory body in India regarding this. A proper evaluation of this organic colour is needed to determine its exact chemical composition, so people are aware about adverse effect of readymade organic holi colours. We must have to encourage uses of organic colors to minimize to ocular injury due to holi colors specially in paediatric population but in the same time need to educate the people about original herbal colour and encourage them to make it at home during holi times.

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