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RESEARCH ARTICLE
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# EFFECT OF FORMALIN EXPOSURE ON MEDICAL STUDENTS: A CROSS-SECTIONAL STUDY

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**Abstract**
Formaldehyde, a known carcinogen, is commonly employed as an embalming agent in anatomy dissection laboratories nationwide for cadaver preservation. While the effects of formalin are well-recognized anecdotally among medical teaching faculty, there is a dearth of well-documented quantitative research examining its impact on students or teaching staff who regularly handle it. This study aims to quantitatively assess the effects of formalin exposure on healthy first-year medical students aged 18-23. The findings revealed that nearly all subjects reported experiencing some adverse symptoms, with an average of 6-7 symptoms per individual. Furthermore, a strong correlation was observed between symptoms related to nasal irritation and syncopal episodes.

## INTRODUCTION

Cadaver embalming is a preservation process that prevents decay through the infusion of chemical substances. A variety of substances, including formalin, alcohol, glycerine, carbolic acid, and dyes, are employed for this purpose. These substances, typically infused via the femoral or internal carotid arteries, each serve specific roles in the embalming process(1,2).

Formalin is the most prevalent chemical agent utilized for cadaver embalming, comprising a 37% to 40% weight/volume (w/v) solution of formaldehyde gas in water(3). Formaldehyde, a flammable and colorless gas commercially available as formalin, readily decomposes at ambient temperatures, leading to the formation of toxic substances(4).

Formaldehyde's significant reactivity allows it to covalently bind to macromolecules, leading to toxicity. While dermal contact is a possible exposure pathway (5), skin absorption is limited. Conversely, upon inhalation and ingestion, exogenous formaldehyde is rapidly and almost entirely absorbed at the point of contact (6).

Given that the respiratory system serves as the primary entry point for formaldehyde, it is the most affected site. Occupational data indicates that prolonged exposure in environments such as dissection halls, pathology labs, and operating theaters can lead to significant changes in lung function. Due to regular exposure during dissection sessions, lasting two hours, first-year MBBS students face a substantial risk of developing related symptoms.

The present study investigates the acute and toxic effects of formaldehyde exposure on these students.

## MATERIALS & METHODS

This cross-sectional study was performed in the Department of Anatomy at Government Medical College, Doda. The participants were 150 healthy first-year MBBS students, aged 18 to 20 years. These students were regularly exposed to formalin during dissection for a minimum of 2 hours per day, at least 6 days per week, over approximately 10 months. Data was collected using a written questionnaire administered to students at the conclusion of the term.

Students with a history of cough, asthma, respiratory symptoms, dermatological problems, or allergies were excluded from participation. Written informed consent was obtained from all participating students. The data was anonymized for analysis, and a detailed quantitative analysis is presented in the subsequent section. The questionnaire consisted of 20 binary questions pertaining to a range of symptoms associated with formalin exposure in humans. Table 1 presents each question alongside the number and percentage of students who responded affirmatively.

## RESULTS

Table 1: Column 2 lists a question per row from the questionnaire used in the study. Each row in columns 3 and 4, respectively lists the number and percentage of students who answered yes to the question

| S.no | Effects of formaldehyde | No. of students | Percentage |
|---|---|---|---|
| 1 | Unpleasant smell | 145 | 97 |
| 2 | Burning eyes | 123 | 82 |
| 3 | Redness of eyes | 88 | 59 |
| 4 | Excessive lacrimation | 69 | 46 |
| 5 | Running nose | 67 | 45 |
| 6 | Nasal itching and burning | 54 | 36 |
| 7 | Nasal soreness and dryness | 49 | 33 |
| 8 | Dry mouth | 45 | 30 |
| 9 | Cough | 43 | 29 |
| 10 | Sore throat or dryness | 40 | 27 |
| 11 | Respiratory distress | 39 | 26 |
| 12 | Disturbance of sleep | 39 | 26 |
| 13 | Disturbance of sight | 33 | 22 |
| 14 | Syncope (fainting episode) | 28 | 19 |
| 15 | Post-dissection nausea | 28 | 19 |
| 16 | Headache | 24 | 16 |
| 17 | Unusual tiredness or dizziness | 18 | 12 |
| 18 | Gastro-intestinal problems | 18 | 12 |
| 19 | Lack of concentration | 13 | 9 |
| 20 | Skin problems | 10 | 7 |

**Table 1: Column 2 presents each question from the survey. Columns 3 and 4 show the number and percentage of students who answered "yes".**

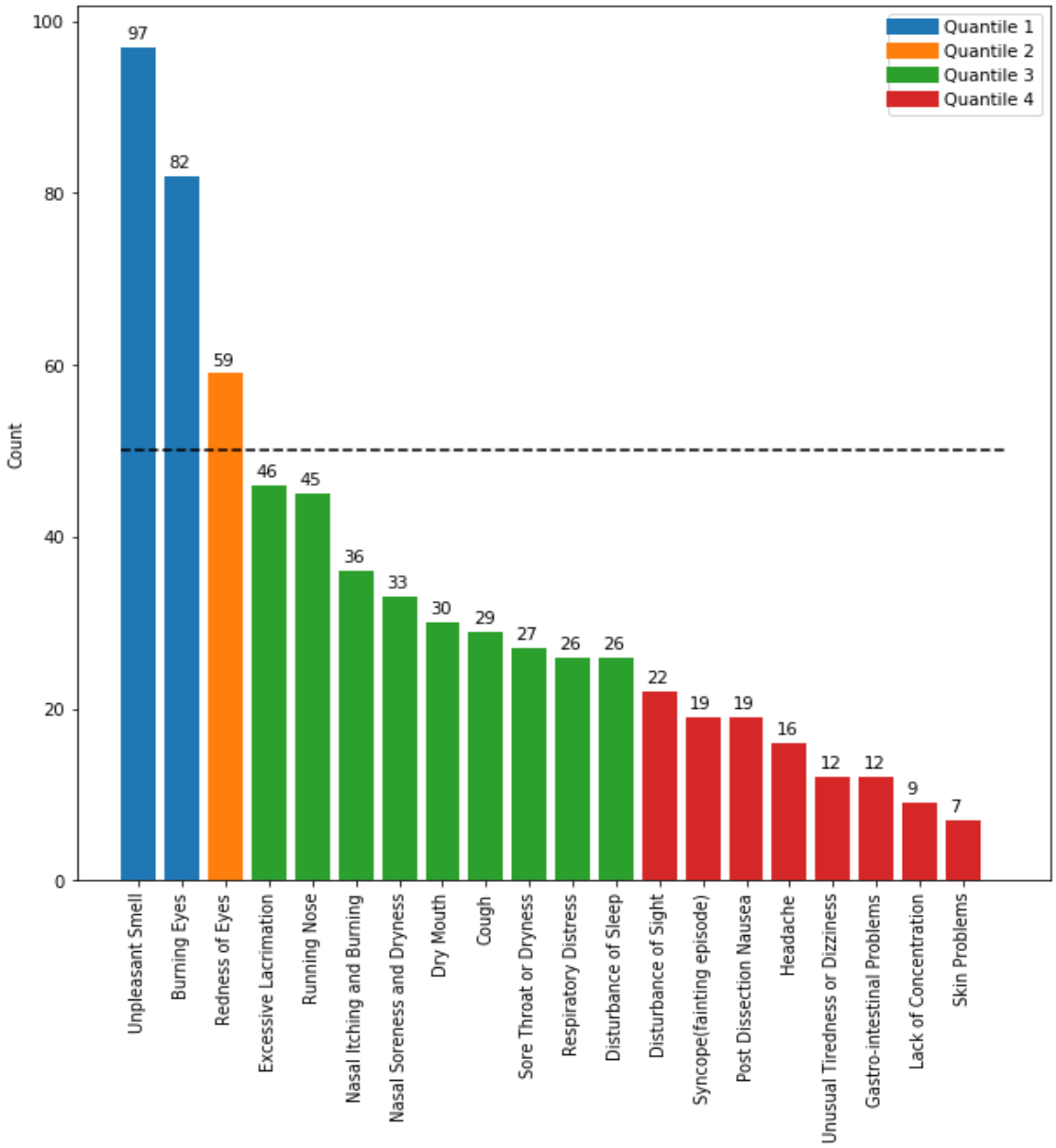


***Figure 1: Distribution of Questionnaire Responses Categorized by Quantiles: Higher response frequencies are concentrated in Quantile 1 and taper off across lower quantiles.***

## DISCUSSION

Formalin toxicity arises from its formaldehyde content, a volatile, colorless gas. Formaldehyde is rapidly metabolized into formate by erythrocytes, which is then oxidized into carbon dioxide and eliminated through exhalation. During this metabolic process, formate facilitates cross-linking of amino acids and nucleic acids, potentially leading to cell death(7).

Formaldehyde primarily enters the body through inhalation. Once inhaled, it can integrate into nucleic acids or covalently bind to proteins within the nasal mucosa of rats, leading to nasal epithelium cell proliferation, congestion, and increased secretion in rodents. Formaldehyde exposure can induce allergic reactions through the formation of haptens, which subsequently trigger an immune response. Damage to the nasal mucosa and capillary beds facilitates the conjugation of formaldehyde with blood proteins, contributing to allergic conditions. Therefore, formaldehyde exposure poses a health risk to students, necessitating the adoption of strategies to minimize exposure. Simple measures such as enhancing room ventilation through open windows and exhaust fans are recommended. Additionally, students should use personal protective equipment like masks and gloves during dissections. Alternative embalming techniques, such as soft embalming, can also limit formaldehyde use, thereby reducing student exposure.

**Bibliography**


1. Girish V.Patil, Shishirkumar, Thejeshwari, Apoorva D, Javed Sharif, C.Sheshgiri, Sushant N.K: Physical reactions of Formalin used as cadaver preservative on First year Medical students. Journal of Evidence Based Medicine and Healthcare; Vol.1, Issue 5, July2014; 279-283.
2. Coleman.R and Kogan I. An improved low formaldehyde embalming fluid to preserve cadavers for anatomy teaching. Journal of Anatomy, 192(Pt. 3), 1998; 443-446.
3. International Programme on Chemical Safety (IPCS). Environmental Health Criteria 89, Formaldehyde.1989.[cited2016Nov7].Available from: http://www.inchem.org/documents /ehc/ehc/ehc89.html.
4. Abdu H, Kinfu Y, Agalu A. Toxic Effects of Formaldehyde on the Nervous System. Int J Anat Physiol.2014; 3(3): 50-59.
5. Lyapina M, Kisselova-Yaneva A, Krasteva A, Tzekova-Yaneva M, Dencheva-Garova M. Allergic Contact Dermatitis From formaldehyde Exposure. J IMAB.2012; 18(4):255-262.
6. Agency for Toxic Substances and Disease Registry (ATSDR). Toxicological Profile for Formaldehyde, US department of Health and Human Services: Atlanta, 1999. pp 1-468.
7. Jain SR, Nahar PS, Baig MM. Study of formalin toxicity in I MBBS students. Cough. 2012;3:233-