

Physical Reactions of Nigerian Health Sciences Students to Formaldehyde Used as Cadaver Preservatives

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Abstract: Formaldehyde has been widely used in the preservations of cadavers in various medical schools in Nigeria for decades and exposure to exogenous formaldehyde has been associated with a number of biological effects in human. A total of two hundred and fifty health sciences students participated in the study from various medical schools. The respondents answered sets of semi-structured questions on various physical reactions associated with use of cadavers that are preserved by formaldehyde. About 62.4% of the respondents are medical students, 19.6 and 18.0% are anatomical and physiological students, respectively. Formaldehyde was used in all the medical and department of anatomy for preservations of cadavers in all the schools. Most of the respondents have contact with cadavers one to twice per week with 8% of them having contact with the preserved bodies >3 times per week. Eyes irritation and upper respiratory tract symptoms are predominant physical reactions suffered by the respondents (56% eyes irritation and 32%, respectively). We concluded that classical embalming mixtures, used for decades are today impracticable and the search for newer low-formaldehyde substitutes has become an urgent issue to minimize a number of biological effects caused by exposure to exogenous formaldehyde used as preservatives.

Key words: Physical reactions, formaldehyde, health science students, cadaver preservatives

INTRODUCTION

Preservation of cadavers in the tropics for anatomical dissection is often more a difficult task than in the comparatively cold climate of Europe and British Isles (Harrower, 1924). There are various methods of technique used in the embalming of the dead and most them are known from ancient times (Carter, 1972) and exposure to exogenous formaldehyde has been associated with a number of biological effects in human such as skin sensitization (Lutz, 1990), irritation of the mucus membrane and the eyes (Chia *et al.*, 1992; Tanaka *et al.*, 2003) and pulmonary function disorders (Kriebel *et al.*, 1993) especially the upper respiratory tract disorders (Kerns *et al.*, 1983).

It has also been indicted in the human carcinogens (US Environmental Protection Agency, 1999). The medical and paramedical students are involved in the use of cadavers for their practical works and this exposes them

to formalin which is commonly used as preservatives. Exposures to airborne chemicals used in the embalming process are common during cadaver dissection especially in anatomy teaching and practical (Whitehead and Savoia, 2008) and the distance of individuals from the cadaveric materials determines the intensity of the exposure (Ohmichi *et al.*, 2006).

The potential health and safety problems for staff and students in gross anatomy laboratory and the need to comply with increasingly restructure exposure limits to components of embalming chemicals especially formaldehyde have cause us the need to find practical solutions (Coleman, 1995).

In recent years, there has been an increasing awareness of the potential health hazards of formaldehyde exposure in workplace (Coleman, 1995).

The introduction of new standards restructuring level of exposure to formaldehyde has resulted in the need to try and find practical solutions to comply with health and

safety regulations or face closure of gross anatomy laboratory. The study was designed to classify and identify physical reactions of health sciences students in Nigeria to formaldehyde used as a cadaver preservative.

MATERIALS AND METHODS

The study was carried out according to the guidelines of the University of the Ilorin Ethics and Screening Committee which parallel those set down by the National Institute of Health (NIH) for use of human in scientific experiments. The study employed a descriptive method using self administered semi structured questionnaire in obtaining vital information from informed participants from medical and paramedical students in Nigeria.

A total of two hundred and fifty students (both sexes) were randomly selected to participate in the study. The questionnaires was divided into parts: Demography indices of the respondents, duration of contacts and type of cadaver preservatives used in their various institutions and types of physical reaction individuals suffered and their possible suggestions and solutions.

The inclusive criteria are the respondents must have direct contact with cadavers, formalin must be used as a means of cadaver preservatives and the exclusive criteria includes individuals with pre existing medical conditions such as Asthma, acute rhinitis, dermatitis and students that are not in the health sciences and who do not offer anatomy are excluded from the study. All the respondents returned their answered questionnaires.

Data analysis: All values are given as mean±Standard Deviation (SD) with n values indicating the number of subjects analyzed. Data were evaluated by one-way ANOVA followed by coefficient of association test using Chi-square. p values<0.05 were considered statistically significant.

RESULTS AND DISCUSSION

All the respondents indicate that formaldehyde was the mainstay stay of cadaver preservation and embalming techniques employed in their various schools. The mean age distribution of the respondents is 22.11±6.12 and 24.18±4.02 years for males and females, respectively. About 62.4% of the respondents are medical students in their 2nd and 3rd year while 19.0 and 18.6% are anatomy and physiology students, respectively. The sex distribution of the respondents is in favour of the males accounting for 60% and females accounting for 40% (Table 1). There was association between attendance of dissection and development of physical reaction among

Table 1: Frequency distribution by age, sex and course distribution of respondents

Age distribution	Male frequency	Female
18	1	2
19	4	3
20	18	11
21	41	37
22	30	14
23	29	16
24	12	4
25	9	4
26	5	4
27	5	4
Total	151	99
Course	Frequency	Percentage
Medicine	156	62.4
Anatomy	49	19.6
Physiology	45	18.0
Total	250	100.0

Table 2: Coefficient of association table using chi-square of physical reaction and attendance of dissections by respondents. (-) indicate the expected values and $\chi^2 = 4.786$

Criteria's	Attendance	No attendance	Total
Reaction	151 (137.6)	37 (50.4)	188
No reaction	10 (16.4)	52 (45.6)	62
Total	164.0	86.0	250

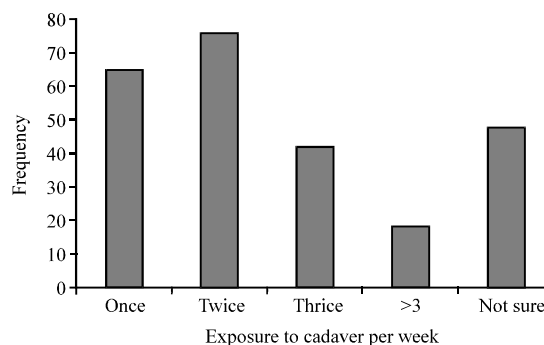


Fig. 1: Attendance at cadaver dissection by respondents per week

the respondents with $\chi^2 = 4.786$ (Table 2). Majority of the respondents attend cadaver dissections once to twice per week (Fig. 1) and most of the respondent have eyes irritation accounting for 70% and upper respiratory tract symptoms account for 36% (Fig. 2). Female respondents show higher incidences of physical reactions compared to their male counterparts across all the reactions (Fig. 3).

Medical education at the very basic and advanced levels required in depth knowledge of gross anatomy through which the students can have a first impression of the normal structure of the human body. The knowledge will aid in proper understanding of the pathophysiological basis of diseases (Groscurth *et al.*, 2001). Exposing students to cadaver dissection is there very crucial and this partly explains why for many centuries, scientists have tried to create an effective and health safe methods

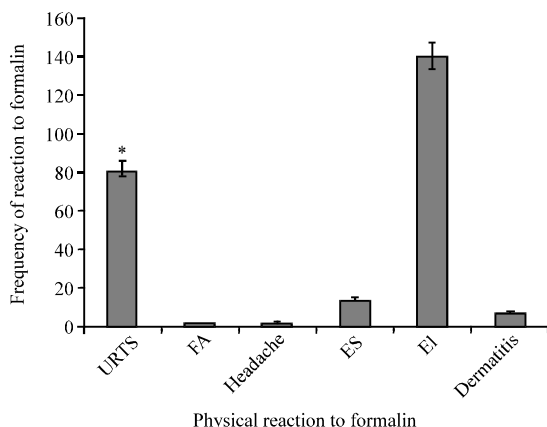


Fig. 2: Frequency distribution of respondents to physical reactions. URTS: Upper Respiratory Symptoms, FA: Fainting Attack, ES: Excessive Salivation, EI: Eye Irritation. Asterisks indicate statistical significance at $p \leq 0.05$ and the bar represents the standard deviation

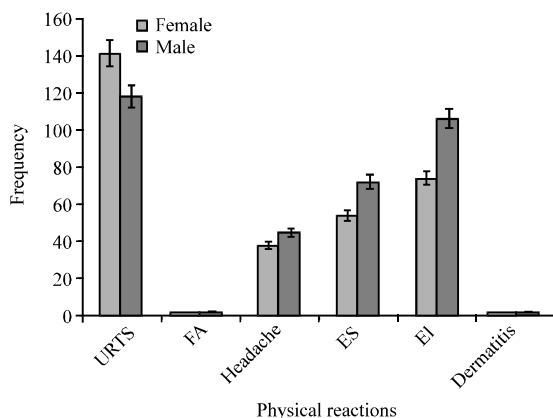


Fig. 3: Sex distribution of respondents to physical reaction. The short bar represents the standard deviation URTS: Upper Respiratory Symptoms, FA: Fainting Attack, ES: Excessive Salivation, EI: Eye Irritation. The bars represent the standard deviation

for conservation and long-lasting processes for the preservations of cadavers for research and teachings (Sivrev *et al.*, 2005), all these with a view to minimized and reduced all forms of stress associated with some of the chemicals used in the processes.

Majority of the respondents suffers respiratory symptoms that range from difficulty in breathing to severe tightness of the chest with a few of them having severe headache and fainting attacks. This correlates the study of Fisher (1986) and Jr Witek *et al.* (1987) where they found that exposure to exogenous formaldehyde has been

associated with a number of biological effects in human such as skin sensitization and eyes and upper airway irritation. This will certainly discouraged most of the students from coming to dissecting room and in some cases complete withdraw from the programs. We aligned with Bradbury and Hashino (1978), Logan (1983) observations that classical embalming mixtures used for decades are now impractical. The search for newer low-formaldehyde substitutes has become an urgent issue. However, the major drawback to this was discussed in a study conducted in Nigeria where the authors found that most of the technologists and mortuary attendants involves in the cadaver preservations lacked basic and practical knowledge of modern embalming techniques such as plastination and cavitation. The reasons they argue was due to low level of their academic qualifications and non attendance of conferences and workshops on modern embalming techniques to update their knowledge. The high cost of plastination and cavitation embalming techniques they claimed might be responsible for the absence of it practice should not be a major factor since the high cost is not comparable to its long term benefits (Ajao *et al.*, 2010).

The findings at attendance of dissection from the study shows that about 50% of the respondents actually have contact with cadavers for dissection once to twice per week and there are strong associations with attendance at dissections and development of physical reaction. The problem is compounded with the fact the anatomy laboratories are not monitored for formaldehyde vapour levels which are to be determined by an approved external independent assessor to ensure compliance with legal limitations for exposure to formaldehyde in the work place by both the students and the staff (Coleman and Kogan, 1998). Formaldehyde is known to be genotoxic to insects and human cells *in vitro* (Ma and Harris, 1988; Schmid *et al.*, 1986). *In vivo* cytogenetic changes in humans due to formaldehyde exposure are of great interest because it is a suspected human carcinogen (Blair *et al.*, 1985). The fact that greater percentages of the respondents are medical students that require good understanding of anatomy is encouraging but is worrisome if exposure to formaldehyde chemicals will militate against them from having enough contact hours with cadaver dissections. We aligned with the submissions of Grosecruth *et al.* (2001) that notes that fixation of cadavers with conventional processes by using mainly formalin for conservation are only of limited use for practical and surgical courses due to profound changes of colour, strength and fragility of organs and tissues. Hence, there are urgent needs to start searching for chemicals of low irritability and at the same that will

achieve the desired result of cadaver preservation. Plastination embalming techniques will have provided suitable solutions to this but cost and availability of skill man power in that area are a major constraint in Nigeria especially with vast number of medical schools. The physical and psychological responses of students after first exposure to cadaver provide them with unique experience and require some mental adjustment to enable them cope. However, there could be aggravated by unpleasant reaction to formaldehyde thus exacerbating physical reactions such as scaring, severe depression and nightmares as observed by Olawepo *et al.* (2008).

Formaldehyde was known to be present in biological systems with its metabolites a one-carbon reaction which is normally found in human cells but at low concentration (Lutz, 1990). It is found to contain an important industrial chemical with many commercial uses and derivatives (National Research Council, 1981). Albert *et al.* (1982) and Kerns *et al.* (1983) observed that exposures of rats to formaldehyde at 6-15 ppm resulted *in vivo* development of nasal carcinomas. However, limited evidence for such carcinogenic activity of formaldehyde in humans is available (IARC, 1987).

The consequences of formaldehyde in the aetiopathogenesis of carcinomas in human should not be down played despite absences of such observations in human because prolonged and sustained interaction of human with formaldehyde required to subsequently lead to development of cancers in human. If these thus occur, it will be potentially hazardous not only to the students but to others staff who have direct contact with these cadavers. It is not surprising that female respondent shown more and profound physical reactions to formaldehyde, this could be attributed to some hysteric behaviors of women to smell especially when they are unpleasant. However, the reason (s) for this was not understood. We correlate the report of Coleman and Kogan (1998) that reduction of environmental chemical hazards is vital with aims of complying with the increasing severe health and safety regulations will create a new awareness of the possible dangers of these chemicals in the workplace.

CONCLUSION

Researchers concluded that the potential health and safety problems caused by formaldehyde used in the preservations of cadavers to staff and students at various medical schools in Nigeria in the gross anatomy laboratories should be reviewed with the sole objectives of the sourcing for alternative means of preservations with high safety records, readily available and less toxic to both humans and environment.

REFERENCES

- Ajao, M.S., A. Olawepo, M. Falaiye, A.G. Adefolaju, A.O. Olayaki, S.A. Jimoh and A.I. Abioye, 2010. Knowledge of Nigerian laboratory technologists and mortuary attendants on various methods of embalming techniques. *Int. J. Biol. Chem. Sci.*, 4: 1575-1581.
- Albert, R.E., A.R. Silkakumar, S. Laskin, M. Kushner, N. Nelson and C.A. Snyder, 1982. Gaseous formaldehyde and hydrogen chlorides induction of nasal cancer in the rat. *J. Natl. Cancer Inst.*, 68: 597-603.
- Blair, A., J. Walrath and H. Malaker, 1985. Review of Epidemiologic Evidence Regarding Cancer and Exposure to Formaldehyde. In: *Formaldehyde: Analytical Chemistry and Toxicology (Advances in Chemistry Series)*, Turoski, V. (Ed.). American Chemical Society, Washington, DC USA., pp: 261-273.
- Bradbury, S.A. and K. Hashino, 1978. An improved embalming procedure for long-lasting preservation of the cadaver for anatomical study. *Acta Anatomical*, 101: 97-103.
- Carter, H., 1972. *The Tomb of Tutankhamen*. Sphere Books Ltd., London.
- Chia, S.E., C.N. Ong, S.C. Foo and H.P. Lee, 1992. Medical students exposure to formaldehyde in a gross anatomy dissection laboratory. *J. Am. Coll. Health*, 41: 115-119.
- Coleman, R. and I. Kogan, 1998. An improved low-formaldehyde embalming fluid to preserve cadavers for anatomy teaching. *J. Anat.*, 192: 443-446.
- Coleman, R., 1995. Reducing the levels of formaldehyde exposure in gross anatomy laboratories. *Anatomical Record*, 243: 531-533.
- Fisher, A., 1986. *Contact Dermatitis*. Lea and Febiger, Philadelphia.
- Groscurth, P., P. Eggli, J. Kapfhammer, G. Rager, J.P. Hornung and J.D.H. Fasel, 2001. Gross anatomy in the surgical curriculum in Switzerland: Improved cadaver preservation, anatomical models and course development. *Anatomical Record*, 265: 254-256.
- Harrower, G., 1924. Embalming in the Tropics. *J. Anat.*, 58: 142-144.
- IARC, 1987. Evaluation of Carcinogenic Risks to Humans: Overall Evaluations of Carcinogenicity: An update of IARC monographs. Vols. 1-42, International Agency for Research on Cancer, Lyon, France, pp: 334-339.
- Jr Wittek, T.J., E.N. Schachter, T. Tosun, G.J. Beck and B.P. Leaderer, 1987. An evaluation of respiratory effects following exposure to 2.0 ppm formaldehyde in asthmatics: Lung function, symptoms and airway reactivity. *Arch. Environ. Health*, 42: 230-237.

- Kerns, W.D., K.L. Davkov, D.J. Donofrio, E.J. Gralla and J.A. Swenberg, 1983. Carcinogenicity of formaldehyde in rats and mice after long-term inhalation exposure. *Cancer Res.*, 43: 4382-4392.
- Kriebel, D., S.R. Sama and B. Cocanour, 1993. Reversible pulmonary responses to formaldehyde. A study of clinical anatomy students. *Am. Rev. Respir. Dis.*, 148: 1509-1515.
- Logan, B.M., 1983. The long-term preservation of whole human cadavers destined for anatomical study. *Ann. Royal College Surgeons England*, 65: 333-333.
- Lutz, W.K., 1990. Endogenous genotoxic agents and processes as a basis of spontaneous carcinogenesis. *Mutat. Res.*, 238: 287-295.
- Ma, T. and M. Harris, 1988. Genotoxicity of formaldehyde. *Mutat. Res.*, 196: 37-59.
- National Research Council, 1981. Formaldehyde and other Aldehydes. National Academy Press, Washington, DC USA.
- Ohmichi, K., M. Komiyama, Y. Matsuno, Y. Takanashi and H. Miyamoto *et al.*, 2006. Formaldehyde exposure in a gross anatomy laboratory-personal exposure level is higher than indoor concentration. *Environ. Sci. Pollut. Res. Int.*, 13: 120-124.
- Olawepo, A., M.S. Ajao, O.O. Eweoya, O.R. Jimoh, T.A. Alimi and W.B. Yahya, 2008. Gender effects on physical reactions of health science students at first encounter with cadaver using pearson chi-square test. *Res. J. Med. Sci.*, 2: 92-95.
- Schmid, E., W. Goggelmann and M. Bauchinger, 1986. Formaldehyde induced cytotoxic, genotoxic and mutagenic response in human lymphocytes and salmonella typhimurium. *Mutagenesis*, 1: 427-431.
- Sivrev, D., M. Miklosova, A. Georgieva and N. Dimitrov, 2005. Modern day plastination techniques-successor of ancient embalment methods. *Trakia J. Sci.*, 3: 48-51.
- Tanaka, K., K. Nishiyama, H. Yaginuma, A. Sasaki and T. Maeda *et al.*, 2003. Formaldehyde exposure levels and exposure control measures during an anatomy dissecting course. *Kaibogaku Zasshi*, 78: 43-51.
- US Environmental Protection Agency, 1999. Integrated risk information system (IRIS) on formaldehyde. National Center for Environment Assessment Office of Research and Development, Washington, DC USA.,
- Whitehead, M.C. and M.C. Savoia, 2008. Evaluation of methods to reduce formaldehyde levels of cadavers in the dissection laboratory. *Clin. Anatomy*, 21: 75-81.