



Effect of Chronic Formaldehyde Exposure on Some Cardiovascular Indices among Medical Students in a Tertiary Institution in Edo State, Nigeria

*EBOJELE, FO; IYAWA, VI

Department of Physiology, School of Basic Medical Sciences, College of Medical Sciences, University of Benin, Benin City, Nigeria

*Corresponding Author Email: frederick.ebojele@uniben.edu; Tel: 08034419399

Co-Authors Email: viyawe@yahoo.com

ABSTRACT: The effect of formaldehyde exposure on some indices of cardiovascular function among medical students in a tertiary institution in Edo State, Nigeria was studied by measuring selected anthropometric parameters using standard methods for 150 subjects recruited and divided into three groups A, B, and C with 50 subjects in each group. Results obtained and presented as mean \pm sem revealed that the anthropometric parameters measured ranged from (20.16 \pm 0.36 – 21.10 \pm 0.24, yrs.) for Age; (58.84 \pm 1.53 – 61.24 \pm 1.67, kg) for weight; (1.69 \pm 0.01 – 1.71 \pm 0.01, m) for height; (89.26 \pm 1.02 – 90.56 \pm 0.80, cm) for chest circumference; (20.31 \pm 0.43 – 21.44 \pm 0.45, kg/m²) for BMI and (1.64 \pm 0.02 – 1.71 \pm 0.02, m²) for BSA respectively. The data showed significant increases in pulse rate, diastolic blood pressure and mean arterial pressure among group B medical students. It was therefore concluded that prolonged exposure to formaldehyde could affect the cardiovascular health of medical students.

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Post-mortem changes are inevitable after the death of an individual. The cells and tissues usually undergo changes that brings about decomposition and decay. However, these changes can be prevented through the use of different chemical fixatives which can help to preserve the tissues and retain their form they held while the individual was still alive and one of the classical fixative that can be used for this purpose is the volatile organic compound known as formaldehyde (Farooqui, 1983; Bjorkman *et al.*, 1986). The property of this reagent in delaying the decomposition of dead bodies (cadavers) makes it useful in preservation and embalming of bodies thus retaining the normal anatomical relations and makes it useful for the purpose of study during anatomy dissections in medical schools (Wantke *et al.*, 2000; Wei *et al.*, 2007). There are concerns about formaldehyde with regard to its possible health

hazards and it is claimed to be carcinogenic, neurotoxic, embryotoxic, teratogenic, cytotoxic, genotoxic and allergenic (US Environmental Protection Agency, 1999; IARC, 2006). Adverse effects on the respiratory health has been reported (Mathur and Rastogi, 2007). Available studies on acute occupational exposure in humans revealed clinical symptoms like skin irritation, eye soreness, nose irritation, throat irritation and rhinorrhea as well as reduction in pulmonary function like FVC, FEV₁/FVC, and PEF_R (Khamgaonkar and Fulare, 1991; Kim *et al.*, 1999; Pourmahabadian *et al.*, 2006; Wei *et al.*, 2007). Chronic exposure studies done in some medical schools in India reported decrease in pulmonary function (Patil *et al.*, 2012; Shrivastava and Saxena, 2013). Petushok investigated the potential of formaldehyde to produce oxidative stress in the liver of animals (Petushok, 2000) while some other

*Corresponding Author Email: frederick.ebojele@uniben.edu

researchers have tried to look at possible effects of formaldehyde on the central nervous system (Aslan *et al.*, 2006; Sarsilmaz *et al.*, 2007). Studies on cardiac function following formaldehyde exposure are quite few and it has been reported that in rats formaldehyde inhalation could produce oxidative stress in the heart (Gulec *et al.*, 2006). Some other researchers reported decrease in heart rate among medical students (Neginhal *et al.*, 2013). A study carried out among morticians in Benin City, Nigeria revealed increase in Systolic Blood Pressure, Diastolic Blood Pressure and Mean Arterial Pressure (Ebojele and Iyawe, 2022). This present study seeks to investigate the effect of formaldehyde exposure on some cardiovascular indices among medical students in a tertiary institution in Edo State, Nigeria.

MATERIALS AND METHODS

Medical students between the ages of 18 and 30 years in a tertiary institution in Edo State, Nigeria were recruited for this study. Subjects were apparently healthy, non-smokers, and had no history of cardiopulmonary disease or recent abdominal or chest surgery. Informed consent was obtained from the subjects who participated in the study while ethical approval was obtained from the College Research Ethics Committee, University of Benin before commencement of the work. The 150 subjects selected were divided into three groups (A,B and C) with 50 subjects in each group. Group A served as control (non-medical students with nil exposure to formaldehyde) while groups B and C served as the test group. Group B consisted of medical students with 0-

9 months exposure to formaldehyde in the Anatomy laboratory while Group C consisted of medical students with 10-18 months exposure to formaldehyde in the Anatomy laboratory. Their anthropometric parameters were measured as well as some cardiovascular indices which included Pulse Rate (PR), Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP), Pulse Pressure (PP) and Mean Arterial Pressure (MAP). Statistical analysis was done using GraphPad prism version 5.0 (GraphPad Software, San Diego, California). Results was presented as Mean \pm SEM. Analysis of Variance was used to compare the means of test and control values while post hoc test was done using Student Newman Keul's test and a p-value of less than 0.05 was considered as statistically significant.

RESULTS AND DISCUSSION

Table 1 shows anthropometric parameters of medical students that were studied and there was no significant differences between control and test groups. There was a significant increase in pulse rate (figure I) in group B that had 0-9 months exposure while group C was not significant. Systolic Blood Pressure (figure II) was increased in group B but it was not significant. However, Diastolic Blood Pressure (figure III) and Mean Arterial Pressure (figure V) were significantly increased in group B when compared with the control. Group C on the other hand did not show any significant difference in Systolic Blood Pressure, Diastolic Blood Pressure and Mean Arterial Pressure. An increase was also seen in the pulse pressure across all the groups (figure IV).

Table 1: Anthropometric parameters of medical students following chronic exposure to formaldehyde

Parameters	Group A n=50	Group B n=50	Group C n=50	P-value
Age (yrs)	21.10 \pm 0.24	20.16 \pm 0.36	20.64 \pm 0.32	0.0989
Weight (kg)	58.84 \pm 1.53	61.24 \pm 1.67	59.54 \pm 1.44	0.5314
Height (m)	1.69 \pm 0.01	1.69 \pm 0.01	1.71 \pm 0.01	0.2712
Chest Circumference (cm)	90.56 \pm 0.80	89.26 \pm 1.02	90.12 \pm 0.96	0.6055
BMI (kg/m ²)	21.44 \pm 0.45	21.33 \pm 0.58	20.31 \pm 0.43	0.2041
BSA (m ²)	1.64 \pm 0.02	1.70 \pm 0.02	1.71 \pm 0.02	0.1138

BMI= Body Mass Index; BSA= Body Surface Area

Formaldehyde effect on pulmonary function has been reported in a number of studies carried out by several researchers (Pourmahabadian *et al.*, 2006; Patil *et al.*, 2012; Shrivastava and Saxena, 2013; Neginhal *et al.*, 2013). Formaldehyde was reported to produce oxidative stress in the liver of Wistar rats (Petushok, 2000; Sogut *et al.*, 2004). Central nervous system effect of formaldehyde has also been reported by some researchers (Aslan *et al.*, 2006; Sarsilmaz *et al.*, 2007) who observed some alterations in brain structures of neonatal rats that were exposed to formaldehyde after birth for a duration of thirty days. Others also reported impaired memory and learning as well as altered

motor activity in mice following acute exposure to formaldehyde (Usanmaz *et al.*, 2002). Testicular toxicity following exposure to formaldehyde in male rats has also been reported (Ozen *et al.*, 2002; Zhou *et al.*, 2006). However, only few studies from literature appeared to have evaluated the effects of formaldehyde on cardiac function. Neginhal *et al.* (2013) reported decrease in heart rate following exposure of medical students to formaldehyde while Gulec *et al.* (2006) suggested that formaldehyde when inhaled could cause oxidative stress to the heart.

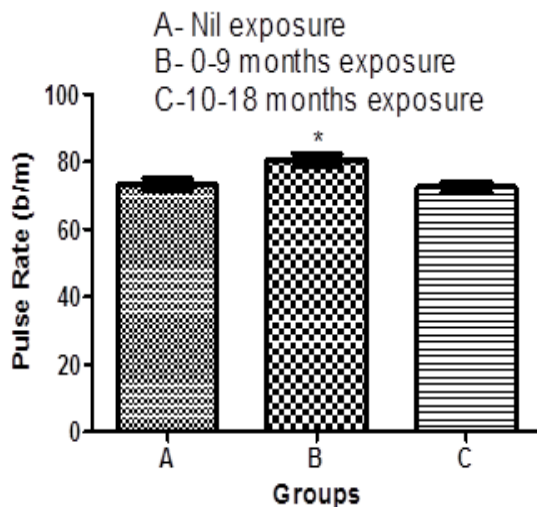


Fig 1: Mean pulse rate of medical students following chronic exposure to formaldehyde
Significant values are mean \pm SEM compared to control (* = $P < 0.005$; n = 50)

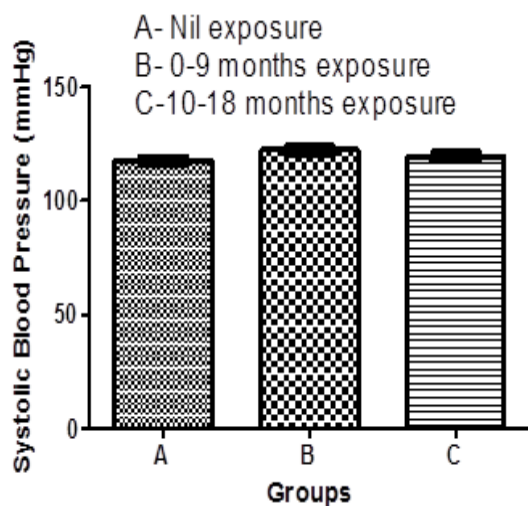


Fig 2: Mean systolic blood pressure of medical students following chronic exposure to formaldehyde

In another study carried out among morticians in Benin City, Nigeria increase in Systolic Blood Pressure, Diastolic Blood Pressure and Mean Arterial Pressure were reported (Ebojele and Iyawe, 2022). Observation from present study among medical students revealed a significant increase in the Pulse Rate (Figure I), Diastolic Blood Pressure (Figure III) and Mean Arterial Pressure (Figure V) in group B with 0-9 months exposure to formaldehyde in the Anatomy laboratory. However, there appears to be a reversal back to normal level among the students in group C who were exposed for 10-18 months. It thus appears from the observation in this present study that the effect of formaldehyde on cardiovascular function among medical student is acute or transient.

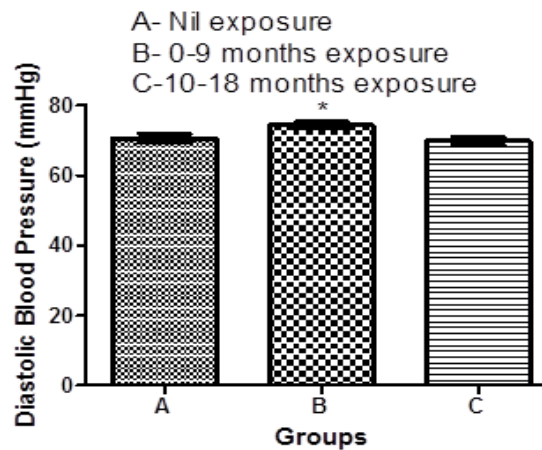


Fig 3: Mean diastolic blood pressure of medical students following chronic exposure to formaldehyde
Significant values are mean \pm SEM compared to control (* = $P < 0.005$; n = 50)

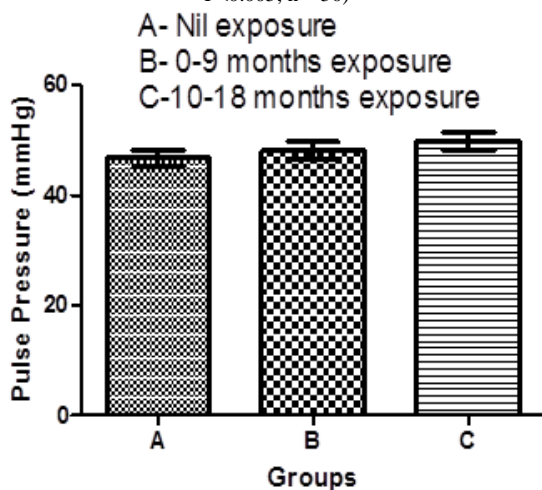


Fig 4: Mean pulse pressure of medical students following chronic exposure to formaldehyde

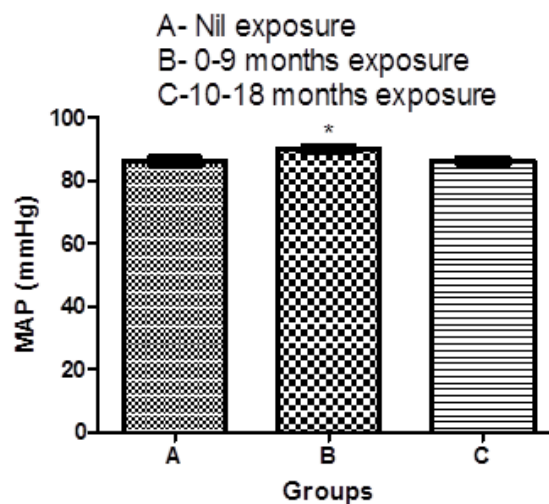


Fig 5: Mean arterial blood pressure (MAP) of medical students following chronic exposure to formaldehyde
Significant values are mean \pm SEM compared to control (* = $P < 0.005$; n = 50)

Unlike in the case of morticians referred to earlier in this discussion where formaldehyde effect increased continuously with increasing duration of exposure, the case of the medical students is the reverse. One possible reason for this difference may be attributed to the fact that the medical students spend shorter period in the Anatomy laboratory after which the exposure is discontinued. Hence, this periodic discontinuation of exposure may have allowed the cardiovascular system enough time to recover and subsequently adapt so that prolonged exposure for another 10-18 months as seen in group C had no visible effect anymore on cardiac function. Nevertheless, in as much as formaldehyde produced an adverse effect among medical students exposed for 0-9 month there is a need to protect their cardiovascular health.

Conclusion: We therefore conclude that measures should be taken to reduce the atmospheric level of formaldehyde in the Anatomy laboratory while on the other hand medical students should be encouraged to use personal protective equipment like facemask as this would help to reduce their exposure to formaldehyde while carrying out dissection in the Anatomy laboratory.

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