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Evaluation of Cardiopulmonary Profile and Atherogenic Indices of Abattoir Operators in Port Harcourt

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Abstract **Original Research Article**

Considering the incidence of rising workplace risks and hazards and how such has largely resulted in more cases of occupational health disorders, the present study evaluated the basic cardiopulmonary and atherogenic profiles of abattoir operators who are resident in Port Harcourt. The purposive/snowball sample size selection tools were used to recruit the subjects of this study. A total of 60 consenting subjects were surveyed for the study, making up 30 abattoir workers and 30 non-abattoir workers. Numerical data got from the study were subjected to statistical analyses using suitable tools of the IBM Statistical Product and Service Solutions (SPSS) version 25.0. The present study has found that the operators of abattoirs located in Port Harcourt were at the peak of their labour productive age (43.43years) and had a comparatively beneficial BMI mean value (21.44) for their age and body size. The operators of abattoir presented with significant ($p<0.05$) raised occupational risks like elevated hypertension / electrocardiographic dysfunctional risks. There were significantly ($p<0.05$) raised levels of total cholesterol (TC), triglyceride (TG) and low-density lipoprotein cholesterol (LDL-C) in the abattoir operators when compared to those of the non-abattoir operators. In conclusion, regular safety and health education and good health seeking attitude are recommended for the study's participants as to lessen or avert possible debilitating impacts of their job type and environment on their cardiopulmonary profiles.

Keywords: Occupational health impacts; cardiopulmonary profiles; atherogenic indices; abattoir operators; Port Harcourt.

INTRODUCTION

It is widely understood that workplace risks and hazards intensify the incidences of occupational diseases (Takala *et al.,* 2012; Rushton, 2017). For example, work accidents, work-related health challenges, disability and unfitness, and other new challenges (Ulutaşdemir *et al.,* 2015). Along with these potential risks, workplace accidents are usually associated with probable negative economic and non-economic impacts on quality of work, worker productivity, work schedule, project cost, stakeholder relations, and corporate reputation (Karakhan & Gambatese, 2018; Tamuno-Opubo *et al.,* 2025). Considering the foregoing, the constant monitoring of occupational hazards is important in order to ensure that employees are safe and healthy (Papadopoulos *et al.,* 2010; Raja & Iqbal, 2019). Of course, to achieve this, the workplace must comply with safety and health regulations. Monitoring helps identify potential risks and take corrective actions to protect employees (Stanton & Stam, 2006).

Specifically, considering the abattoir or slaughterhouse in an urban setting; its main essence is to ensure the safety of the meat from a public health perspective, and meat inspection is a crucial instrument for controlling animal diseases and ensuring public health (Njisane & Muchenje, 2016; Bandaw & Herago, 2017). Indeed, the slaughterhouse can serve as a livestock disease surveillance facility (García-Díez *et al.,* 2023). While it is valuable to have consumers' top priorities on food safety and quality, the health and safety of the abattoir operators should be of great importance as well (Gebeyehu & Tsegaye, 2022; Jerie & Matunhira, 2022).

Truly, a more balanced perspective of health and safety with respect to a typical urban abattoir is the general well-being of both the populace and the operators of abattoir/slaughterhouse, as such, the thought of the health/safety of the operators, the meat/product and the public at large is more holistic (García-Díez *et al.,* 2023).

Accordingly, the present study set out to evaluate basic cardiopulmonary and atherogenic profile of abattoir operators who are resident in Port Harcourt.

MATERIALS AND METHODS

Study Design

The investigation used the cross-sectional approach to unevaluated the possible link between cardiopulmonary and atherogenic profiles of abattoir operators and their work nature/workplace. As earlier reported by Tamuno-Opubo *et al.,* (2025), the approach was adequate to efficiently understand the nature and extent of workplace danger confronting this set of workers. The approach juxtaposed collation of data on various cardiopulmonary/atherogenic health indicators and work-related exposures.

Study Area

The study area was Port-Harcourt Metropolis and Port Harcourt is an urban area that serve as the capital of Rivers State of Nigeria. The study area is a known home to many multinationals who divergent population. With a considerably large population, the metropolis places a huge demand on both dairy and beef/meat products to meet their protein nutrient needs. Thus, the need for the multiple and dispersed abattoirs or slaughterhouses around the city. As earlier stated, the abattoir is a specialized facility saddled with the responsibility of overseeing the proper handling, stunning, butchering, bleeding, dressing, and cleaning of animals in order to produce meat fit for human consumption. The facility helps to guarantee food safety, operations include carcass processing, waste disposal or waste management (hides, rendering). Thus, there would be need to rigorously maintain high hygiene levels.

Indeed, on all a large scale, the activities in a typical abattoir, like other related facilities, is capable of seriously affecting both operators themselves and close-by residents (Akpanama & Ekenta, 2022; Tamuno-Opubo *et al.,* 2024). All of the foregoing amongst others informed the choice of the present study area for this evaluation.

Study Population

The study population was made up of abattoir or slaughterhouse workers dispersed through the Port Harcourt Metropolis, Rivers State.

Sample Size and Sampling Methods

In view of the dispersed distribution of the study population as well as the difficulty involved determining a precise population size, the purposive and snowball sample size determination tools were employed. Exactly 30 abattoir workers and another 30 non-abattoir workers, summing up to 60 were recruited for the present study.

Eligibility Criteria

The criteria for eligibility to participate in the study included consenting apparently healthy male workers within 18 to ≤50 years; who have been on the job for not less than two years. The non-abattoir workforce participants were recruited using convenience sampling from non-exposed population in similar location with comparable demographic attributes in order to decrease confusing factors. Those that fell out of the aforementioned criteria were not considered.

Methods of Data Collection

Standard measuring devices/apparatuses and a semi-structured questionnaire were adopted to collate the data. The survey considered health status, duration of exposure and other demographic information. Trained and skilled research assistants were used to administer the questionnaire and obtain measurements and samples from the study participants. Following issuance of consent by the study participants, blood samples were got from the antecubital vessel by phlebotomists, by means of standard procedures.

Methods of Data Analysis

Numerical data obtained from the study participants were statistically analysed using version 25.0 of the IBM Statistical Product and Service Solutions (SPSS) software. Statistical significance was conducted using one-way analysis of variance (ANOVA) and then followed by post-Hoc LSD multiple comparison test. A P-value less than 0.05 were taken to be statistically significant. Virtually all data were presented as mean ± standard deviation (SD).

Ethical Consideration/Informed Consent

The approval for the study was sought and got from the Research Ethics Committee of the Department of Human Physiology, Faculty of Basic Medical Sciences, Rivers State University, Nigeria as well as other relevant civic agencies. Properly signed consent letter were as wel received from the study participants before there recruited by the study.

RESULTS

This section presents the results of the study in tables and charts and was interpreted accordingly.

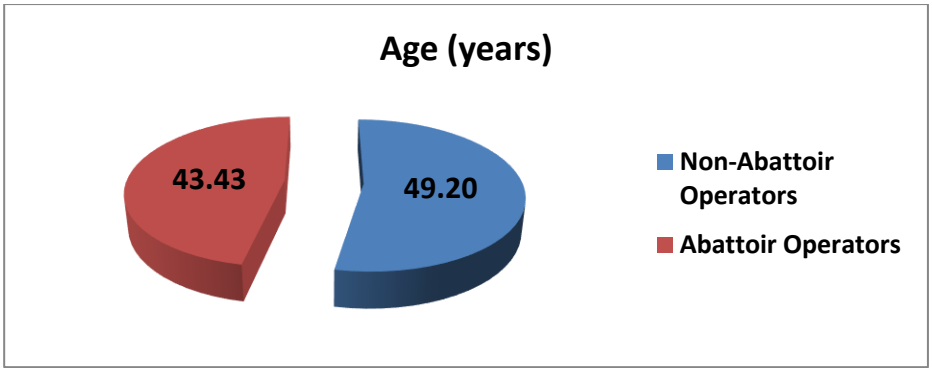

Figure 1: Age Distribution of Participants of the study

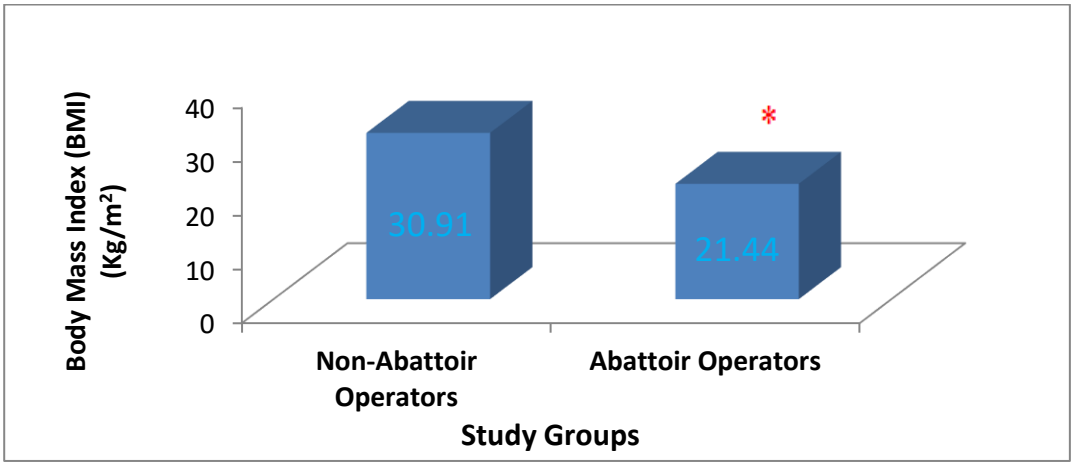

Figure 2: Variations of Body Mass Index (BMI) across Non-Abattoir operators and Abattoir Operators Resident in Port Harcourt

Values are expressed as Mean ± SD; n=30; *Significant at P<0.05 when the respective values of the Abattoir operators are compared to those of non-abattoir operators.

The data on Figure 1 displays the age distribution of the study participants.

The mean age of the non-abattoir subjects was 49.20 years; while that of the abattoir subjects was 43.43 years. The mean ages of the two set of subjects only varied narrowly as were all just before their Middle Ages.

Considering the outcome of the present study body mass index (BMI), it was found that the abattoir operators had significantly (p<0.05) reduced value when compared to their non-abattoir operator counterparts.

Table 1: Comparison of Blood Pressure Parameters of Non-Abattoir operators and Abattoir Operators Resident in Port Harcourt

S/N	Parameters	Study Groups	
		Non-Abattoir operators	Abattoir operators
1.	**SBP (mmHg)**	121.97 ± 17.71	129.10 ± 13.02*
2.	**DBP (mmHg)**	74.00 ± 10.83	87.33 ± 11.03*
3.	**MAP (mmHg)**	89.99 ± 12.10	101.23 ± 11.03*

Values are expressed as Mean ± SD; n=30; *Significant at P<0.05 when the respective values of the Abattoir operators are compared to those of non-abattoir operators.

Table 1 shows the comparison of blood pressure parameters of non-abattoir operators and abattoir operators who are resident in Port Harcourt.

The result indicated significant (P<0.05) elevations for systolic blood pressure (SBP)), diastolic blood pressure (DBP) and mean arterial pressure in the abattoir operators when their values were compared to those of the non-abattoir operators.

Table 2: Electrocardiographic Changes in Non-Abattoir operators and Abattoir Operators Resident in Port Harcourt

S/N	ECG Findings on Heart Rhythm	Study Groups	
		Non-Abattoir operators [Frequency (%)] (n=30)	Abattoir operators [Frequency (%)] (n=30)
1.	Normal sinus rhythm	30(100)	6(20)
2.	Sinus Bradycardia		2(6.67)
3.	Sinus Tachycardia	-	3(10)
4.	Sinus arrythmea with first degree AV block, premature arterial complexes	-	1(3.33)
5.	Sinus rhythm with abnormal findings	-	19(63.33)

(Source: Field Research Data by Researcher).

Table 2 shows the electrocardiographic changes in non-abattoir operators and abattoir operators' resident in Port Harcourt.

All of the non-abattoir operators indicated sinus rhythm with normal electrocardiographic (ECG) findings. The outcome on ECG changes amongst the abattoir operators revealed 20% of them presenting normal sinus rhythm. The rest of this sub-population presented with sinus bradycardia (6.67%), sinus tachycardia (10%) and sinus arrythmea with first degree AV block, premature arterial complexes (3.33%); they also indicated showed sinus rhythm with abnormal findings ranging from left axis deviation, left/ or ventricular hypertrophy, incomplete right bundle branch block, left axis, deviation to clockwise QRS rotation. Further, this 20% sub-population presented with sinus rhythm with no abnormal ECG findings while another 20% indicated sinus tachycardia.

Table 3 below represents the outcome on comparison of variations in lipid profile of non-abattoir operators and Abattoir Operators Resident in Port Harcourt.

The result revealed significantly ($p<0.05$) raised levels of total cholesterol (TC), triglyceride (TG) and low-density lipoprotein cholesterol (LDL-C) in the abattoir operators when compared to those of the non-abattoir operators.

Only the high-density lipoprotein cholesterol (HDL-C) level in the abattoir operators was found to be marginally high when compared to that of the non-abattoir operators.

Table 3: Comparison of Variations in lipid profile of non-abattoir operators and Abattoir Operators Resident in Port Harcourt

Group and Treatment	Study Groups	
	Non-Abattoir Operators	Abattoir Operators
Total Cholesterol (TC) (mmol/L) (3.5-6.8mmol/L)	3.01 ± 0.51	3.69 ± 1.13*
Triglyceride (TG) (mmol/L) (0.68-1.58 mmol/L)	1.04 ± 0.20	1.58 ± 0.95*
High-density lipoprotein cholesterol (HDL-C) (mmol/L) (0.8-1.8 mmol/L)	0.99 ± 0.17	1.07 ± 0.23
Low-density lipoprotein cholesterol (LDL-C) (IU/L) (1.8-4.0 mmol/L)	2.26 ± 0.30	3.31 ± 2.19*

Values are expressed as Mean ± SD; n=30; *Significant at $P<0.05$ when the respective values of the Abattoir operators are compared to those of Non-Abattoir operators.

Table 4: Comparison of changes in atherogenic profile of non-abattoir operators and Abattoir Operators Resident in Port Harcourt

Group and Treatment	Study Groups	
	Non-Abattoir Operators	Abattoir Operators
Atherogenic Index of Plasma (AIP) (-0.3 to.24)	0.05 ± 0.25	0.09 ± 0.29
Atherogenic coefficient (AC) (>3.0)	2.08 ± 0.42	2.50 ± 1.08*
Castelli risk index (CRI-1) (>3.5)	3.08 ± 0.42	3.50 ± 1.08*

Values are expressed as Mean ± SD; n=30; *Significant at P<0.05 when the respective values of the Abattoir operators are compared to those of non-abattoir operators.

The data on Table 4 above represent the result of the comparison of changes in atherogenic profile of non-abattoir operators and abattoir operator's resident in Port Harcourt.

All the indices of atherogenic profile [atherogenic index of plasma (AIP), atherogenic coefficient (AC) and Castelli risk index 1 (CRI-1)] were found to be elevated in the abattoir operators but only AC and CRRI-1 were statistically significant (p<0.05).

Table 5: Comparison of some Lung Function Indices between Non-Abattoir operators and Abattoir Operators Resident in Port Harcourt

S/N	Parameters	Study Groups	
		Non-Abattoir operators	Abattoir operators
4.	FVC (%)	92.53 ± 4.70	37.50 ± 19.24*
5.	FEV1 (%)	88.96 ± 5.89	46.81 ± 5.52*
6.	FEV6	93.08 ± 5.02	37.50 ± 19.24*
7.	FEV1/FVC	95.60 ± 4.39	91.61 ± 28.60*

Values are expressed as Mean ± SD; n=30; *Significant at P<0.05 when the respective values of the Abattoir operators are compared to those of non-abattoir operators.

Note: FVC = forced vital capacity, FEV1 = forced expiratory volume in 1 second, FEV6 = forced expiratory volume in 6 seconds and FEV1/FVC = FEV1/FVC ratio

The data displayed on Table 5 represent the result of the comparison of some lung function indices between non-abattoir operators and abattoir operator's resident in Port Harcourt.

The outcomes on the forced vital capacity (FVC) level, forced expiratory volume in 1 second (FEV1) and forced expiratory volume in 6 seconds (FEV6) and FEV1/FVC ratio showed significantly (p<.0.5) decreased levels when they were respective compared to those of the non-abattoir operators. Thus, the abattoir operators presented with depressed pulmonary function indices.

DISCUSSION

It has been reported that workplace risks and hazards increase occupational diseases, work accidents, work-related health challenges, disability and unfitness, as well as emergence of new problems (Ulutaşdemir *et al.,* 2015). Along with this potential harm, workplace accidents are associated with potential negative economic and noneconomic impacts on quality of work, worker productivity, work schedule, project cost, stakeholder relations, and corporate reputation (Karakhan & Gambatese, 2018). Considering the foregoing, the constant monitoring of occupational hazards is important in order to ensure that employees are safe and healthy, and that the workplace is compliant with safety and health regulations. Monitoring helps identify potential risks and take corrective actions to protect employees (Stanton & Stam, 2006).

Consequently, the present study has made useful evaluations on abattoir operators' resident in Port Harcourt and put forward the discussion of the discussion of the relevant findings in the following paragraphs.

The present study found that the mean age of the non-abattoir subjects was 49.20 years; while that of the abattoir subjects was 43.43 years. The mean ages of the two set of subjects only varied narrowly as were all just before their middle-ages. According to Aubert & Crépon, (2003), productivity increases with age until age 40 and then remains stable after this age. Thus, this finding of the present study is an indication that the surveyed abattoir operator's resident in Port Harcourt are at the peak of labour productivity age. So, there will be need to ensure the improvement of productivity enhancement indices to maximize productions at this level.

In another finding of this study, the body mass index (BMI) of abattoir operators had significantly reduced value when compared to their non-abattoir operator counterparts. This finding is very unique to this study and reveals that the much physical activities associated with operating the abattoir can rule out the known effect of sedentary lifestyle on BMI of a given populace (Hills *et al.,* 2007). Thus, this finding of the present study as shown that the surveyed abattoir operators' resident in Port Harcourt has a lower mean BMI for their age but yet within the normal range. This is indeed a beneficial health attribute for the abattoir operators as their counterparts who are non-abattoir operators in the same location were having a BMI indicating obese class I.

One of the main findings of the present study was on the evaluation of changes of blood pressure parameters in the abattoir operator's resident in Port Harcourt. It revealed significant (P<0.05) elevations for systolic blood pressure (SBP), diastolic blood pressure (DBP) and mean arterial pressure in the abattoir

operators when their values were compared to those of the non-abattoir operators.

Earlier reports have it that many factors can increase the risk of high blood pressure, and such may include: lifestyle like unhealthy diet, smoking, drinking too much alcohol, physical inactivity, and being overweight or obese. Other factors include family history (i.e. having biological family members with high blood pressure); age (being over 65 years old); co-existing diseases (like having diabetes, kidney disease, chronic kidney disease, metabolic syndrome, obstructive sleep apnea, or thyroid disease); environmental factors (including air pollution); medications; stress (experiencing high-stress situations) and race or ethnicity (Lawes *et al.,* 2004; Fuchs & Whelton, 2020). According to Mackie et al.., (2015), some risk factors, like age and family history, can't be controlled, but others can be changed to lower your risk.

Thus, placing the above result on the blood pressure of the abattoir operator with the foregoing reports, it can be suggested that, lifestyle, environmental factors and tress may be responsible for the remarkably elevated blood pressure parameters of the subjects. There is thus, a great need for the moderation or modification of such factors as to reduce their risk of hypertension and other associated cardiovascular disorders.

Furthermore, the present study found that the forced vital capacity (FVC) level, forced expiratory volume in 1 second (FEV1) and forced expiratory volume in 6 seconds (FEV6) and FEV1/FVC ratio showed significantly decreased levels when they were respective compared to those of the non-abattoir operators. Although, this outcome was expected, giving that the operations, lifestyle, and environments are notable risk factors, but the fact that all surveyed pulmonary indices were reduced significantly reduced is something to be worrisome; as this is a clear pointer to possible respiratory disorders. For instance, the FEV1/FVC ratio represents the proportion of a person's vital capacity that they are able to expire in the first second of forced expiration to the full, forced vital capacity. A reduction in this ratio may imply obstructive or restrictive lung disorder. Thus, the abattoir operators, as seen from the current study, presented with depressed pulmonary function indices.

The result on variations in lipid profile, revealed significantly raised levels of total cholesterol (TC), triglyceride (TG) and low-density lipoprotein cholesterol (LDL-C) in the abattoir operators when compared to those of the non- abattoir operators. The elevation in HDL-C level in these subjects was not significant. High levels of TC, TG and LDL-C can result in higher likelihood of the incidence of CVDs including: coronary artery disease, peripheral artery disease, chest pain (angina) and heart attack, etc., (Yeang *et al.,* 2015; Navarese *et al.,* 2018). From the above result of the present study, it is thus suggestive to state that, lipid profile of the abattoir operators in Port Harcourt points at the high tendency to present with both metabolic and cardiovascular disorders.

The study found that all the indices of atherogenic profile [atherogenic index of plasma (AIP), atherogenic coefficient (AC) and Castelli risk index 1 (CRI-1)] were elevated in the abattoir operators but only AC and CRRI-1 were statistically significant ($p<0.05$).

Increase in AIP values increase is understood to be associated with increasing cardiovascular (CV) risk. Usually, AIP values of -0.3-0.1 are associated with low CV risk, 0.1-0.24 are associated with medium and above 0.24 is associated with high CV risk (Niroumand *et al.,* 2015).

For the AC values, it is helpful in diagnostic measurement of atherosclerotic risk used by clinicians. On the other hand, CRI-1 is an atherogenic index that is frequently used for risk assessment of coronary artery diseases (CAD) as well as cardiovascular diseases (Abid *et al.,* 2021).

Considering the outcome of the present study with earlier reports on the implications of changes in atherogenic indices, it can be posited here that, the abattoir operators by their predispositions, may be prone to cardiovascular disorders, atherosclerotic risk and coronary artery diseases (CAD). Lifestyle moderations and proper health care can helpful in averting the possible adverse effects of these risks.

CONCLUSION

The present study has revealed that operators of abattoir resident in Port Harcourt are at the peak of their labour productive age (43.43years) and have a comparatively beneficial BMI mean value (21.44) for their age and body size. On the other hand, the operators of abattoir resident in Port Harcourt are faced with a number of significant occupational hazards, including and raised hypertension/cardiovascular disorder dysfunction risks. Standard design and good environmental hygiene should therefore, be always taken into account in order to guarantee that occupational health hazards among abattoir workers are properly controlled. From the finding of this study, it is recommended that operators of abattoir resident in Port Harcourt should monitor the effectiveness of the measures they put in place and control the risks in their workplace.

The outcome on variations in lipid profile, indicated significantly raised levels of total cholesterol (TC), triglyceride (TG) and low-density lipoprotein cholesterol (LDL-C) in the abattoir operators when compared to those of the non- abattoir operators. It was also noticed that the abattoir operators by their

predispositions, may be prone to cardiovascular disorders.

Accordingly, it is suggestive to state here that the operators of abattoir resident in Port Harcourt may be faced with several substantial occupational hazards, like elevated incidences of hypertension/cardiovascular disorder and dyslipidemic conditions. Good lifestyle moderations and good environmental hygiene should therefore, be always be considered as to prevent against occupational health hazards among abattoir workers. All current laws governing abattoir operations should be applied, and the regulatory authorities should implement an exposure control plan that includes risk identification/classification and quantification as well as assessment of workers at risk and risk control. Regular safety and health training and good health seeking attitude should also be promoted amongst operators of abattoir resident in Port Harcourt.

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