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# Assessment of Peak Expiratory Flow Rate and Other Cardiometabolic Parameters of Meat Roasters (Mai Suya) in Kano Nigeria

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## Abstract
*Occupational exposure to wood smoke and oil fumes is an important cause of respiratory problems. Meat roasting exposes workers to hazard of wood smoke and oil fumes. The aim of this study was to assess peak expiratory flow rate (PEFR) and other cardiometabolic parameters of meat roasters (Mai suya) in Kano, Nigeria. A total of 105 participants consisting of 55 meat roasters and 50 controls were recruited. All participants were assessed for PEFR, pulse rate, oxygen saturation, blood pressure, weight, height, and body mass index (BMI) according to standard protocols. Data were analyzed using SPSS version 23.0 and p value ≤ 0.05 was considered statistically significant. Mean age of the meat roasters and controls was 30.64±10.28 and 23.68±3.15 years. Meat roasters had statistically significant lower PEFR (243±85.35 vs 377.40±64.93 mL/min; p = 0.01), elevated diastolic pressure (81.91±6.64 vs 78.36±4.59 mmHg; p = 0.01), mean arterial pressure (94.12±7.96 vs 90.75±4.88 mmHg; p = 0.01) and BMI (19.53±2.40 vs 18.49±2.08 kg/m$^2$; p = 0.02) compared to the controls. Number of years of working as meat roaster was positively correlated with systolic pressure (r = 0.67, p = 0.01), diastolic pressure (r = 0.41, p = 0.01), mean arterial pressure (r = 0.60, p = 0.01), BMI (r = 0.37, p = 0.01), and pulse rate (r = 0.46, p = 0.01). Meat roasting is associated with impaired lung function and altered blood pressure. Routine assessment of lung function and use of safety equipment should be encouraged among meat roasters.*

**Keywords**: peak expiratory flow rate, mai suya, wood smoke, oil fumes

## INTRODUCTION
Respiratory diseases are one of the leading causes of morbidity and mortality globally. Together, they constitute the third leading cause of death (Forum for International Respiratory Societies [FIRS], 2017). According to FIRS (2017), an estimated 65 million people suffers from chronic obstructive pulmonary disease (COPD) with 3 million deaths annually; about 334 million people suffer from asthma while 14% of all children are affected by it globally; Pneumonia is a leading cause of death among children under the age of five; and about 4 million people die from chronic respiratory diseases prematurely. In Nigeria, a hospital-based morbidity and mortality review in southeast reported that, respiratory problems account for about 9.3% of total admissions into medical wards (Umoh *et al*., 2013).

One major risk factor for respiratory diseases is exposure to wood smoke and oil perfumes (Liu *et at*., 2007). Wood smoke, tobacco smoke, and oil fumes are frequently emitted when biomass is used as a source of energy. It has been estimated that about two billion people are exposed to outdoor pollutants and tobacco smoke globally and as a result about 50 million

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people are struggling with occupational lung diseases (FIRS, 2017). Indeed, more than 50% of all households and 90% of rural households use biomass as domestic source of energy thereby exposing about 50% of world population (Torres-Duque *et al*., 2008).

In addition to exposure to wood smoke in households, some individuals are continuously exposed to wood smoke and oil fumes due to the nature of their occupation. In a systematic review of literature on exposure to wood smoke and its attendant health effects in sub-Saharan Africa, Bede-Ojimadu and Orisakwe (2020) reported that, occupational exposure to wood smoke is one of the major sources of exposure to air pollutants. They also reported a strong and consistent association between occupational exposure to wood smoke and respiratory diseases including impaired lung function and elevation of blood pressure (Bede-Ojimadu and Orisakwe, 2020).

Meat roasting, a form of barbecue, in which meat is prepared over open burning fire mainly from wood is a common occupation especially in northern Nigeria. This practice exposes individuals to wood smoke in addition to oil fumes thereby putting them at risk of various respiratory diseases. Despite high prevalence of this occupational exposure to wood smoke in northern Nigeria, there is little literature looking at its possible respiratory health effects. Furthermore, the few studies that did look at the problem did so by using spirometer, an advanced tool use in assessing lung function. Peak expiratory flow meter is a simple tool that can be used quickly and easily to assess lung function even at work places (Daman, 1984). The aim of this study was to assess peak expiratory flow rate and other cardiometabolic parameters of meat roasters (Mai suya) in some selected local government areas in Kano state, Nigeria.

## MATERIALS AND METHOD

### Study area and sampling technique

The study was conducted in three metropolitan local government areas of Kano state: Kumbotso, Gwale,and Ungogo. The study population was made up of all meat roasters in these local government areas. Multistage sampling technique was employed to select the three local government areas out of the 44 local government areas in the state. One political ward each from the three local government areas was selected using simple random sampling technique: Rijiyar zaki ward in Ungogo, Kabuga in Gwale and Na'ibawa in Kumbotso local government areas. A comprehensive list of all meat roasting places in these wards were generated and simple random sampling used to select 25 from which 55 consenting participants were recruited. Fifty non-meat roasting participants were recruited from Faculty of Basic Medical Sciences, Bayero University, Kano. All participants were initially screen for history of any respiratory problem, heart diseases, and use of psychoactive substances. Those found to be having these problems were excluded from the study.

### Study design and sample size determination

The study was a cross sectional comparative study. G*power computer software was used to determine minimum sample size. An α level of significance of 0.05, an effect size of 0.5, and a power of 0.8 were used which gave a minimum sample size of 47.

### Ethical clearance

Ethical approval was obtained from Kano State Ministry of Health and all participants were required to sign an individual informed consent form before commencement of the study.

**Data collection**

A data capture form was used to collect sociodemographic information of the participants. Results of clinical, anthropometry, PEFR, and oxygen saturation were also entered into the form.

Peak expiratory flow rate was determined using an Omron peak flow meter, PF9940 (Omron healthcare Inc., USA, IL) according to manufacturer's specification. The mouth piece of the meter was thoroughly cleaned, participants were made to sit down comfortably, and the pointer of the meter was placed at the 50 mark. Each participant was asked to take a deep breath and blow forcefully into the meter. The procedure was repeated three times by each participant and the average of the three results was taken. Pulse rate and oxygen saturation were assessed using digital fingertip Pulse oximeter, FS20F (Shenzhen Viatom, Technology Co., Ltd., China). The oximeter gives automated pulse rate and oxygen saturation digitally once it is placed on the participant's fingertip.

Blood pressure was measured with the participant seated using a mercury sphygmomanometer (Accoson™ Ltd., Ayrshire, UK) and Littmann's stethoscope (3M Littmann®, Minnesota, USA). Systolic pressure was taken as the first appearance of Korotkoff's sound and its disappearance was considered diastolic. Weight and height were measured following standard protocol (Lohman *et al*, 1988). Weight was measured using Omron HN286 digital weighing scale (Kyoto, Japan) with the participant wearing light clothing while height was measured using stadiometer with the participant without shoes or cap, standing erect and facing forward. Body Mass Index was calculated as weight in kg divided by height in meter squared ($kg/m^2$).

**Statistical analysis**

Data were analyzed on SPSS version 23.0. Independent t test was used to compare mean values of quantitative variables. Pearson's correlation coefficient was used to determine relationship between number of years of working as meat roaster with other quantitative variables. Results were presented as frequencies, proportions, and mean±SD. $p$ value ≤ 0.05 was considered statistically significant.

**RESULTS**

A total of 105 participants consisting of 55 meat roasters and 50 non-meat roasters were recruited for the study. The meat roasters were significantly older than the non-meat roasters (30.64±10.28 vs 23.68±3.15; t = 4.59; $p$ = 0.01). While majority of the meat roasters were married (65%), 98% of the non-meat roasters were singles. Similarly, majority of the participants in the two groups are of Hausa ethnicity and were non-smokers. However, while all the non-meat roasters had western education, only 26% of the meat roasters had some level of western education. Results of sociodemographic characteristics of the participants are shown on table 1.

The meat roasters had statistically significant lower PEFR compared to the non-meat roasters (243±85.35 vs 377.40±64.93; t = -8.99; $p$ = 0.01). This implies impaired lung function among the meat roasters compared to the controls. Similarly, the meat roasters had significantly higher diastolic blood pressure (81.91±6.64 vs 78.36±4.59; t = 3.15; $p$ = 0.01) and mean arterial blood pressure (94.12±7.96 vs 90.75±4.88; t = 2.59; $p$ = 0.01) compared to the controls. Even though there was no statistically significant difference in systolic blood pressure among the two groups, the higher diastolic and mean arterial blood pressures among the meat roasters could indicate a possible impairment in blood pressure. The meat roasters also had statistically

significant higher BMI compared to the control group (19.53±2.40 vs 18.49±2.08; t = 2.37; *p* = 0.02) even though the two groups were of similar height and weight – table 2.
When the number of years working as meat roaster was correlated with PEFR and other cardiorespiratory parameters using Pearson's correlation, only systolic blood pressure (r = 0.67, p = 0.01), diastolic blood pressure (r = 0.41, *p* = 0.01), mean arterial blood pressure (r = 0.60, *p* = 0.01), BMI (r = 0.37, *p* = 0.01), and pulse rate (r = 0.46, *p* = 0.01) were positively correlated with it - table 3. This indicates that the longer a person stays in the occupation of meat roasting the worst the person's blood pressure indices and BMI.

Table 1: Sociodemographic characteristics of the participants

| **Variable** | **Controls n=50 N(%)** | **Cases n=55 N(%)** | **$X^2$** | ***p* value** |
|---|---|---|---|---|
| Marital status | | | | |
| Single | 49(98) | 19(35) | 46.21 | 0.01* |
| Married | 1(2) | 36(65) | | |
| Ethnicity | | | | |
| Hausa | 29(58) | 47(86) | 9.92 | 0.02* |
| Fulani | 11(22) | 4(7) | | |
| Others | 10(20) | 4(7) | | |
| Western Education | | | | |
| No | 0(00) | 41(74) | 90.15 | 0.01* |
| Yes | 50(100) | 14(26) | | |
| Smoking | | | | |
| No | 50(100) | 52(95) | 2.81 | 0.09 |
| Yes | 0(00) | 3(5) | | |

*Statistically significant association. Cases = meat roasters.

Table 2: Mean age, PEFR, and other cardiorespiratory parameters of the participants

| **Variable** | **Controls Mean±SD** | **Cases Mean±SD** | **t statistic** | ***p* value** |
|---|---|---|---|---|
| Age (years) | 23.68±3.15 | 30.64±10.28 | 4.59 | 0.01* |
| SBP (mmHg) | 115.90±7.69 | 118.91±13.31 | 1.40 | 0.16 |
| DBP (mmHg) | 78.36±4.59 | 81.91±6.64 | 3.15 | 0.01* |
| MAP (mmHg) | 90.75±4.88 | 94.12±7.96 | 2.59 | 0.01* |
| Height (m) | 1.78±0.10 | 1.75±0.11 | -1.29 | 0.20 |
| Weight (kg) | 58.40±5.82 | 59.96±7.66 | 1.17 | 0.25 |
| BMI ($kg/m^2$) | 18.49±2.05 | 19.53±2.40 | 2.37 | 0.02* |
| PEFR (mL/min) | 377.40±64.93 | 243.27±85.35 | -8.99 | 0.01* |
| $O_2$ Saturation (%) | 96.82±1.12 | 96.78±1.05 | -0.18 | 0.86 |
| Resp rate (cycles/min) | 15.92±1.66 | 15.93±1.79 | 0.02 | 0.98 |
| Pulse rate (b/min) | 72.64±4.80 | 72.08±7.46 | -0.52 | 0.61 |

*Statistically significant, SBP = Systolic blood pressure, DBP = Diastolic blood pressure, MAP = Mean arterial blood pressure, BMI = Body mass index, PEFR = Peak expiratory flow rate, cases = meat roasters.

Table 3: Correlation between number of years working as meat roaster and other cardiorespiratory parameters of the participants

| **Variable** | **r** | **$r^2$** | ***p* value** |
|---|---|---|---|
| SBP | 0.67 | 0.45 | 0.01* |
| DBP | 0.41 | 0.17 | 0.01* |
| MAP | 0.60 | 0.36 | 0.01* |
| Height | -0.18 | 0.03 | 0.20 |
| Weight | 0.15 | 0.02 | 0.27 |
| BMI | 0.37 | 0.14 | 0.01* |
| PEFR | -0.21 | 0.04 | 0.12 |
| $O_2$ Saturation | 0.04 | 0.00 | 0.77 |
| Resp rate | 0.07 | 0.00 | 0.63 |

| | | | |
|---|---|---|---|
| Pulse rate | 0.46 | 0.21 | 0.01* |

Statistically significant, SBP = Systolic blood pressure, DBP = Diastolic blood pressure, MAP = Mean arterial blood pressure, BMI = Body mass index, PEFR = Peak expiratory flow rate.

## DISCUSSION

This study assessed PEFR and other cardiometabolic parameters among meat roasters in Kano Nigeria. The meat roasters had statistically significant lower PEFR compared to controls suggesting possible impaired lung function. This is similar to what was reported by Mabonga *et al.* (2021). They reported lower PEFR among Malawians exposed to biomass fuel in indoor cooking environments. Another group of researchers reported air flow obstruction and impaired lung function among Cameroonians exposed to indoor biomass compared to controls (Ngahane *et al*., 2015). Equally, Kurmi *et al.* (2013) reported reduced ventilatory function and air flow obstruction among young adults exposed to biomass fuel in rural areas of Nepal. However, this finding is in contrast to what were reported by other researchers (Isara *et al*., 2016; Obiebi and Oyibo, 2019). In their study of Quarry workers in Edo state southsouth Nigeria, Isara *et al.* (2016) noted no significant difference in mean PEFR between the study group and controls. Conversely, Obiebi and Oyibo (2019) found non-statistically significant higher mean PEFR among charcoal workers in southern Nigeria compared to controls. This study was conducted among meat roasters that are directly exposed to the products of combustion of biomass fuel in contrast to quarry and charcoal dusts in their studies. This could explain why they did not find significant difference in PEFR among their study participants.

Studies reporting impairment in lung function and respiratory symptoms among different group of people exposed to biomass fuel is overwhelming. Exposure to excessive amount of biomass fuel has been strongly associated with chronic obstructive pulmonary disease (COPD) (Liu *et al*., 2007; Po *et al*., 2011) and respiratory symptoms (Kurmi *et al*., 2014). Indeed, in a systematic review and meta-analysis of published works, Po *et al.* (2011) reported association between exposure to biomass fuel and acute respiratory infection in children and chronic bronchitis and COPD in women. In another systematic review exclusively for African studies, Bede-Ojimadu and Orisakwe (2020) reported strong and consistent association between exposure to wood smoke and respiratory diseases including impaired lung function. However, while there seems to be consistent association between exposure to biomass fuel and COPD and respiratory symptoms, that of asthma remain inconsistent (Po *et al*., 2011). In their systematic review and meta-analysis of literature on possible association between exposure to biomass fuel and asthma, Po *et al.* (2011) found no association between exposure and asthma.

The meat roasters had statistically significant higher diastolic and mean arterial blood pressures compared to the controls even though there was no significant difference in systolic blood pressure. Similarly, systolic blood pressure, diastolic blood pressure, mean arterial blood pressure and pulse rate were positively correlated with number of years working as meat roaster. This suggests an increased risk of cardiovascular disease in people exposed to biomass fuel and oil fumes. Similar changes in blood pressure as a result of exposure to biomass fuel in different cohorts have also been reported by many authors (Quinn *et al*., 2016; Alexander *et al*., 2017; Quinn *et al*., 2017; Ofori *et al*., 2018). Quinn *et al*. (2017) in Ghana Randomized Air Pollution and Health Study reported that peak carbon monoxide, a major constituent of biomass fuel, exposure 2 hour before blood pressure measurement was associated with hourly elevation in systolic blood pressure (4.3 mmHg) and diastolic blood pressure (4.5mmHg) compared to blood pressure during low carbon monoxide exposure. They also found use of clean energy cookstoves that emits no carbon monoxide to be associated with significant lower systolic blood pressure post intervention (Quinn *et al*., 2017). In another segment of the same Ghanaian Randomized Air Pollution and Health Study, Quinn *et al.* (2016) reported significant positive association between exposure to wood smoke and diastolic blood pressure with non-significant rise in systolic blood pressure among pregnant women. Furthermore, in another randomized controlled trial involving use of clean fuel cookstoves as an intervention, Alexander *et al.* (2017) reported reduction in diastolic blood pressure by 3 mmHg among the intervention group compared to controls. There was however no change in systolic blood pressure. Apart from changes in blood pressure, exposure to biomass fuel has also been implicated in other cardiovascular events. About 0.04 mm increase in carotid artery intima media thickness and increased odds of pre-hypertension have been reported in people exposed to biomass fuel compared to controls (Ofori *et al*., 2018). There seems to be a fairly consistent association between exposure to biomass fuel with diastolic blood pressure even though same cannot be said of systolic blood pressure. Despite this consistency however, some studies reported no association between exposure to biomass fuel and blood pressure. In a prospective study that looked at blood pressure changes in people exposed to indoor biomass fuel, Mabonga *et al.* (2021) found no changes in blood pressure before, during or after exposure except for two participants that were noted to have higher blood pressure after the exposure.

The atmospheric air in many west African countries is polluted with many gases emitted from use of biomass fuel (Alvarez *et al.,* 2020). The near general lack of air quality monitoring policy in most cities in the region complicates the situation even further. Occupational exposure to biomass fuel has thus become an additional source of these gases to those whose occupation is associated with combustion of this type of fuel. Meat roasters are therefore exposed to multiple sources of gases from use of biomass fuel and, hence, at increased risk of developing respiratory symptoms and diseases especially COPD. Routine screening using simple and inexpensive tools like peak flow meter can go a long way in preventing and early detection of these diseases.

## CONCLUSION

Meat roasters had statistically significant lower PEFR, elevated mean arterial blood pressure, and BMI compared to controls. Similarly, systolic blood pressure, diastolic blood pressure, mean arterial blood pressure, pulse rate, and BMI were positively correlated with number of years working as meat roaster. Routine assessment and use of safety equipment among meat roasters in Kano Nigeria should be encouraged.

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