Respiratory Symptoms and Oxygen Saturation Levels of Female Bean Cake (*Kosai*) Fryers in Kano Metropolis

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Abstract

Bean cake (kosai) frying is a common roadside food vendor occupation among women in many parts of the West African region including Kano State, Nigeria. However, the occupation is associated with many health hazards due to exposure to persistent smoke and fumes from the use of unclean cooking energy sources particularly firewood, charcoal and other biomass fuels. This study assessed the prevalence of respiratory symptoms and the oxygen saturation level of female kosai fryers in Kano state. A case-controlled study involving 170 females, comprising 85 kosai fryers (test group) and 85 control participants who had no history of exposure to smoke from frying kosai or similar endeavours. Demographic characteristics, respiratory symptoms as well as oxygen saturation and blood pressure of all participants were measured using standardized procedures. The data obtained was analysed using descriptive and inferential statistics. The alpha level was significant at 0.05. The findings showed that both the test and control group participants had similar demographic characteristics (p>0.05). Participants in the test group (kosai fryers) reported significantly higher rates of occurrence of respiratory symptoms compared to controls as follows; cough (44.7% vs. 18.8%), bringing up phlegm (34.1% vs. 12.9 %), breathlessness (25.9% vs. 9.4 %) and wheeze (20% vs. 8.2 %) (p<0.05, all). Furthermore, the results also indicated that the mean oxygen saturation level was significantly lower among the bean cake fryers compared with the control group participants (97.3±1.65 Vs. 98.4±1.18,p=0.02   p<0.05). Age (p=0.03) and longer duration of working (p=0.01) were more associated with respiratory symptoms compared to other variables assessed in the study. It was concluded that high rates of respiratory symptoms and reduced oxygen saturation levels are common among kosai fryers in the studied population. It was also found that the older kosai fryers and those with longer working durations were more likely to present with these problems. Hence, they can be particularly targeted during appropriate public health interventions.

Keywords: *Respiratory symptoms, oxygen saturation, bean cake, fryers,*

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Introduction

Fried bean cake, or "Akara" or "Kosai", is one of the most popular local dishes in Nigeria due to its cheapness, availability and an important source of plant protein (Ogundele, Ojubanire, & Bamidele, 2014; Adedeji & Ade-Omowaye, 2013). Kosai is made from peeled beans, formed into a ball and fried in oil (Manafa et al, 2020). Frying bean cake is a common trade of cake frying for commercial purposes is associated with a significant occupation that is done on the streets mainly by women in many parts of Nigeria including Kano state. Unfortunately, bean exposure to smoke and oil fumes is due to the use of firewood, nylons, charcoal and biomass. In particular, smoke from firewood constitutes a mixture of gas, liquid and solid in addition to carbon monoxide, fine particles and soot (Manafa et al, 2020). Moreover, the use of protective gear is not a common practice among female bean cake fryers.

The use of cleaner or renewable cooking fuels such as electric stove or cooking gas is quite expensive and still unpopular in low and middle-income countries (Ohimain, 2012; Schlag & Zuzarte, 2008), thereby making firewood and charcoal the readily available option for cooking fuels in many homes. Moreover, exposure to wood smoke and oil fumes is potentially harmful since they both contain toxins and carcinogens such as aldehydes, alkanoic, and polycyclic aromatic hydrocarbons (Adewole *et al.,* 2013; Naeher *et al.,* 2007). Smoke inhalation causes severe ventilation and oxygenation abnormalities (Tanko *et al*, 2008). These harmful substances in turn cause lung airway irritation that triggers presentation with respiratory symptoms even in the short term (Svedahl *et al.,* 2009; Tzanakis *et al.,* 2001). Exposure to biomass smoke is a risk factor for respiratory disease. Fine particles from firewood smoke can induce cytotoxicity, which may negatively affect the lung tissue (Manafa et al 2020). Some respiratory diseases have been linked to a number of chronic respiratory diseases. These include chronic obstructive pulmonary disease (COPD), asthma-COPD overlap syndrome, usual interstitial pneumonitis, hut lung, and bronchial arthrofibrosis and chronic bronchitis (Assad, Kapoor & Sood, 2016). Therefore, individuals, especially women, who are exposed to these emissions are likely to have a higher risk of developing chronic respiratory diseases in the long term (Perez-Padilla et al, 1996; Ekici et al, 2005).

In Nigeria, women exposed to wood smoke have been reported to be at risk of developing obstructive airway diseases (Erhabor, *et al.,* 2002). Likewise, roasted meat vendors (*Mai Suya*) who are exposed to wood smoke and cooking oil fumes have been found to present with respiratory symptoms compared to non-exposed individuals (Adewole *et al.,*2013). The closest study to ours was the case study by Tanko *et al* (2008) who assessed the lung function (using a peak flow meter) and cardiovascular parameters of bean cake fryers in Kaduna state, Nigeria. They reported that the peak expiratory rate significantly decreased with age compared to apparently healthy individuals. Presently, little or no information is available on respiratory symptoms

such as cough, phlegm, wheezing and breathlessness and oxygen saturation levels of female bean cake fryers. Hence, this study. We hypothesize that female bean cake fryers will present with more respiratory symptoms and reduced oxygen saturation levels.

Methods

This study employed a case-control design to compare the respiratory symptoms and oxygen saturation levels between female bean cake fryers and a control group. The participants were recruited using a purposive sampling technique, which is a non-probability sampling technique. The control group participants involved females of similar age (age grouping) as the test group, and were also purposively recruited from within the same environment as the participants in the test group. Study questionnaires were distributed to the participants based on convenience after obtaining their consent This study procedure was approved by the Ethical Committee of the Ministry of Health Kano, Kano State (MOH/OH/797/14/1382).

Participants

Female bean cake fryers were contacted and selected to participate in this study using a purposive sampling technique from the township of Dala Local Government Area of Kano State. The recruitment of the participants was done by randomly selecting an index political ward within Dala LGA. If the sample size required was not exhausted, other adjoining wards were then included.

The bean cake fryers were met at their place of trade on the streets during the early hours of each day of the data collection (7 am to 9 am). After explaining the process and objectives of the study, those who were willing to participate in the study and gave written/informed consent were included. The female bean cake fryers who smoke cigarettes, or have a history of thoracic surgery or suffer from asthma or other chronic respiratory diseases (self-reported) were excluded. Also, a control group was recruited and it comprised females of similar age groups within the study area. The control group participants mainly comprised females involved in other trades or occupations that did not involve exposure to cooking smoke

Questionnaire Administration

Participant's respiratory symptoms (cough, phlegm, wheezing, breathlessness as well as lifestyle) were assessed using a Hausa-translated version of the Respiratory Symptom Questionnaire, which was developed by the Medical Research Council and has been in use for over 60 years, The questionnaire is reliably correlated symptoms with lung function and reported to be valid. Moreover, it has been recommended for use in epidemiological and occupational respiratory surveys and as part of a consultation for respiratory symptoms or assessment of lung function (Cotes & Chinn, 2007). The questionnaire was initially translated into Hausa by two independent

Native Hausa speakers who were fluent in English. The resulting translation by them was then harmonized. Thereafter, the Hausa-translated version was then given to another set of translators who did a backward translation of the Hausa version back to English. The back-translated version and the original English version were compared for inconsistencies. In the end, a panel comprising experts from the Department of Nigerian Languages and the Faculty of Allied Health Sciences of Bayero University Kano was constituted to endorse the final version. The questionnaire was self-administered to the participants at their place of business during working hours (mainly in the morning) and retrieved on the same day. For those who were unable to complete the questionnaire themselves, a research assistant was readily handy to help them do so.

Pulse Oximetry and Heart/Pulse Rate

Oxygen saturation (SPO_2) levels were measured with the aid of a pulse oximeter that was placed onto the thumb with the palmar aspect of a finger in direct contact with the sensor as earlier recommended. Both SPO_2 and pulse rate readings for each participant were documented.

Blood Pressure Measurements

The blood pressure of the participants was measured using a mercury sphygmomanometer and stethoscope. The participants were instructed to adopt a comfortable sitting position with their arms exposed. The cuff of the sphygmomanometer was applied evenly and snugly around the bare arm, with the lower edge 2.5 cm above the antecubital fossa, with the centre of the cuff in line with the region of the brachial artery of the dominant arm of each participant. The measurement was done by pumping/inflating the cuff of the sphygmomanometer (with a closed valve) until maximal pressure inflation. The maximal pressure inflation was determined by palpating the radial artery prior to and during inflation of the blood pressure cuff until the pulse was obliterated, and then continuing to inflate it to about 30 mm Hg, while the diaphragm of the stethoscope was placed over the brachial artery. Thereafter, the cuff was immediately deflated carefully at the rate of 2-3mmHg per second by opening the valve. During deflation, the manometer of the sphygmomanometer was closely observed and the point at which the Korotkoff (first) sound was heard was recorded as the systolic blood pressure, while the point on the manometer where the Korotkoff sound disappears was recorded as diastolic blood pressure (Guyton, 2003).

Statistical Analysis

Descriptive statistic of mean, frequency, percentages and standard deviation was used to describe and summarize the data obtained. The difference between the oxygen saturation levels of the test group (bean cake fryers) and the control was analyzed using an independent-t test. Chi-square was used to compute the association between

socio-demographic characteristics, anthropometrics and respiratory symptoms. Pearson correlation was used to compute the relationship between age, body mass index, years of working experience and oxygen saturation level. The level of significance was set at 0.05.

Results

A total of 170 females comprising 85 bean cake fryers and 85 control subjects participated in this study. **The** mean age of the participants **was** 44.1±1.34 years and 44.4±1.62 years for the test and control groups, respectively. The socio-demographic characteristics of the participants indicated that **the** majority of the participants were between the ages of 37 and 54 years, married (75.3%), had a working experience of less than 5 years (44.7%) and a normal range BMI (50.6%) as shown in Table 1.

Table 1: Socio-Demographic and Anthropometric Characteristics of the Participants

Variables	Bean cake fryers n(%)	Controls n(%)
Age		
18-36	16(18.8%)	25(29.4%)
37-54	60(70.6%)	47(55.3%)
55-72	9(10.6%)	13(15.3%)
Marital Status		
Single	6(7.1%)	13(15.3%)
Married	64(75.3%)	64(75.3%)
Divorced	15(17.6%)	8(9.4%)
Working Experience		
0-5 Years	38(44.7%)	-
6-10 years	33(38.3%)	-
11-15 years	14(16.5%)	
Body Mass Index		
Underweight	7(8.2%)	-
Healthy	43(50.6%)	-
Overweight	26(30.6%)	
Obese	9(10.6%)	

A Comparison between anthropometric and clinical characteristics of Bean cake fryers and non-bean cake fryers is indicated in Table 2. Here, the highlights of the results show that the participants were mostly comparable in their age, height and weight ($p>0.05$), but not in SPO_2 ($p<0.05$) variables.

The results further indicated that cough and breathlessness were significantly associated with the sociodemographic variables of age and years of experience ($p<0.05$), but not with variables of marital status, body mass index and blood pressure ($p>0.05$). Wheezing was associated with only working experience ($p<0.05$). Meanwhile, bringing up phlegm was not associated with any of the assessed sociodemographic variables ($p>0.05$). Lastly, no linear relationship was found between oxygen saturation level with the variables of age, working experience, body mass index, blood pressure and pulse rate ($p>0.05$).

Table 2: Anthropometric and Clinical Characteristics of the Participants

Parameters	Bean cake fryers	Controls
Age (years)	44.12±1.341	44.39±1.619
Height (m)	1.59±0.008	1.58±0.008
Weight (kg)	62.1±0.56	64±0.6
Body mass index (kg/m^2)	24.4±0.5	25.5±0.6
Systolic blood pressure (mm Hg)	127±1.66	126±1.68
Diastolic blood pressure (mm Hg)	81.±1.01	80±1.1
Pulse Rate (bpm)	81.45±1.58	80.35±1.16
Oxygen saturation level (%)	97.3±1.65	98.41±1.18

Table 3 shows the results of the association of respiratory symptoms with the occupational status of participants. All respiratory symptoms were found to be significantly associated with bean cake frying. Coughing was the commonest respiratory symptom (44.7%) while wheezing was the least reported symptom (20%).

Table 3: Comparison (and association) of Respiratory Symptoms among the Two Groups of Participants

Respiratory symptoms		Bean cake fryers n (%)	Control n (%)	P - value
Cough	Yes	38(44.7%)	16(18.8%)	0.001
	No	47(55.3%)	69(81.2%)	
Phlegm	Yes	29(34.1%)	11(12.9%)	0.001
	No	56(65.9%)	74(87.9%)	
Breathlessness	Yes	22(25.9%)	8(9.4%)	0.005
	No	63(74.1%)	77(90.6%)	
Wheezing	Yes	17(20%)	7(8.2%)	0.028
	No	68(80%)	78(91.8%)	

Discussion

This study aimed to determine the prevalence and correlates of respiratory symptoms and also assess the level of oxygen saturation among bean cake fryers in the Kano metropolis. Moreover, the association of respiratory symptoms and the relationship between oxygen saturation level with sociodemographic variables and anthropometrics were computed at the end of the study. The study observed that the majority of the participants were of middle age and Hausa (ethnic group). However, this was not surprising because the study area is predominantly Hausa (Dawaki et al, 2016), and women within this age group often have to complement their household livelihoods and economy regions by engaging in mostly informal entrepreneurial endeavours (Zakaria, 2001).

The major outcomes of the study show a substantially higher prevalence of respiratory symptoms among bean cake fryers than those women who do not engage in bean cake frying. These results were not unexpected because of the harmful effect of prolonged exposure to biomass smoke bean cake fryers used for frying (Ana et al, 2013; Tanko et al, 2008; Naeher *et al.,* 2007). Furthermore, the findings agree with that of Adewole *et al.* (2013) who found that there was a higher prevalence of respiratory symptoms among food vendors exposed to similar wood smoke and cooking oil fumes.

This study also shows that cough is the most common respiratory symptom among female bean cake fryers, with about half of them reporting that they currently experience it. These findings are in agreement with those of Nagoda et al. (2012) and Olufemi et al. (2010) who all found cough to be the most prevalent respiratory symptoms among textile workers and women users of biomass fuels in Nigeria. The use of biomass or other unclean sources of fuels for cooking and illiteracy has been earlier shown to have a relationship with the risk of presenting with respiratory symptoms (Kurmi et al, 2014). Furthermore, exposure to unclean cooking smoke offers additional risk factors for women (Ramirez-Venegas et al, 2018). However, in two contrasting views, Adewole *et, al.,* 2013 reported chest tightness to be the most prevalent consequence of exposure to cooking smoke (accounting for about 59%), while Ijadunola *et, al.*(2004) found nasal congestion to be the most common symptoms.   Furthermore, this study reported a prevalence of about 20% of participants presenting with wheezing. Nevertheless, the occurrence wheeze following exposure to smoke from unclean energy sources appears to be lower ranging from 7 to 13% in previous studies (Adewole *et, al.,* 2013; Ijandula *et, al.*, 2004; Nagoda *et, al.*, 2012; Olufemi *et, al.*, 2010).

This study also shows an association between respiratory symptoms and years of working experience and age as was earlier reported (Adewole *et, al.,* 2013). The pathophysiology of most chronic respiratory diseases presenting as respiratory symptoms has a gradual onset and slower progression course (Welte, Vogelmeier &

Papi, 2015). Respiratory symptoms are also common among elderly individuals due to the gradual decline in many aspects of their immune function, and physiological and anatomical changes in respiratory system organs that can be associated with ageing. Unfortunately, many individuals in developing countries often ignore these symptoms. Therefore, we recommend the need for more public awareness regarding preventive strategies such as the use of cleaner cooking energy sources or protective gear from direct exposure to smoke or fumes.

This study has a few limitations. Firstly, all respiratory symptom assessments were done by self-report without further clinical assessment. Secondly, we did not take into account or investigate how their living conditions such as socioeconomic status and sources of cooking fuels outside frying bean cake may affect the results presented in this study. Nevertheless, the study has some strengths which include its large size and the use of a control group, which allowed us to present the results within a comparative perspective.

Conclusion
This study concluded that female bean cake fryers present with higher rates of respiratory symptoms and slightly more reduced oxygen saturation levels than exposed females of similar characteristics. The study also concluded that older females and those with longer working duration were more likely to present with respiratory symptoms. Hence, they can be particularly targeted during appropriate public health interventions.

References
Adedeji, T. O., & Ade-Omowaye, B. I. O. (2013). The preservative effects of two local Nigerian spices on the shelf life of fried bean cake snacks. *Journal of Nutrition and Food Science*, *3*(2), 188.

Adewole, O.O., Desalu, O.O., Nwogu, K.C., Adewole, T.O. & Erhabor, G.E. (2013). Respiratory symptoms and lung function patterns in workers exposed to wood smoke and cooking oil fumes (Mai Suya) in Nigeria. *Annals of Medical Health Sciences and Research*. 3(1), 38-42.

Ana, G., Adeniji, B., Ige, O., Oluwole, O., & Olopade, C. (2013). Exposure to emissions from firewood cooking stove and the pulmonary health of women in Olorunda community, Ibadan, Nigeria. *Air Quality, Atmosphere & Health*, *6*(2), 465-471.

Cotes, J. E., and D. J. Chinn. "MRC questionnaire (MRCQ) on respiratory symptoms." *Occupational Medicine* 57, no. 5 (2007): 388-388.

Dawaki, S., Al-Mekhlafi, H. M., Ithoi, I., Ibrahim, J., Atroosh, W. M., Abdulsalam, A. M., & Lau, Y. L. (2016). Is Nigeria winning the battle against malaria? Prevalence, risk factors and KAP assessment among Hausa communities in Kano State. *Malaria journal*, *15*(1), 351.

Ekici, A., Ekici, M., Kurtipek, E., Akin, A., Arslan, M., Kara, T. & Demir, S. (2005). Obstructive airway diseases in women exposed to biomass smoke. *Environmental Research*, *99*(1), 93-98.

Erhabor, G.E., Kolawole, O.A. & Adewole, O.O. (2002) Chronic obstructive pulmonary disease in OAUTHC Ile☐ Ife: A ten☐ year review of hospital mortality. *Journal of National Medical Association*. 94,1071☐ 6.

Guyton, A. C. & Hall, J. E. (2002). Pocket companion of textbook of medical physiology (10th Ed). New Delhi: Harcourt Company Limited. Pp. 136-142.

Ijadunola KT, Erhabor GE, Onayade AA, Ijadunola MY, Fatusi AO, Asuzu MC. Prevalence of respiratory symptoms among wheat flour mill workers in Ibadan, Nigeria. Am J Ind Med. 2004 Mar;45(3):251-9. doi: 10.1002/ajim.10344. PMID: 14991852.

Kurmi, O. P., Semple, S., Devereux, G. S., Gaihre, S., Lam, K. B. H., Sadhra, S., ... & Ayres, J. G. (2014). The effect of exposure to biomass smoke on respiratory symptoms in adult rural and urban Nepalese populations. *Environmental Health*, *13*(1), 92.

Manafa, P. O., Daniel-Ogheneke, L. U., Ukibe, N. R., Ekuma-Okereke, O., Ibeh, C. N., Chukwuanukwu, C. R., ... & Manafa, C. C. (2020). Levels of cholesteryl-ester transfer protein in female bean cake fryers in Nnewi metropolis. *The Journal of Medical Research*, *6*(2), 62-66.

Nagoda, M., Okpapi, J.U.& Babashani, M. (2012). Assessment of respiratory symptoms and lung function among textile workers at Kano Textile Mills, Kano, Nigeria, *Nigerian Journal of Clinical Practice.* 15, 373-79

Naeher, L.P., Brauer, M., Lipsett, M., Zelikoff, J.T., Simpson, C.D. & Koenig, J.Q. (2007) 'Wood smoke health effects: A review' *Inhal Toxicol*. 19,67-106.

Ohimain, E. I. (2012). The benefits and potential impacts of household cooking fuel substitution with bio-ethanol produced from cassava feedstock in Nigeria. *Energy for Sustainable Development*, *16*(3), 352-362.

Olufemi O. D., Adebowale O. A.& Bolawale A.A. (2010) Increased risk of respiratory symptoms and chronic bronchitis in women using biomass fuels in Nigeria *Jornal Brasileiro de Pneumologia*. 36(4),441-446

Ogundele, G. F., Ojubanire, B. A., & Bamidele, O. P. (2014). Evaluation of various characteristics of akara (fried beans cake) made from cowpea (Vigna unguiculata) and soybean (Glycine max) blends. *Journal of Experimental Biology and Agricultural Sciences*, *2*(5), 455-459.

Perez-Padilla, R., Regalado, J., Vedal, S., Paré, P., Chapela, R., Sansores, R., & Selman, M. (1996). Exposure to biomass smoke and chronic airway disease in Mexican women. A case-control study. *American journal of respiratory and critical care medicine*, *154*(3), 701-706.

Ramírez-Venegas, A., Velázquez-Uncal, M., Pérez-Hernández, R., Guzmán-Bouilloud, N. E., Falfán-Valencia, R., Mayar-Maya, M. E., ... & Sansores, R.

H. (2018). Prevalence of COPD and respiratory symptoms associated with biomass smoke exposure in a suburban area. *International journal of chronic obstructive pulmonary disease*, *13*, 1727.

Schlag, N., & Zuzarte, F. (2008). Market barriers to clean cooking fuels in sub-Saharan Africa: a review of the literature.

Svedahl, S., Svendsen, K., Qvenild, T., Sjaastad, A.K. & Hilt, B. (2009) 'Short-term exposure to cooking fumes and pulmonary function.' *Journal of Occupational Medicine and Toxicology*. 4,4-9.

Tanko, Y., Shemang, D., Saleh, M.I.A., Magaji, R.A., Musa, K.Y. & Mohammed, A. (2008), 'Lung Function Test and Some Cardiovascular Parameters Among Bean Cake Fryers (A Case Study of Tudun Wada Area of Kaduna State, Nigeria)', *European Journal of Scientific Research.* 24(2) ,179-186

Tzanakis, N., Kallergis, K., Bouros, D.E., Samiou, M.F. & Siafakas, N.M. (2001) 'Short-term effects of wood smoke on the respiratory system among charcoal production workers'. *Chest* .119,1260-5.

Welte, T., Vogelmeier, C., & Papi, A. (2015). COPD: early diagnosis and treatment to slow disease progression. *International journal of clinical practice*, *69*(3), 336-349.

WHO, World Health Organization. (2014)Burden of disease from household air pollution for 2012.

Zakaria, Y. (2001). Entrepreneurs at home: Secluded Muslim women and hidden economic activities in Northern Nigeria. *Nordic Journal of African Studies*, *10*(1), 107-123.