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MODELLING THE PEAK EXPIRATORY FLOW RATE OF FEMALE BAKERS IN ABEOKUTA, NIGERIA

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ABSTRACT

The current cross-sectional study investigated the relationship between the Peak Expiratory Flow Rate (PEFR) and the anthropometrical parameters (body mass and height) among female bakers who are exposed to flour dust. A total of One hundred and twenty (120) participants were investigated with sixty (60) female bakers (study group) who are exposed to flour dust and sixty (60) control subjects. The PEFR and anthropometrical parameters were measured using the mini-Wright peak flow meter (PFM 20, OMRON) and Detecto PD300MDHR (Cardinal Scale manufacturing company, USA) column scale respectively. The PEFR of the study and control groups were compared using descriptive statistics and T-test analysis. A model was developed to determine the PEFR with four factors of body mass (kg), height (cm), age and year of exposure where applicable. The study showed that the mean value of PEFR in female bakers was 158.17 ± 12.55 L/min with 267.50 ± 26.85 L/min for the control study. The result of the model also revealed that bakers have 158.07 L/min PEFR as against 267.96 L/min for control study. The study concluded that with model developed, individuals who are susceptible to lung function impairment can easily be diagnosed and given or recommended a medical treatment.

Keywords: Model, Bakery, Peak Expiratory Flow Rate, Exposure, Asthma

INTRODUCTION

The Peak Expiratory Flow Rate is a person's maximum speed of expiration, as measured with peak flow meter which is hand-held device is used to monitor a person's ability to breathe out air. It measures the airflow through the bronchi and thus the degree of obstruction in the airways. The peak flow readings are higher when patients are healthy and lower when the airways are constricted. It is classically reduced in obstruction lung disorders such as asthma. Bakers have the highest incidence rates of occupational asthma (Ige and Awoyemi,

2002). The incidences are around 80 times than the average Nigerian workers in the other allied industries. The incidences are around 80 times more likely to develop occupational asthma than the average Nigerian workers. In recent years, bakery industries are one of the fastest growing agro allied industries creating impacts of daily life in Abeokuta metropolis of Ogun State, Nigeria. Bakery products are being used on large scale as daily food items in locality of the state. The peak flow readings are often classified into three (3) zones of measurement of green, yellow and red. The green zone indicates that the asthma is under control while the yellow indicate caution, which mean respiratory airways are narrowing and additional medication may be required. The red indicates a medical emergency, that is, severe airways narrowing may be occurring and immediate action is needed to be taken.

Ige and Awoyemi (2002) investigated the occupational induced long function impairment in bakery workers as a result of exposure to grain and flour dust. They reported that the mean values of Peak Expiratory Flow Rate (PEFR) among the bakery workers are significantly lower than those of the control subject. Yach et al. (1985) found that the grain mill workers had significant deteriorated lung function values compared to their matched control. Essen (1997) demonstrated that the grain dust exposure is a common cause of respiratory symptoms and these workers developed obstructive change on pulmonary testing. Zustin et al. (1998) suggested that workers employed in the processing of flour may be at a risk in the development of respiratory impairment.

The respiratory effects of exposure to flour dust are influenced by the dose and duration of exposure (Shamssain, 1995: Brisman et al., 2000; Meo, 2006), and these differ from one work environment to another. Therefore, it may not be correct to extrapolate the results of studies conducted in a different environment to our bakeries (Burstyn et al., 1997; Bulat et al., 2004; Elms et al., 2003). The most frequently reported clinical features among worker exposed to dust are respiratory symptoms and disorders such as rhinitis, chronic cough wheezing and lung function (Oleru, 1984; Abudhaise et al., 1997). In addition to these signs and symptoms, various methods have been employed to evaluate respiratory function. One of such method is the measurement of Peak Expiratory Flow Rate (PEFR), which is a measure of how fast a person can breathe out after taking a deep breath (Abou Taleb et al., 1995).

Different researches has been done to establish the physiological status of bakery workers like allergic condition, respiratory problem due to daily exposure to flour dust (Baatjies et al., 2010; Fishwick et al., 2011). Abou Taleb et al, (1995) and Rafnsson et al, (1997) reported that the normal values for Peak Expiratory Flow Rate for an healthy adult and non-exposed to dust is between 300 – 600 L/min with variation for age, body mass, height, and gender.

Similarly Vestbo et al., (1991) also found that the most appropriate PEFR values for healthy adult female not exposed to dust are between 300 – 500 L/min.

Elebute and Femi-Pearse (1971) performed a study to establish the standard values of PEFR in Nigeria where they measure the anthropometric parameters and PEFR of 142 healthy subjects. The study revealed that the mean values of PEFR for male and female were 482.1 ± 83.3 L/min and 385.6 ± 65.7 L/min respectively. The study conducted by Elebute and Femi-Pearse (1971) was considered as too distant and this prompted the present study to revalidate the findings. The aim of this present study is to determine a model for the Peak Expiratory Flow Rate of female bakers with respect to their anthropometric parameters. The objectives of this research is to develop a statistical model associated with the Peak Expiratory Flow Rate and anthropometric parameters and propose a control measure to the health hazards and the level of exposure of the bakery workers to the flour dust.

MATERIALS AND METHODS

The present study was conducted in Abeokuta metropolis between the period of October 2014 to December 2014 with sixty (60) female bakery workers having contact with flour whose age ranged from 19 – 27 years and they have involved in this bakery business between 6 months and 4 years. Sixty (60) healthy female was also selected as the control to the bakery workers.

These control subjects were of the same age group with the bakery workers mostly house wife and students recruited within Abeokuta metropolis. Both the bakery workers and the control subjects had no earlier report of systematic diseases. Subjects that are smoking and suffering from any respiratory illness were exempted from the study.

A structured questionnaire was developed and used as a tool for data collection. The data collected includes the details demographic data of the subject such as age, marital status, education level, smoking habit, duration of flour dust exposure, working experience in the bakery industries.

The PEFR was measured with mini-Wright peak flow meter, (PFM 20, OMRON) (Figure 1). Three readings were taken from each subject in standing position and the best of the three were considered as Peak Expiratory Flow meter reading for that subject. Detecto PD300MDHR (Cardinal Scale manufacturing company, USA) column scale with digital height rod **(**Figure 2) was used to measure body mass (kg) and height (cm) of the subjects simultaneously.

Figure 1: mini-Wright peak flow meter

Figure 2: Detecto (PD300DHR column scale with digital height rod

Data collected were analysed statistically with SPSS Version 17.0 and Microsoft Excel (2010). Based on the data collected from the study, the relationship between the Peak Expiratory Flow Rate and anthropometric parameters of the bakers and control were used to design a multi linear model where PEFR remain the dependant of all the remain four factors.

The model follows the treads in equation (1) and (2)

$Y = a + b_1x_1 + b_2x_2 + b_3x_3 + \ldots + b_nx_n$ -------- (1)

$PEFR = a + b_1(\text{Body mass}) + b_2(\text{Height}) + b_3(\text{Age}) + b_4(\text{years of exposure})$ ---- (2)

Where a is the constant and b is the coefficient of regression. Each coefficient b represent the effect of the independent variable y. b_4 is only applicable to bakers only.

RESULTS AND DISCUSSIONS

Table 1 showed the descriptive statistic and the T-test (on sample test) analysis of the investigated participants. Table 2 and Table 3 showed the result of multi linear regression analysis between the Peak Expiratory Flow Rate (PEFR) and the demographical parameter. From the analysis, a model to predict the PEFR of the subject was derived.

The results obtained were expressed using mean ± standard deviation, T-test for the two groups' comparisons and regression analysis.

Table 1: T-test (one sample test) for Female Subjects

	FEMALE (STUDY)						FEMALE (CONTROL)				
	N	Mean	Std. E Mean	Std. Dev	T	df	Mean	Std. E Mean	Std. Dev	t	Df

Body mass (kg)	60	50.167	.5174	4.0078	96.959	59	51.718	.5651	4.3770	91.526	59
Height (cm)	60	159.652	.3557	2.7555	448.788	59	157.520	.5796	4.4893	271.787	59
PEFR (L/min)	60	158.167	1.6207	12.5538	97.592	59	267.500	3.4659	26.8470	77.180	59
Age (yrs)	60	23.02	.269	2.087	85.426	59	22.93	.215	1.666	106.635	59
Yrs of Expo	60	2.38	.079	.613	30.107	59	51.718	.5651	4.3770		

Table 2: Result of Regression analysis between PEFR and other parameter for the women Bakers

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	T	Sig.
1	(Constant)	195.290	88.015		2.219	.031
	Body mass	.213	.406	.068	.525	.602
	Height	-.400	.576	-.088	-.695	.490
	Age	1.519	.723	.253	2.100	.040
	Years of Exposure	-7.942	2.521	-.388	-3.150	.003

a. Dependent Variable: PEFR

From Table 2 and the trend in Equation (2), the model for the determination of PEFR for Female baker can be deduced and written as in Equation (3).

$$PEFR_{Female\ baker} = 195.29 + 0.21(\text{Body mass}) - 0.40(\text{height}) + 1.52(\text{Age}) - 7.94(\text{yr of exposure}) \quad \text{----- (3)}$$

Table 3: Result of Regression analysis between PEFR and other parameters for the women that are not bakers (i .e Control Study)

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	T	Sig.
1	(Constant)	640.141	126.528		5.059	.000
	Body mass	.603	.782	.098	.771	.444

Height	-2.423	.757	-.405	-3.203	.002
Age	-.963	1.992	-.060	-.484	.631

a. Dependent Variable: PEFR

Similarly, from Table 3 and the trend in Equation (2), the model for the determination of PEFR for the women not exposed to dust (i.e control study) can be deduced and written as in Equation (4).

$PEFR_{Female\ control}$ = 640.14 + 0.60(Body mass) –

2.42(height) - 0.96(Age) ------ (4)

Equations (3) and (4) imply that the body mass, height, age and years of exposure affects the Peak Expiratory Flow Rate of any bakery workers.

Table 4: Comparison of direct measurement and Calculation with Model Equation of PEFR (L/min)

	Direct Measurement of PEFR	Model Equation of PEFR
Bakers	158.17	158.07
Control subject	267.50	267.96

Table 4 showed that a female baker has lower PEFR (158.17 ± 12.55 L/min) compared to the control subjects (265.50 ± 26.85 L/min). The variation is as a result of the exposure of bakers to the flour dust. This result was compared with Abou Taleb et al (1995), Rafnsson et al (1997) and Vestbo et al (1991) which showed that the bakers are not healthy and they were affected with the lung obstruction.

Table 2 and Table 3 showed the results of the regression analysis between the Peak Expiratory Flow Rate (PEFR) and other anthropometric parameters. The regression equation where PEFR were taken as the dependant variable was derived as a model to determine the Peak Expiratory Flow Rate of the individuals. The applied anthropometric parameters were body mass, height, age and years of exposure (where applicable). All the anthropometric parameters were considered as independent variables. Verma et al, (2000) and Host et al, (1994) presented that an accuracy of predicted value of PEFR will be higher when age is considered along with height.

To interpret the significance of Peak Expiratory Flow measurements, comparison is needed to be made to reference (direct and calculated measurement) values based on the measurement taken from the general population. Table 4 showed the comparison between direct measurement and calculated measurement from the model equation for PEFR (L/min). It was discovered that the mean PEFR and the predicted PEFR were similar but with little difference. These differences may be due to the instrumental variations and characteristics of studied population. PEFR (L/min) predicted based on the regression model equation was the most consistent finding in a good number of studies

(Benjaponpitak et al., 1999) including the present study.

CONCLUSION

This study has revealed that a very high prevalence of respiratory symptoms and occupational asthma among female bakery workers existed. The occupational asthma has long term health, social and economic consequences and thus early diagnosis is crucial for a favourable and better outcome of the disease. The diagnosis and management of bronchial asthma requires assessment of pulmonary function specially ventilator function. The Peak Expiratory Flow Rate (PEFR) measurement is a very simple, reliable, reproducible ventilator function test which can be performed by using mini Wright peak flow meter (a cheap, portable instrument).

The key determinant of reduced lung function in this study was poor use of personal protective equipment (PPE). This showed the risk of occupational lung diseases from reduced lung function in bakery workers that are exposed to flour dust. It is also shows that knowledge and effective use of PPE is a major contributor to low percentage of workers with lung function. It is therefore recommended that periodic and scheduled screening of lung function using simple tools like respiratory symptoms evaluation and Peak Expiratory Flow Rate should be done on workers at risk for early detection and prevention of occupational lung disease. The use and education of PPE should be encourage and promoted as it has been shown to significantly reduce the risk of lung function impairment.

The result obtained in this study can be used as a standard Peak Expiratory Flow Rate for any female individuals who are exposed or not to the flour dust. The model equation developed can also play a major role in determining the Peak Expiratory Flow Rate of any subject in the absence of the hand-held devices for the measurement. Further study is also required to understand the difference (if any) of peak expiratory flow rate between the various workers in the bakery and the flour mills workers.

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