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Effects of Impaired Lung Function on Farm Labour supply in Eleme, Rivers State, Nigeria

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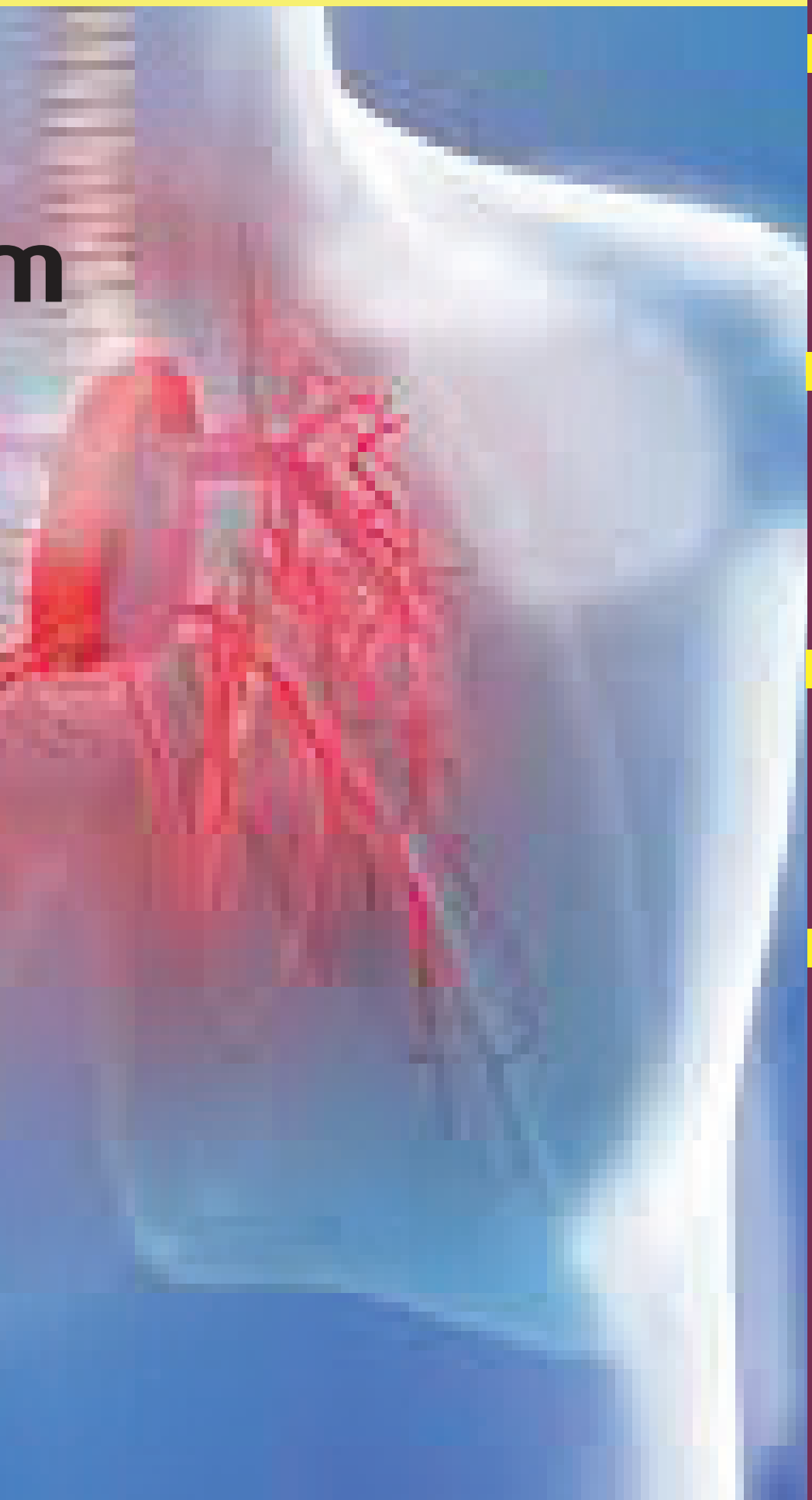

PURPOSE

Agriculture is labour intensive in Nigeria, yet the sector is hindered by dwindling human capital; among other reasons, this can be linked to the poor health status of the agrarian population. Consequently, this study aimed to determine the effect of impaired lung function on farm labour supply in Eleme, Nigeria.

DESIGN/METHODOLOGY/APPROACH

Primary data were collected from 229 respondents drawn by a stratified random sampling technique. Preliminary analyses included determination and categorisation of the respondents' lung function. The research objective was realised using the Tobit regression analysis.

FINDINGS

Of the respondents 34.93% had critically impaired lung function, 59.39% impaired lung function and 5.68% normal lung function. Impaired lung function had a negative but not a significant impact on farm labour supply.

VALUE OF THE PAPER

The paper substantiates the need for further public health research and policy in favour of the agrarian populace.

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LIMITATIONS/IMPLICATIONS (if applicable)

Comparative research is limited, necessitating further studies of lung function among the agrarian populace.

PRACTICAL IMPLICATIONS (if applicable)

To curb a dwindling farm labour supply and enhance food production, medical intervention is appropriate once these research findings are validated.

KEYWORDS

Agriculture; labour supply; impaired lung function

BIOGRAPHY

Dr Egbe B. Etowa is a Lecturer I at the Department of Agricultural Economics and Extension, Faculty of Agriculture, University of Port Harcourt, Nigeria. Dr Etowa completed MSc and PhD in Agricultural Economics (Agricultural Finance and Project Analysis) at the University of Nigeria. Etowa was a visiting researcher at the Department of Economics, University of Ottawa, Canada, under the Canadian Commonwealth Postgraduate Exchange Programme. Among others, his research interests include the relationships between public health and agricultural development.

Given that a capital intensive approach to agriculture is still in its development phase, farming in Nigeria continues to depend on a human labour force. Because of this reliance on human labour, agriculture is largely subsistent in the country. The situation is still hindered by labour scarcity as young people often prefer to migrate to the urban areas in search of greener pastures (Nwajiuba, 2012).

Consequently, the Nigerian agricultural labour force is comprised mainly of old people (Echebiri and Mbanasor, 2003; Oluyole and Lawal, 2010), and this has a negative impact on productivity. Moreover, the drudgery of farm production and the absence of social infrastructure, including the inadequacy of healthcare facilities in rural areas, the old people, women and children left to bear the burden of food production become susceptible to ill-health; this, in turn, leads to low life expectancy. Also, heat stress limits daily working hours and lowers farm labour productivity (Nwajiuba, 2012).

These conditions generate a downward spiral of poor health, poor work performance, low productivity, low income, and low nutrition. The cycle draws insight from the human capital theory, which postulates a positive correlation between health and labour productivity in both market and non-market activities (Tompa, 2002). Moreover, few empirical works have established the effects of health on agricultural labour supply. Umeh (1991) found a causal relationship between the descriptors of rural healthy days and labour supply for the two sample datasets.

To further study this relationship, this research focused on Peak Expiratory Flow Rates (PEFR) given that they are a valid measure of health status in older people (Roberts and Mapel, 2012). Because of the ease of this approach, PEFR has become a popular measure of impaired lung function. It is the maximum flow rate generated during a forceful exhalation, starting from full lung inflation. Peak flow rate primarily reflects large airway flow and depends on the voluntary effort and muscular strength of the patient. Thus, to avoid errors of measurement, the study respondents were encouraged to provide maximal airflow during the effort-dependent portion of the expiratory manoeuvre.

Impaired lung function (ILF) measured by PEFR reduces labour input by depleting the level of physical activity of a farmer, which in turn reduces the level of farm productivity. This occurs in air polluted farming communities, with Eleme, Nigeria as a case study. ILF can be described as a medical condition triggered by all or any of the following: ineffective breathing pattern, ineffective airway clearance, and impaired gas exchange (ElsevierHealth.com, 2016). The predominance of old people among the farming population is an important factor for their susceptibility to lung impairment. According to Sharma and Goodwin (2006), lungs are mature by age 20–25 years, and thereafter aging is associated with a progressive decline in lung function. The ILF is a major clinical indicator of mortality risk in both men and women for a wide range of diseases (Hole et al., 1996). After adjusting for risk factors known to affect lung function, a strong association between ILF and cognitive decline was found (Vossoughi et al., 2015).

Cognitive decline could translate to reduced performance for agricultural workers. Studies have shown that ILF was associated with increased mortality from cardio-vascular diseases (Ma et al., 2013) leading to a reduction of the total labour supply in the agricultural sector, and consequently food insecurity. Studies have also found that chronic obstructive pulmonary disease (COPD), an offshoot of ILF, contributes to exercise intolerance (O'Donnell et al., 2001). This implied that impaired lung function will retard physical activity, such as farming, and will therefore reduce farm labour supply.

Although it is a well-known fact that impaired lung function has an adverse effect on labour productivity, this study empirically determined the extent of this effect on the supply of farm labour in Eleme, Rivers State, Nigeria. Prior to the preceding objective, the study also described the prevalence of impaired lung function among the farming population in the area.

METHODOLOGY

Eleme Local Government Area of Rivers State, Nigeria was chosen for the study. Eleme is characterised by the localisation of industries with over 200 industries in this area. It is an administrative subdivision of Rivers State of Nigeria, located around 20km east of the Port Harcourt local government area. As at the 2006 census, Eleme had a population of 190,884. It belongs to the south-south geo-political zone of Nigeria. On the South-eastern Nigeria map, Eleme can be found between the co-ordinates 7°E and 8°E, 4°N and 5°N. The Eleme people live in clusters and occupy a total territory of approximately 140 square kilometres. Eleme is bounded in the north by Obio-akpor and Oyigbo, in the south by Okrika and Ogu bolo, in the east by Tai, and the west by Okrika and Port Harcourt. It is broadly divided into two major clans, namely Nchia and Odido. Nchia is made up of Agbonchia, Akpajo, Alesa, Aleto, Alode and Ogale, while Odido comprises of Ebubu, Ekporo, Eteo and Onne.

Sample size estimation was based on the total farming population, which was approximately 70% of the entire population of 190,884 (National Population Commission (NPC), 2006), margin of error of 5% and a confidence level of 95%. Inputting these values into the qualtrics sample size calculator yielded an appropriate sample size of 384 (Smith, 2013). Rounding up to the nearest 100, gave a total of 400 respondents selected via a simple random sampling technique. The interview response rate was 57.25%, that is, a total of 229 respondents were accessible for interview and testing. Frequency distribution of the 229 respondents was 42, 13, 18, 51, 65 and 40 across the six communities of Agbonchia, Alesa, Aleto, Ebubu, Eteo and Onne, respectively.

To measure lung function (LF), an experimental approach was adopted. Because of the ease of this approach, Peak Expiratory Flow Rate (PEFR) has become a popular measure of impaired lung function. Roberts and Mapel (2012) found that PEFR is a valid measure of health status in older persons, and that low PEFR is an independent predictor of hospitalisation and poor subjective mortality assessment.

BIOGRAPHY CONT.

Dr Seye Babatunde is a graduate in Public Health from the University of Liverpool and a fellow of the West African College of Physicians. He is the Acting Director of the Centre for Health and Development, a bilateral collaborative project to build capacity for a quality health service. Dr Babatunde is also Public Health Physician and a Senior Lecturer in epidemiology, medical statistics, demography and environmental health. He is a National Programme Officer of the World Health Organization on secondment from the University of Port Harcourt to provide technical support to the National and State Malaria Control Programmes.

BIOGRAPHY CONT.

Dr Josephine B. Etowa is a Full Professor at the University of Ottawa's Faculty of Health Sciences, School of Nursing, and the Loyer-DaSilva Research Chair in Public Health Nursing. She is also a Fellow of the American Academy of Nursing. Dr Etowa completed her PhD in Nursing at the University of Calgary. Her research programme, which is grounded in over 23 years of clinical practice, is in the area of inequity in health, health care and maternal-new born health. Dr Etowa has worked in various capacities within the Canadian health care system. She was a Visiting Professor at the Centre for Health and Development, University of Port Harcourt, Nigeria.

A PEFR for each selected farmer was taken with the aid of a Peak Flow Metre. Reference values, or the normal peak expiratory flow rates, were determined for male and female respondents, adapting the models used by Nunn and Gregg (1989), and Radeos and Camargo (2004); these are shown in Equations (1) and (2), respectively.

$$PEFR_{Female} = e^{((0.376*\ln(Age)) - (0.012*Age) - (58.8/Height) + 5.63)} \quad (1)$$

$$PEFR_{Male} = e^{((0.544*\ln(Age)) - (0.0151*Age) - (74.7/Height) + 5.48)} \quad (2)$$

For analytical reasons, a generic classification partially based on the American Lung Association's classification was realised by categorising the respondents into three groups: those with critically impaired lung function (defined by the Red Zone), i.e. those with less than 50% of their "normal" peak flow rate; impaired lung function (defined by the Yellow Zone), i.e. those with 50–80% of their "normal" peak flow rate; and normal lung function (defined by the Green Zone), i.e. those with 80–100% of their "normal" peak flow rate.

Farm labour productivity would be the ideal dependent variable for this analysis. The conventional approach to measuring labour productivity, output per unit of labour, would yield bias regression estimates. The estimates would be biased because the respondents operated varying agricultural enterprises with different types of outputs that do not have a uniform scale. Again, as part of their weekly farm labour inputs, the respondents provided shared or hired labour in farms whose output they could not account for. Consequently, average weekly labour inputs (hours of labour per week) over the last one year of the survey was used as the dependent variable. This may be taken as a proxy for labour productivity because, in the short run, additional units of labour will increase output at a higher rate, thereby making labour proportional to productivity.

A priori, sex and age are confounders of the independent variable, PEFR readings (for lung function) and the dependent variable, weekly farm labour supply, a situation that could generate biased regression estimates. Consequently, once the respondents' lung function zones or categories (Table 1) were diagnosed based on the PEFR readings, dummy variables were used to capture the two lung function variables of interest; critically impaired lung function (Cim) and impaired lung function (Imp) in the model.

The observation on weekly hours spent on farm work includes those of 229 respondents, 51 of whom worked zero hours per week while 174 respondents worked for a fairly wide range of hours per week, extending from 4 to 32 hours per week. Because the variable (hours per week) is zero for the non-trivial fraction of the population but roughly continuously distributed over positive

TABLE 1 **Respondents Distribution by Categories of Lung Function**

Lung Function Categories	*Percentage of Normal PEF*	*Frequency*	*Percentage*
Red Zone (critically impaired)	<50	80	34.93
Yellow Zone (impaired)	50–80	136	59.39
Green Zone (non-impaired)	>80	13	5.68
Total		229	100.00

Source: Author's analysis from results of field experiments in 2015

TABLE 2 Tobit Regression Results: Effects of Impaired Lung Function on Labour Productivity in Eleme

Dependent variable=Flb (farm labour hours per week on the average since the past year)				
Independent Variables	*Variable Definitions*	*Coefficient*	*Standard Error*	*t-Statistics*
Imp	Impaired lung function (1=impaired, 0=non-impaired)	–0.4722	1.9410	–0.24
Cim	Critically impaired lung function (1=critically impaired, 0=non-critically impaired)	–0.4315	0.9899	–0.44
Ext	Participation in agricultural extension programme in last one year (if yes=1, or 0 otherwise)	4.4576*	0.7242	6.16
Fex	Number of years engaged in farming occupations	0.2330*	0.05436	4.29
Fin	Monthly income from farming activities (Naira)	0.0003*	0.0001	4.75
Nfi	Monthly income from non-farming activities (Naira)	–0.0001*	0.0000	–3.02
Age	Age of the respondent in years	0.0402	0.0454	0.88
Sex	Sex of the respondents (1=female, 0=male)	–0.0586	1.0129	–0.06
Hsi	Household size (number of persons)	0.2082	.1477	1.41
Les	Length of stay in present location (number of years)	–0.1697*	0.0527	–3.22
α_0	Constant	–0.9876	2.771	–0.36
δ	/sigma	6.3911	0.3455	
Model summary:				
Left censored observation (at labour hours <= 0) = 51		Right censored observations = 0		
Uncensored observations = 178		Total observations = 229		
LR Chi-square = 210.26		Probability (Chi-square) = 0.00		
Log likelihood = –604.48		Pseudo R-Square = 0.1482		

*Significant at 1% probability level

Source: Summary of Tobit regression results from Stata 14.0 analysis of 2015 field survey data

values, a tobit model was applicable (Wooldridge, 2013). Consequently, the tobit regression model (Equation (3)) was used to determine the effects of impaired lung function on farm labour input.

$$E(Flab/X) = \alpha_0 + \alpha_1 Imp + \alpha_2 Cim + \alpha_3 Ext + \alpha_4 Fex + \alpha_5 Fin + \alpha_6 Nfi + \alpha_7 Age + \alpha_8 Sex + \alpha_9 Hsi + \alpha_{10} Les + \mu \quad (3)$$

Where:

E(Flab/X) = expected hours of farm work per week given X

Flab = hours of farm work per week

X = the array of independent variables (defined in Table 2, respectively)

α_0 = Constant (shown in Table 2)

α_1 to α_{10} = Regression coefficients (shown in Table 2, respectively)

μ = error term

A priori, α_3, α_4 and $\alpha_5 > 0$ while α_1, α_2, α_6 to $\alpha_{10} < 0$

Decision rule: Accept null hypothesis (H_0) at P (statistics) >0.05, otherwise reject

RESULTS AND DISCUSSION

Data Description

On average, the respondents had been in their current location for 30.93 years. This is an indication that a few of the residents over 31 years of age migrated from elsewhere. The mean age of the respondents was 40.25 years, and 59.39% of them were women. Exactly 45.85% of the respondents were married, while mean household size was 5.25 persons. Only 46.72% took farming as their primary occupation; this posed a small limitation on the study as our analysis focussed on farm labour supply. This limitation was partly handled by including non-farming income as a cofounder of farm labour supply. Average farm labour supply was 9.63 hours per week, of which 8.21 hours was labour on their own farm and 1.43 hours was paid labour on someone else's farm. Average monthly income as at 2015 when the survey was done was ₦31,264.19 (US$144.31), of which ₦20,229.26 (US$93.55) was from non-farming activities. Perhaps because farming in the area was not a primary occupation, mean monthly farm income was as low as ₦11,034.93 (US$50.94).

Table 2 depicts the distribution of the respondents according to lung function categories. Results shown in the table were obtained based on the peak expiratory flow readings and estimations from Nunn and Gregg's (1989) and Radeos and Camargo's (2004) Equations (1) and (2). Precisely, 34.93% of the respondents had critically impaired lung functions, while 59.39% of them had impaired lung function. Only 5.68% of the respondents had normal lung function. This call for confirmatory lung function tests in the population and possibly medical intervention.

Effects of impaired lung function on farm labour supply in Eleme: Tobit regression results

Entering the key variables of interest (Imp and Cim as shown in Table 2) and all the socioeconomic variables of farm labour supply into the Tobit regression model produced a degenerative effect. A gradual and stepwise elimination of some socio-economic variables yielded a set of variables that gave the model with the best fit in terms of the highest log likelihood estimate, highest chi-square statistics (significant at 1% probability level) and highest number of significant variables.

In line with the *a priori* expectations, negative signs on the coefficients of the variables of interest (Imp and Cim) show that impaired lung function (Imp) and critically impaired lung function (Cim) reduced farm labour supply. Also, in line with the null hypothesis, at 0.05 significance level, Imp and Cim have no significant effects on farm labour supply. Therefore, although Imp and Cim had a negative impact on farm labour supply, this impact was not significant in Eleme, Nigeria. Taking the view that impaired lung function can be linked with poor health, the finding contradicts much past research explaining the association between health and labour. Umeh (1991) established a causal relationship between the descriptors of rural healthy days and labour supply in Nigeria. Hawkes and Ruel (2006) found that poor health reduces work performance. They also observed that being an agricultural producer is a determinant of health relative to income and labour.

An empirical work found that the strongest association exists between impaired lung function and cognitive decline (Vossoughi et al., 2015), *a priori*, cognitive ability will have a strong association with farm labour contribution. A few studies found

exercise intolerance among patients with chronic obstructive pulmonary disease (COPD) (O'Donnell et al., 2001; van Helvoort et al., 2016); this is a common feature of impaired lung function. Exercise intolerance occurs when a person is unable to perform physical exercise at the intensity or for the duration that would be expected of someone at their age and general physical condition. Thus, if impaired lung function is strongly associated with exercise intolerance in an individual, their level of physical activity is retarded and will invariably reduce the individual's farm labour supply.

This preceding position is confounded by arguments that COPD (or its covariate: impaired lung function) is not directly implicated for reduced physical activity in some individuals. This argument could be the likely explanation for the result of this study; impaired lung function has no significant relationship wit farm labour supply. Patients suffering from COPD (or its covariate: impaired lung function) have reduced physical activity when they also suffer from any or all of the following:

- lower limb muscle dysfunction (Debigaré and Maltais, 2008);
- dynamic hyperinflation (O'Donnell and Webb, 2008); and
- inadequate energy supply to the respiratory and locomotor muscles (Aliverti and Macklem, 2008).

Although lung function did not significantly influence farm labour supply in Eleme, some economic variables were implicated. Participation in an agricultural extension programme, monthly farm income, number of years of farming experience, and monthly farm income had a positive and significant causal relationship with farm labour supply (Table 2). In contrast, monthly income from non-farming activities and length of stay in their communities of residence had a negative and significant impact on farm labour supply.

PUBLIC HEALTH SIGNIFICANCE

The study revealed the public health status, particularly the lung function status, of the farming population in Nigeria, with particular reference to the study site. It is potentially an incentive for further public health research, for example, the high percentage of impaired lung function among the study population calls for exploratory research to identify the factors of impaired lung function in the study area. The study has identified an existing need for government public health interventions in terms of policy, programme planning, implementation and control with regards to the pulmonary health of the agrarian population. Again, the result of this study is a potential leverage for relevant interest groups, including health-related civil society organisations, to commence public awareness raising and overall public health promotion.

CONCLUSIONS AND RECOMMENDATIONS

Although a follow-up study is necessary, this research identified significant cases of impaired lung function among the farming population in Eleme, Nigeria. By the signs on the regression parameters, it was concluded that impaired lung function had a negative effect on labour supply; however, it was not a significant determinant of low labour supply in the area. Economic and geographic factors were the important factors limiting farm labour supply in the area. A farmer with impaired lung function could reduce farm labour if they also had lower limb muscle dysfunction, dynamic hyperinflation and/or inadequate energy supply to the respiratory and locomotor muscles.

Based on the findings the paper recommends the following:

- confirmatory research needs to be carried out in the area to diagnose and validate the lung function status of the farming population in Eleme, and a medical intervention may be necessary;

- the place of health education is vital, a role that can be played by health organisations and agricultural extensions service. Learning about the effects of cigarette smoking (or even the long-term effects of traditional practices, e.g. local fish smoking techniques) on lung function will definitely create a change that can sustain farm labour supply;
- environmental regulation, including regular air quality assessment of the area, is necessary to maintain clean air in the area. This is because impaired lung function may be attributed to poor air quality.

ETHICAL CONSIDERATION

The research protocol obtained ethics approval from the University of Port Harcourt-Nigeria Ethics Committee. The research process strictly adhered to the approved research protocol. Informed consent was obtained from the study respondents and they were informed that participation in the study was voluntary and they could withdraw at any point of the study without any repercussions. Total confidentiality of the respondents was ensured throughout the research process, and personal identifying information of respondents was not obtained during the survey. No form of coercive force was used to obtain information from the respondents. Experimental procedure for data collection ensured that diseases were not transmissible; for example, the respondents were provided their own disposable mouthpieces to be used on the peak expiratory flow metre. Also, only medically approved equipment, such as peak expiratory flow metres, were used in data collection.

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