

ASSOCIATION OF RESPIRATORY SYMPTOMS AND OXYGEN SATURATION IN GAS VENDORS CHRONICALLY EXPOSED TO COOKING GAS

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ABSTRACT

An investigation was carried out among cooking gas vendors chronically exposed to cooking gas to determine the possible deleterious effects on their respiratory system. Thirty cooking gas vendors who spent on average of 12-18hrs a day in the shops were randomly selected in Calabar, Nigeria for survey. They were aged between 15-40 years and had been exposed for a minimum duration of 2years. They were age and sex matched with a control population of 50 medical students who were not exposed to any known pollutant. Both the subjects and control population were non-smokers. A modified British Thoracic Society questionnaire on respiratory symptoms was administered to both test and control groups after thorough explanation. This was followed by ventilatory function test determined by use of mini Wright peak flow meter. The percentage of oxygen saturation (SPO₂) of both the subject and control population was determined using pulse oximeter. The results revealed a significant increase prevalence of respiratory symptoms among the subjects when compared with controls ($P < 0.001$). Similarly the peak expiratory flow rate of the gas vendors were significantly lower than the control ($P < 0.05$). There was also a correlation between duration of exposure and severity of ventilatory function impairment. The percentage of oxygen saturation among the test subject was significantly lower than the control $p < 0.001$. Chronic inhalation of cooking gas is therefore deleterious to the respiratory system. Gas vendors should therefore be encouraged to use protective devices like face mask and also reduce the duration of exposure to cooking gas at these shops.

KEY WORDS: Respiratory Symptoms, Oxygen Saturation, Gas Vendors.

INTRODUCTION

Cooking gas vendors in Nigeria spend most of their time in shops refilling gases. These vendors chronically inhaled these gases during the process of refilling which is often done manually. This is coupled with the fact that a lot of gas spillage occurs from faulty gas cylinder nipples and the odour could be perceived from a distance. Thus the concentration of nitrogen dioxide and butane which are the

principle components of cooking gas is extremely high in these shops.

Chronic exposure of individuals to cooking gas has been associated with reduced ventilatory function in a number of studies (1-3). Similarly, high concentration of nitrogen dioxide has been found to have deleterious effects on the respiratory system (4). It has been observed recently that some of these vendors chronically exposed to cooking gas presented with respiratory symptoms and two sudden deaths have also been

reported among them. (E. J. Peters' Personal Observation).

This study is therefore aimed at determining the major respiratory system abnormalities among cooking gas vendors who chronically inhale cooking gas. Various ways of ameliorating these effects on individual will further be evaluated.

SUBJECTS AND METHODS:

Thirty gas vendors who must have been in the business for a minimum duration of 2 years were randomly selected in Calabar for the study. They were age and sex matched against 50 medical students of the University of Calabar who were never exposed to any known pollutant and were non smokers. They served as control group for the study. An informed consent was obtained from all the test and control subjects before the survey.

The vendors were interviewed and examined individually. A thorough general and physical systemic examination was carried out in all the vendors used for the survey. The various systemic symptoms elicited from each vendor were documented in a protocol sheet prepared for each person.

Procedure:

Subjects were called in groups and instructed on the test procedure. To facilitate the understanding of the test procedure, demonstration of the test was performed and any question answered. The ventilatory function was assessed by the use of a mini Wright peak flow meter (Air med Ltd. Hallow, England). The peak flow meter was used to measure peak expiratory flow rate (PEFR). Three trials were made per subject using the peak flow meter and the best reading recorded. The data obtained for analysis

met American Thoracic Society standards (5). The percentage saturation of oxygen (SPO₂) was obtained from both the test and control groups using pulse oximeter. Physical (anthropometric) parameters like weight with light clothing and height were measured. The same weighing scale and height scale were used for all the test subjects and control under the study.

Questionnaire:

The pattern of respiratory symptoms was further facilitated by the use of questionnaire for each subject. A modified British Medical Council respiratory disease questionnaire was administered to all subjects. The questionnaire elicited information on respiratory symptoms, medical history, occupational history, smoking history and bio-data of the subjects.

Data Analysis

The master sheet of data were eventually compiled before analysis. Results were expressed as means and standard deviation (SD) as well as percentages. The students - t test was used to compare means. The Chi square test was used to compare proportion or percentages. P - value less than 0.05 was taken to indicate statistically significant results. The information obtained from both the protocol sheets and questionnaire was used in assessing ventilatory function status of the test subjects and control.

RESULTS.

Table 1 shows the general characteristics and duration of exposure of both the test and control population. A total of 30 gas vendors and 50 control population were used for the study. Majority of both the test and control

groups were however male. Similarly majority of the test subjects (45%) were exposed for period more than 24 months while 30% were exposed for longer duration of above 48 months.

Table 2 shows the comparison of Anthropometric parameters, ventilatory function indices and percentage of oxygen saturation between test subjects and controls.

There was no significant difference in the anthropometric parameters of both groups as they were equally match for age and sex. However, the ventilatory function indices of PEFR, was significantly lower in the test group than control group with P values < 0.001. Similarly, the percentage of oxygen saturation, among the test group was significantly lower when compared with the controls P < 0.001.

Table 3 A shows the respiratory symptoms experienced by the test group and control groups. There was a significantly higher prevalence of respiratory symptoms among the test group than their control. Chest tightness and catarrh /sneezing topped the list of respiratory symptoms while 10% of the test subjects develop bronchial asthma. In contrast, only 6% and 4% of the controls had catarrh/sneezing and chest pain/unproductive cough respectively. No other respiratory symptom was observed among the control subjects.

Other non-respiratory symptoms observed also had higher prevalence in the test group than in the control groups (table 3B). Skin irritation topped the list with 17%, followed by headache and internal heat. In contrast only 6%, 4% and 0% of the control group had headache, internal heat and skin irritation respectively.

Fig. 1 is an Histogram showing the relationship between PEFR and

duration of exposure to cooking gas. There was a gradual reduction in PEFR values with increased duration of exposure to cooking gas.

DICUSSION:

This study has shown significant ventilatory function impairment among persons chronically exposed to cooking gas. The ventilatory function (PEFR) of the persons exposed to cooking gas was significantly lower than the control values, whereas the anthropometric, parameters namely age, height and body weight that affected ventilatory function (6) were not statistically different between the gas vendors and the control group.

Some studies have shown that gas cooking is associated with reduced lung function in Children. (7,8). Similarly, several studies have shown that children who lived in homes with gas stoves experience more respiratory symptoms than those who lived in homes that use other fuels for cooking. (9,10). The butane and nitrogen dioxide gases which form major components of cooking gas have been implicated in a number of studies of causing both acute and chronic effects on health, particularly people with asthma (11,12).

The study revealed a higher prevalence of respiratory symptoms and other symptoms among the gas vendors than their control. This was similar to findings by Comstalk et al (13) who reported a higher prevalence of respiratory symptoms or diminished lung function among adults with gas stove than among those without, particularly among male non smokers. However, Keller et al (14) found no association between cooking gas and respiratory symptoms or diminished lung function in adults. From the results of the survey

it was observed that the gas vendors spend about 80% of their time indoors in their shops and given the amount of gas spillage from faulty nipples of cylinders, they are thus exposed continuously to a variety of chemical irritants. This may probably explain, the high prevalence of respiratory symptoms among the vendors. The high prevalence of other related symptoms such as skin and eye irritation are in agreement with findings by other workers (15,16). The fact that the gas vendors do not use any protective devices or face mask may have contributed to the increase prevalence of these symptoms.

The ventilatory function (PEFR) of the gas vendors was significantly lower than their controls ($p < 0.001$ Table 2). This is similar to reports of other studies on the effect of chronic exposure of cooking gas on ventilatory function (3, 17, 18). Jarvis et al (3) reported severe lung function impairment among women who used gas stoves for cooking or who lived in homes with open gas fires. Similar findings were found by other workers in Singapore (17). Thus, considering the duration of exposure of gas vendors to cooking gas and the degree of gas spillage from cylinders, the vendors must have been exposed to higher concentration of Nitrogen dioxide. Higher levels of Nitrogen dioxide affect the airways of the lungs causing respiratory illness and impaired lung function (4, 18). This may probably account for the reduced ventilatory function experienced by the gas vendors.

There was also a significant reduction in the mean percentage of oxygen saturation of the vendors when compared with the control. ($P < 0.001$). The reduced percentage of oxygen saturation may have resulted from chronic exposure to cooking gas as this has been documented in a number of studies (19, 20).

The severity of impaired ventilatory function (PEFR) of the vendors Correlated with prolonged duration of exposure at work environment. The worsening of this function in relation to the length of service may be a reflection of the severity of the observed symptoms with time. This is similar to the findings in other studies of the possible effects of cooking gas on ventilatory function (9,12). Moreover, high concentration of indoor nitrogen dioxide as found in gas vendors' shop has been found to cause very severe lung damage (17). Similarly, exposure of human bronchial epithelium cell cultures to nitrogen dioxide leads to cell damage, lower cilia beat frequency and release of pro-inflammatory mediators (21).

In conclusion, this study has amply demonstrated that there is an association of increased respiratory symptoms and impaired ventilatory function with chronic exposure to cooking gas by gas vendors. There is need therefore for the use of protective devices by the vendors, and they should also be encouraged to spend less hours in their unvented gas shops.

Table 1: General Characteristic of Test Subjects and Controls (Mean ± SD)

Parameters	Subjects n = 30		Control = 50		
Mean Height (m)	1.62 ± 2.54		1.65 ± 2.80		
Mean weight (kg)	56.0 ± 6.2		57.5 ± 3.8		
Mean Age (yrs)	18.0 ± 3.5		19.2 ± 3.8		
Sex Distribution					
	Total	Male	Female	Male	Female
	30	25	5	33	17
Duration of exposure (months)					
		Male	Female	Male	Female
0 – 24		-	-	33	17
25 – 48		10	2	-	-
49 – 72		5	3	-	-
73 – 96		6	-	-	-
96 – 120		2	-	-	-
> 120		1	-	-	-

Table 2: Comparison of Anthropometric, Parameters, Peak Expiratory Flow Rate, and Oxygen Saturation Between Gas Vendors and their Control (Mean ± S.D)

Parameters	Test Subjects	Control	p. Value
Height (m)	1.62 ± 2.5	1.65 ± 2.8	>0.005 N.S
Weight (kg)	56 ± 6.2	57.5 ± 6.5	>0.05 N.S
Age (years)	18 ± 3.5	19.2 ± 3.8	>0.05 N.S
PEFR (L/min)	346 ± 14.0	523 ± 16.1	<0.001
Mean Oxygen Saturation %	89	98	<0.001

N.S = Not Significant

Table 3a: Respiratory Symptoms Distribution

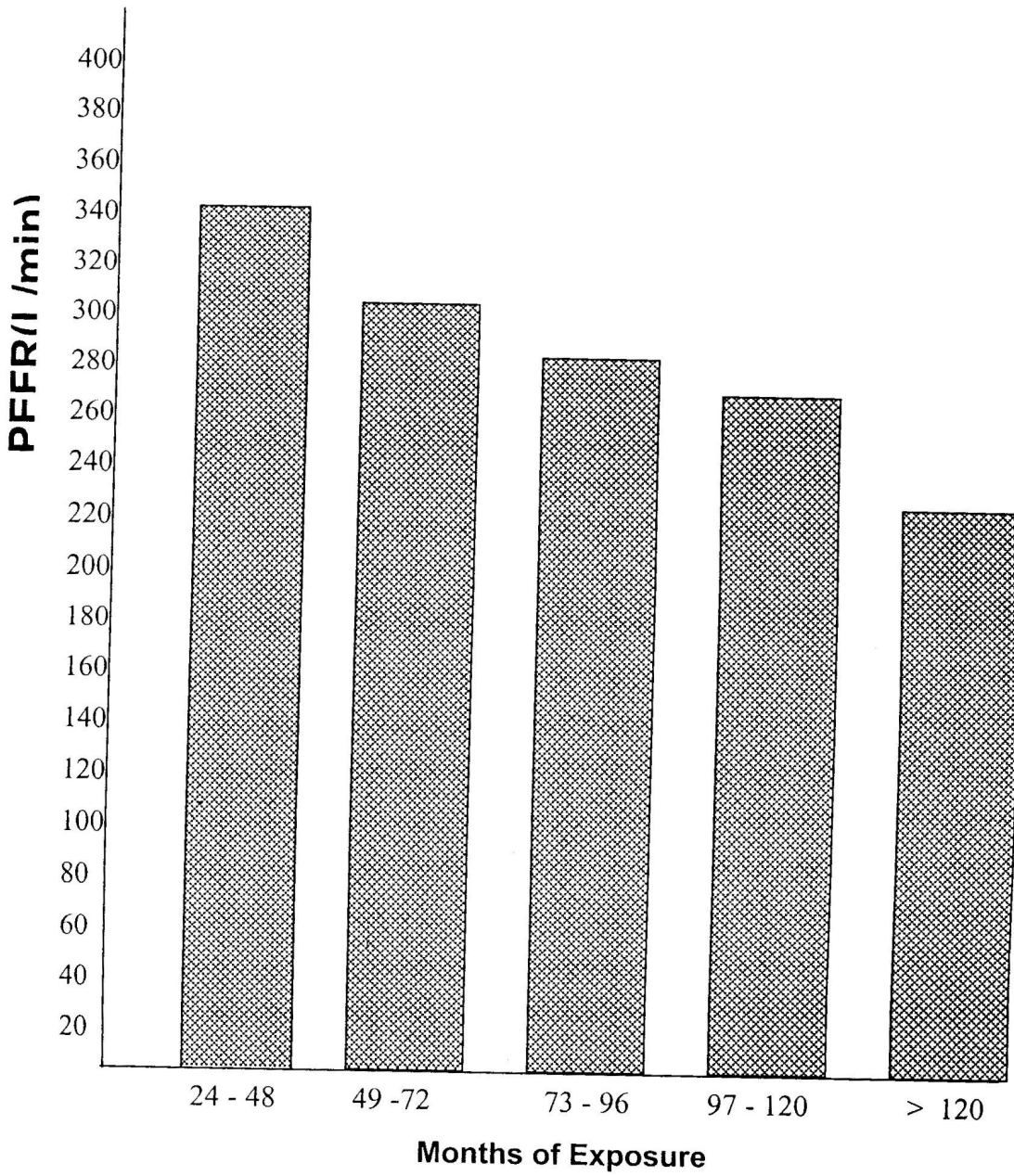
Respiratory Symptoms	Test Subjects (%) n = 30	Controls (%) n = 50	P. value
	11(37)	0 (0)	<0.001
Wheezing	4(13)	0 (0)	<0.001
Wheezing with breathlessness	14 (47)	0 (0)	<0.001
Chest tightness	5 (17)	0 (0)	<0.001
Shortness of breath.	13 (43)	2 (4)	<0.001
Unproductive cough	7 (23)	0 (0)	< 0.001
Productive cough	14 (47)	3 (6)	<0.001
Catarrh and sneezing	15 (50)	2 (4)	<0.001
Chest pain	3 (10)	(0)	<0.001
Asthma action			

Table 3b: Comparism of other symptoms observed among Test Subjects and controls

Symptoms	Subjects (%) n = 30	Controls (%) n = 50	P. value
Eye irritation	2 (7)	1 (2)	<0.001
Headache	5 (17)	3 (6)	<0.005
Internal heat	6 (20)	2 (7)	<0.005
Semi irritation	5 (17)	0 (0)	<0.001
Nausea	2 (7)	1 (2)	<0.001

HISTOGRAM SHOWING RELATIONSHIP BETWEEN PEFR AND DURATION OF EXPOSURE

Figure 1.



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