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EFFECT OF OCCUPATIONAL EXPOSURE TO LOCAL POWDERED TOBACCO (SNUFF) ON PULMONARY FUNCTION IN SOUTH EASTERN NIGERIANS

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Summary: The effect of occupational exposure to local powdered tobacco (snuff) on pulmonary function was studied. Snuff industry workers in Onitsha and Enugu markets were studied and compared with age-, weight-, and height-matched control not exposed to any known air pollutant. The pulmonary indices studied include; forced vital capacity (FVC), forced expiratory volume in one second (FEV_1) and ratio of FEV_1/FVC as percentage using a vitalograph spirometer and Peak Expiratory Flow Rate (PEFR), using a mini Wright Peak Expiratory Flow Meter. The respiratory and non-respiratory symptoms frequently associated with these workers were also analyzed and dust sampling in both test and control environments was also done. The mean anthropometric parameters, (age, height and body weight) between the two groups were not statistically different. The results obtained showed statistically significant impairment of lung function of workers chronically exposed to snuff. FVC, FEV_1 and PEFR in the exposed (test) subjects were significantly decreased in comparison with the control subjects ($P<0.05$). However, the mean value of FEV_1/FVC (%) of the test subjects was 86.8% which was within the normal range and was not significantly different from control. This signified that the test subjects had restrictive pattern of lung function defect. All respiratory symptoms, such as cough, chest tightness had a higher prevalence in test subjects than their control group. The lung function indices of snuff-producing workers proportionately decreased with their length of exposure in the industry. The respirable dust level in the vicinity (indoor) of the snuff-workers ($1.11\pm0.35 mg/m^3$) was significantly higher than in the control environment,[($0.37\pm0.086 mg/m^3$) ($P<0.001$)]. Although it was not possible to determine all the factors that may be responsible for lung function impairment, the dust sampling result showed that chronic exposure to Nigerian snuff (powered tobacco) dust impairs lung function and the effect is progressive with time.

Key words: *Lung function, Snuff, Occupation, Symptoms*

Introduction:

Snuff (powered tobacco with some additives) has been recommended as nicotine substitute of cigarette that is devoid of hazardous elements such as tar and carbon monoxide (Russel *et al,* 1980). The absorption of snuff is sometimes considered inefficient to provide an adequate nicotine substitute (Armitage et al 1978; Turner et al 1985). Snuffing has become quite popular as a medication for long grief, pain and aches (Tuner *et al*, 1985). It has been reported that 12.6% of students between 14 and 19 years of age in England use snuff (Paulson et al 1984) in the studied population. The widespread use of tobacco in Nigeria is well known. Owing to the high demand for snuff, there is a corresponding maintenance of a high supply by those employed in Snuff producing industry.

In most major markets in the South-Eastern Nigeria especially in Onitsha, Enugu and Aba, snuff producing industries abound. Each industry employs about 1000- 2000 workers in each market. Majority of these workers are men with very few women who work together in groups in the snuff industry using grinding, blending and mixing machines. Dried tobacco leaves are used to produce the snuff. During the process, snuff dust saturates and pollutes the entire atmosphere and beyond. The employees of the industry form isolated groups using special pestle and mortar to produce snuff by pounding dried tobacco leaves for hours and sieving the snuff dust, thereby inhaling high doses of dust.

Many of these snuff producers have been employed in the industry for upward of more than twenty years. They are regularly exposed to the risk of inhaling high doses of snuff dust over a long period. Although there are several reports on the harmful effects of exposure to tobacco/cigarette smoke (Tredaniel *et al*, 1994; Wells, 1994) and flue curing of tobacco in preparation for export (Osim *et al*, 1998), no reports have been found on the effect of occupational exposure to the preparation of Nigerian snuff (powdered tobacco with some additives) on the lung function of exposed workers.

Owing to the fact that the respiratory tract has direct contact with the environment, it is often the site of injury from occupational exposure (Wang *et al*, 1998; Horak *et al*, 2000). Snuff (powered tobacco) contains nicotine which is toxic in addition to other elements, e.g. natron, locally called "kanwa". Inhalation of potentially toxic materials in the work places can lead to major lung diseases (Musk *et al*, 1980; Crosbie 1986; Meister, 1990; Osim *et al*, 1992; Nowak 1998; Osim *et al*, 1996). Virtually all the workers in the snuff industry in the locality studied were unaware of potential harmful effect of exposure to snuff over a long period. There are no precautionary measures aimed at protecting workers at their work place owing to ignorance of the health implication of inhaling such high doses of tobacco dust for a long time. Winn *et al* (1981) reported increased mortality from oral and pharyngeal cancers in a case-controlled study of use of snuff. Nigerian powered tobacco contains other additives like natron and there are no studies on the effect of the local snuff exposure on lung function.

Although not on long function, a limited number of studies have been undertaken to determine the physiological and pharmacological effects of natron. In one of such studies, Oyeleke (1988) revealed that with chronic natron ingestion, there were severe growth retardation, skin changes and diarrhoea. Soladoye and Oyeleke (1989) showed that moderate intake of natron had adverse effects on growth rate and blood indices in rats even when diarrhoea was absent as earlier reported by Oyeleke (1988). The habitual consumption of natron was reported by Davidson et al (1974) to have contributed to the incidence of peripartal cardiac failure in Zaria and Malumfashi areas of Northern Nigeria. Therefore the aim of this study was to determine the lung function status as well as respiratory and other associated symptoms of workers occupationally exposed to Nigerian snuff dust (powered tobacco) in Onitsha and Enugu markets of South Eastern Nigeria.

Materials and methods

The study was carried out on workers occupationally exposed to snuff. A total of one hundred and twenty one were selected for the study. The control group consisted of seventy-five age-, height-, and weight-matched healthy people who are not occupationally exposed to snuff or any other air pollutant. The anthropometric parameters i.e. age, height and weight of test and control groups were similar. Those included in the test group were workers in the industry who were willing to participate fully in the study and were of Igbo extraction. Cigarette smokers and physically deformed workers were excluded from the study since these parameters affect lung function.

Having obtained the necessary ethical clearance from the Ethical Committee of Abia State University Uturu, the study was conducted in the premises of snuff producing industries in Onitsha and Enugu markets. A standard questionnaire on respiratory symptoms, knowledge and attitude of snuff producing workers with regards to hazards and protective measures was given to each subject to respond to under guidance. Weight of each subject was recorded in kilograms with the subject wearing light clothing and without shoes. Standing height of every subject was taken with a non-stretable meter rule. Pulse rate, respiratory rate and blood pressure were taken. Forced vital capacity (FVC), Forced Expiratory volume in one second (FEV_1) and the ratio of FEV_1 to FVC as a percentage were used to assess lung function. A vitalograph spirometer (Spiro vit SP by Schiller, UK) was used for the measurements of the above-stated lung function indices. A mini-Wright peak flow meter (Air med Clement International, UK) was used to measure PEFR to add to the above-listed lung function parameters.

Test Procedure

Before testing, the purpose of the test was explained to each subject and the method of testing demonstrated as well. For the measurement of peak expiratory flow rate PEFR), the subject was seated on a straight back chair and his or her belt loosened. The subject breathed in as much as possible, and applied his or her lips firmly around the mouth piece to prevent any air leak and breathed out as quickly and forcefully as possible into the peak flow meter with his or her nose clipped to prevent loss of air through the nose. While the subject was doing this, a check was made for air leaks around the mouth piece, and if detected the blow was repeated. Each subject performed three blows with a minimum of five minutes interval between each blow to allow the subject adequate rest. The best of the three readings was taken. FVC and FEV_1 were obtained from each subject using a vitalograph spirometer and following the same procedure described above for PEFR (Hertzberg, 2002). FEV_1 % was computed from FEV_1 and FVC.

Dust Measurement

Respirable dust level was determined at the sites of work of the snuff producers to establish the concentration of air-bone particles. This was done using "Haz-Dust Monitor" (Environmental Device Corporation, U.S.A., Model No: HDNOO serial No. – 298622). Range of measurement was 0-10µm. This hazardous dust monitor is a possible direct reaching particulate monitor that uses infrared electronmagnetic radiation to sense the air-borne particulates. The sensing method is technically referred to as forward light scattering. The infrared source and photo detectors are positioned at 90^o to each other. As the particulates intersect the sensing values, they scatter the light in a forward angle of $45\text{-}90^o$, the amount of scattering being proportional to hazardous dust concentration in the air. The dust concentration readout was expressed in milligram per cubic meter (mg/m^3). The dust measurement was done at all the sites of snuff production and in areas where control subjects were exposed to serve as control for the snuff production sites.

Statistical Analysis

The student's unpaired t-test was used for the comparison of ventilatory function induces, and dust levels in the control of and test environments. Chi-squire test was used to test significance between percentages. Then data were presented as mean ± standard error of the mean (SEM). A in P-value of <0.05 was considered as significant.

Results

Study Population

A total of 121 workers occupationally exposed to snuff and 75 control subjects, not exposed were evaluated in the two study centres; Onitsha snuff production industry and that of Enugu. All were south-eastern Nigerians of Igbo origin.

The age distribution of workers in the snuff industry and control is shown in table 1. The highest number of persons among age range was 40-49years which contributed 47 workers followed closely by the age range of 30-39 that had 41 workers. These age ranges constituted more than 70% of the study population. Snuff producing workers less than 29 years of age contributed less than 10% of the study population. These workers were therefore in the prime of their life. The mean age of these workers exposed to snuff was 41.5± 6.2 years. The youngest was 25years and oldest 58years. In the control subjects the age range that contributed the least was 20-29 and they contributed 5.3% and the range of 30-39years contributed the highest which was 33%. The mean age of the control subject was 40.4 ± 8.4 years. The youngest was 22years and oldest 57 years. This mean age of the control subjects was not statistically significant when compared with the population exposed to snuff (P>0.5).

Table 2 shows that the mean body weights of the test group (exposed workers) and their control (70.5 ± 7.6 vs 71.9 ± 9.3 kg respectively) were also not significantly different. The majority (79.3%) of the exposed workers fell within 60-79 kg body weight. A similar percentage (73.3%) fell within the same body weight range among the control group.

Table 3 shows the distribution of the subjects studied into different height ranges. The mean heights of the test group and their control (168.5± 5.0 vs 169.0 ± 5.2 respectively) were also not significantly different. The height range of 160-169 cm had majority of the exposed workers (65.2%) and their control (58.7%).

Table 1: Age Distribution of Snuff Producers and the Control Subjects.

Age Group	*Exposed*	*%*	*Control*	*%*	*Total*
20-29	7	5.8	4	5.3	11
30-39	41	33.9	33	44	67
40-49	47	38.8	28	37.3	67
50-59	26	21.5	10	13.3	36
Total	121	100	75	100	196
Mean age ±SD	41.5±6.2		40.4±8.4		
P-value	>0.05				

Table 2: Distribution of exposed and control subject according to weight.

Wt (kg)	*Exposed*	*Control*	*Total*
<50	1	-	1
50-59	6	5	11
60-69	49	23	72
60-79	47	32	79
80-89	17	12	29
90-99	1	3	4
Total	121	75	196
Mean wt±SD	70.5+7.6kg	71.9+9.3kg	
P-value	>0.05		

Table 3: Distribution of exposed subjects and control According to height

Height (cm)	*Exposed*	*Control*	*Total*
150-159	4	2	6
160-169	79	44	63
170-179	35	28	123
180-189	3	1	4
Total	121	75	196
Mean ± SD	168±5.0cm	169±5.2 cm	
P-value	>0.05		

Table 4 shows that the mean FVC for workers exposed to snuff was 2.67L±0.6L while that of the control subjects was 3.61L±0.58L. There was therefore a significant difference between the FVC of the two groups (p<0.001). The same pattern was also observed in the FEV_1 which was 2.3±0.53L for the exposed subject and 3.07±0.5L for the control group. Another important index of lung function was the peak expiratory flow rate (PEFR). The value of PEFR of the exposed subjects as shown by table 4 was significantly different from the control; (379±70.5 L/min vs 511.3 ± 86.8 L/min respectively; p<0.001). Every index of respiratory function showed a significant difference between the exposed and the control (P>0.001). However, the ratio of FEV_1/FVC expressed as percentage showed no significant difference between the exposed and the control (86.8±6.64% vs 84.3±6.08% respectively.

Table 4: Summary of Anthropometric measurement and Lung function indices compared between exposed and control subjects.

Parameter	*Exposed subjects mean ±SD*	*Control subjects mean ±SD*	*P-value*
Age (years)	41.5±6.2	40.6±8	P>0.05 (NS)
Body Weight (kg)	70.3+7.6	71.9±9.3	P>0.05 (NS)
Duration of Exposure (years)	9.5±3.9	Not exposed to any known air pollutant	NA
Height (m)	1.68±0.05	1.69±0.052	P>0.05 (NS)
FVC(L)	2.67±0.6	3.61±0.58	p<0.001 (**)
FEV_1 (L)	2.3±0.53	3.07±0.521	p<0.001 (**)
FEV_1 /FVC (%)	86. ±6.64	84.3±6.08	P>0.05 (NS)
PEFR (L)/min)	379±70.5	551±86.8	P<0.001 (**)

** * = P<0.001 when compared with control; NS = Not statistically significant when compared with control*

Table 5: Respiratory symptoms / signs compared between exposed and control subjects.

Symptom	*Exposed subjects N=121 (%)*	*Control subjects, N= 75 (%)*	*p-value*
Persistent cough	44(36.4%)	15(20%)	P<0.05*
Frequent Sneezing	67(55.4%)	21(28%)	P<0.001*
Wheezing	23(19%)	5(6.7%)	P<0.05*
Chest Tightness	25(20.7%)	6(8%)	P<0.05*
Sputum production	33(27.3%)	9(12%)	P<0.001*
Running Nose	53(43.8)	19(25.3%)	P<0.001*
Breathless on Level ground.	19(15.7%)	5(6.7%)	P<0.05*

** Statistically significant when compared with control.*

Table 6: Correlation of anthropometric Measurement and Duration of Exposure with Lung Function parameters among the Exposed group

Anthropometric measurements/ Exposure Duration	Lung Function parameters			
	FVC	FEV_1	FEV_1/ FVC	PEFR
Duration of exposure	r= -0.3 p<0.01 *	r= -0.25 NS	r= +0.1 NS	r= - 0.23 p<0.0 2*
Age	r = 0.17 p<0.01 *	r = 0.18 NS	r = - 0.05 NS	r = 0.15 NS
Height	r = +0.28 p<0.01 *	r =+0.3 NS	r = +0.11 NS	r = +0.34 p<0.0 1*
Weight	r = +0.09 NS	r = +0.09 NS	r = +0.00 5 NS	r = +0.15 NS

** = Statistically Significant ; NS = Not significant.*

The respiratory symptoms of snuff exposed subjects and their control are shown in table 5. The prevalence of respiratory symptoms was 84.2% in the exposed workers against 33.5% observed in their control group. The difference was significant (p<0.001). With regards to specific symptoms frequent sneezing (nasal stuffiness) has the highest frequency of 55.4%. This is followed by running nose (43.8%) and then persistent cough (36.4%). 27.3% complained of sputum production, 207% had complaint of chest tightness. Others are wheeze (19%) and breathless on level ground 18.7%. Compared with the control subjects, there were statistically significant differences in all the symptoms when the test subjects were compared with their control (p<0.05 – 0.001).

Table 6 shows correlation of the anthropometric parameters with duration of exposure among the exposed workers in the snuff industry. It was noted that there was a negative correlation between the length of exposure and all the indices of lung function except FEV_1/FVC expressed as a percentage. Thus, there was depreciation of lung function indices, namely; FVC, FEV_1, and PEFR as the length of exposure increased. There was also a significant positive correlation of the height and age with some function indices, notably, FVC and FEV_1. The correlation of body weight with the lung function indices was not significant in the study.

Table 7 shows the correlation of anthropometric parameters with lung function indices among the control group. There was positive correlation of height and weight with FVC, FEV_1 and PEFR. Age correlated significantly with FEV_1 %.

Table 7: Correlation of Anthropometric Parameters with Lung Function among the Control Group

Anthropometric measurements	*Lung Function parameters*			
	FVC	*FEV_1*	*FEV_1 /FVC*	*PEFR*
Age	r = 0.15 NS	r = 0.03 NS	r = 0.30 p<0.05*	r = 0.13 NS
Height	r = +0.39 p<0.01*	r = +0.3 p<0.01*	r = +0.09 NS	r = +0.45 p<0.01*
Weight	r = +0.34 p<0.01*	r = +0.09 NS	r = 0.09 NS	r = +0.36 p<0.01*

** = Statistically Significant.; NS = Not Significant*

DISCUSSION

Snuff industry workers are chronically exposed to high level of snuff dust. Such long term exposure to snuff dust has been shown to have deleterious effects on their lung health. It has been associated with high prevalence of respiratory symptoms and ventilatory function impairment, (Philips, 1998). However, these studies were not done on Nigerian workers. Nigerian snuff also known as powered tobacco contains some additives, notably, natron not found in snuff elsewhere.

This study has shown that workers in the snuff industry had a high rate of prevalence of respiratory symptoms when compared with control group. The prevalence of respiratory symptoms in the snuff industry was 88% while the control was 33%. This difference was statistically significant (p<0.001). A similar work done by Walling (1981) produced less respiratory symptoms than this study. The reason for the high prevalence of symptoms likely to be due to high concentration of the snuff dust inhaled by these workers and the total lack of precautionary measures in the snuff producing industry in Eastern Nigeria. The high concentration of snuff (sometimes a single measure of up to 1.55mg/m^3) may be due to low level of roofs which made the escape of the snuff dust difficult. The results showed high prevalence of specific respiratory symptoms when compared with the control that was statistically significant. Other studies (Dool and Peto, 1985; Michael and Petty, 1982) have also shown a high prevalence of respiratory symptoms viz: cough, wheeze, sputum production and breathlessness among workers occupationally exposed to atmospheric pollutants like asbestos, saw dust and granite. The prevalence of respiratory symptoms of workers exposed to snuff dust was high in this study. The most prevalent was the nasal symptoms namely, frequent sneezing and running nose. Frequent sneezing constituted the highest (55.4%), while running nose was 43.8%, cough and sputum production constituted 36% and 33% respectively, chest tightness, 20.7% and breathlessness 15.7%. It is likely therefore that the snuff contained irritants of the respiratory system.

Comparing the mean values of the four indices of lung function employed in this study with their control showed that the control group had higher mean values of FVC, FEV_1, and PEFR than the snuff-producing workers. FEV_1 % in the two groups was not significantly different and was all in the normal range i.e. 86.8% for exposed workers and 84.3% for the control. This pattern of impaired ventilatory function is indicative of restrictive lung function defect – and is inconsonance with dust related exposure (Osim *et al*, 1992, 1996; Kunzli *et al*, 2000; Jinadu *et al*, 1988; Okwari *et al*, 2005). The absence of any incidence of obstructive respiratory defects like asthma supports the restrictive respiratory defect that is indicated in this study. This impairment in the lung function is not unexpected as snuff dust and its constituents cause allergic and non-allergic chronic inflammation of the respiratory airways of the lungs which affect their functions. (Okpapi and Bosan, 2004). Although, it was not possible to determine all the factors responsible for lung function impairment in snuff producing workers, dust sampling in both test and control environment suggested that chronic exposure to snuff dust was likely to be the causative factor. The indoor respirable dust level in the snuff industry was significantly higher than the control environment. (p<0.001). It has been established from various reports that anthropometric parameters viz; age, height, weight, sex and ethnicity are factors that can account for variation in FVC, FEV_1 and PEFR. (Cotes, 1975; Aderele and Oduwole, 1983; Jaja and Fagbenro, 1995; Njoku and Anah, 2004). These factors were taken into consideration and so, were similar in the test and control groups.

Correlation tests showed that while the lung function of snuff workers significantly increased with height and body weight, it decreased with longer duration of exposure, and age. This means that with time the lung function impairment and respiratory symptoms in the snuff producing industry in the area studied will worsen. There is therefore the need to take precautionary measures, do frequent monitoring of lung function and redeploy subjects severely affected to other less hazardous areas.

In conclusion, chronic exposure to Nigeria powered tobacco dust (Snuff) without precautionary measures may impair lung function and provoke respiratory symptoms.

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