The Effect of Wood Dust on Lung Function of Woodworkers in Na'ibawa Wood Market Kano State, Nigeria

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Abstract

Background

The wood industry is one of the occupations where exposure to wood dust has been shown to lead to chronic lung diseases long after such exposure has ceased. This study assessed the effect of wood dust and other irritants on lung function of wood workers in Na'ibawa market, Kano.

Method

Using a descriptive cross-sectional design, 370 wood workers and 150 controls were studied. The forced vital capacity (FVC), forced expiratory volume in one second (FEV1) and peak expiratory flow rate (PEFR) of the subjects were measured using Compact II Computerized Electronic Spirometer. Data collected were analyzed using Minitab 12.21 and Epi info 3.2.02 Computer Statistical Softwares.

Results

The percentage predicted mean FEV1 for majority of the wood workers were lower than the 75% limit for normal subjects. The percentage predicted mean FEV1/FVC for the wood workers across most of the age groups was normal except for age groups 25-29 and 30-34 years. The percentage predicted mean FVC for both study and control groups were within normal limit. This study observed significant differences in lung function parameters between subjects in the study and control groups.

Recommendations

The government, development partners and professional groups should strengthen activities for improving awareness of the wood workers on the hazards associated with wood work and the available methods of preventing and/ or mitigating exposures.

Key words: *Wood dust; Exposure; Lung function; Impairment; Kano*

Introduction

Wood is one of the world's most important renewable natural resources. At least 1700 million cubic meters is harvested for industrial use each year[1]. Processing wood results in the formation of wood chips and wood dust which are partly suspended in the air and may be inhaled by the workers[2]. In Nigeria, the wood industry is a viable one as wood is used for furniture, building and other construction works. The processes involved in the average sawmill in Nigeria include stacking, planking, grading and sawing of wood. Both soft and hard wood are used in Nigeria's wood industry[3].

It is estimated that at least 2 million people are occupationally exposed to wood dust globally, with the highest exposure documented amongst those involved in furniture and cabinet making[1]. It has been established that repeated exposure to certain irritants in the work place can lead to an array of lung diseases that may have lasting effects long after exposure ceases[3,4,5,6,7,8]. A previous study also demonstrated the relationship between exposure to wood dust and impairment of lung function[9]. However, the use of protective devices by wood workers at work in Nigeria is very limited, especially in the northern part of the country where there have been a few reports on the aforementioned relationship.

It was against this background the study was planned, to assess the effect of wood dust exposure on the lung function of a selected population in Na'ibawa market Kano State.

Materials and method

The study employed a cross-sectional descriptive study design to evaluate the effect of wood dust exposure on lung function of woodworkers, using controls that were matched for age, sex and ethnicity. The study population comprised 370 wood workers that were randomly selected (using systematic sampling methods) from Na'ibawa Wood Market in Kano, and 150 non-wood workers who were randomly drawn from Sabon-gari market, Kano. The sample size for the study was estimated using an appropriate statistical formula for descriptive studies[10].

Wood workers who were known to be asthmatic and hypertensive and those with features suggestive of Chronic Obstructive Pulmonary Disease were excluded from the study. Also excluded were those with features suggestive of on-going chest infection.

A semi-structured interviewer administered questionnaire was employed to collate the subjects' personal data, their exposure to wood dust as well their lung function parameters. An informed consent was obtained from all subjects before data collection began.

Lung function was assessed using Vitalograph Compact II Electronic Spirometer that automatically generates measured lung function parameters (VC, FVC, FEV1, FEV1/FVC and PEFR) for age, weight, height and gender against predicted reference values based on Kundson's formula for calculating the parameters in blacks. A value of the measured parameters exceeding 75% of the predicted value was adjudged as normal, while a value more than 65% but less than 75% was interpreted as mild lung function impairment. In the same vein, any value greater than 50% but less than 65% was interpreted as moderate lung impairment, whereas a value less than 50% of its predicted was adjudged as severe impairment of lung function[11.] The bronchodilator provocation test was not done in this study due to logistic limitations.

Data were analyzed using the Epi – info 3.2.2 and Minitab 12.1 Computer Statistical Softwares. Quantitative variables were summarised using mean and standard deviation. Frequencies and percentages were used to summarise qualitative data. Chi-square test ($\chi 2$) was used to determine statistical association between qualitative variables, while the Students' "t" – test was used to compare the means of quantitative variables. A p-value of ≤ 0.05 was considered significant.

Results

Socio-demographic characteristics of the respondents

Most of the respondents in both the study and the control groups were Hausa and Fulani by tribe (Table I). Majority of the wood workers, 99 (26.7%) were involved in sawing wood. On the other hand, all the 150 controls were involved in selling provisions, shoes, clothes and similar items in a different market as shown in Table II.

Assessment of lung function

The distribution of the mean ventilatory indices of the wood workers and the controls by age groups are as shown in Tables III and IV. The percentage predicted mean FEV1 for majority of the wood workers were lower than the 75% limit for normal

subjects except for those in the age groups 15 to 24 and 35 to 44 years as shown in Table III.

On the other hand, the corresponding values for the workers in the controls were all above 75% as shown in Table IV. The mean values for FVC and PEFR across all age groups for both the woodworkers and their controls were all within normal limit. The percentages of the predicted mean FEV1/FVC for the woodworkers across most of the age groups were normal except for age groups 25-29 and 30-34 that had 74.16% and 73.82% of their predicted ratios respectively as in Table III. Table V shows a significant association between means of lung function parameters of study and control groups.

Relationship between woodwork and lung function

One hundred and thirty eight (94.5%) of those who had impairment of lung function (% predicted FEV1 /FVC less than 75%), were involved in wood work while only 8 (5.5%) of those with lung function impairment had not been exposed (controls). The study observed a statistically significant association between wood work exposure and impairment of lung function ($\chi 2 = 54.0$, df = 1, $p < 0.05$). The exposed workers were 10 times more likely to have impairment of lung function than the non-exposed controls (O.R = 10.56, 95% C.I 4.84, 23.99) as shown in Table VI. The study also observed a statistically significant association between lung function impairment and types of woodwork as depicted in Table VII. Specifically, significant impairment in lung function was observed among workers in sanding, sawing and spraying sections of the wood market.

Discussion

Pulmonary function tests provide objective quantifiable measures of lung function. They detect impairment in lung function and assess the effect of treatment or progress of a disease[12].

In this study, the mean percentage of the predicted FVC for all age groups in both the study and the controls were within normal values. The percentages predicted mean FEV1 were however low for the subjects between 25 and 34 years and those between 45 and 59 years age group. The mean FEV1/FVC ratio for the woodworkers across most of the age groups were similarly normal except for the age groups 25 – 29 years and 30 – 34 years that had 74.12% and 73.8% of their predicted values respectively.

The corresponding mean values for FEV1 and FEV1/FVC were all within normal values for the controls. This finding of a low FEV1, normal FVC and a low FEV1/FVC observed among the subjects in the age groups 25-29 years and 30-34 years is suggestive of obstructive pattern of lung function impairment. Lung function impairment was similarly reported by other researchers in Nigeria and elsewhere, amongst workers who were exposed to wood dust and other lung irritants in their work places [8,13,14]. The reduction in FEV1 among the younger workers may perhaps be due to the fact that they are more involved with strenuous activities like sanding and sawing which are sources of more exposure to wood dust. On the other hand, the reduction in FEV1 in the older age groups may be explained by the fact that under normal circumstances a reduction in FEV1 by about 20 – 30 millilitres in non-smokers, and up to 60 millilitres in smokers normally occurs per year of life[15,16,17].
This study also observed significant relationship between wood dust exposure and lung function impairment ($p < 0.05$). Thirty seven percent of the wood workers had impairment of lung as opposed to 5.3% amongst non-wood workers. This corresponds with what other workers reported amongst similar group of wood workers[6,18,19]. The similarity in finding between this study and those of other studies may be attributable to the common exposure to wood dust and other irritants in the wood work places. On the other hand, 5.3% of the non-exposed group had lung function impairment. This may perhaps be associated with other confounding factors such as cigarette smoking, sub-clinical co-existing diseases and varied exposure to other types of dusts.
This study also observed that ventilatory indices of the wood workers varied with the type of wood work. Workers involved in sanding and spraying of wood had more reduced forced expiratory ratio compared to the other job titles. A statistically significant association between type of woodwork and impairment of lung function was observed in this study ($p < 0.05$). Other workers reported similar finding[5,14].

Conclusion

In conclusion, this study observed that lung function impairment was more common among the wood workers than in the non-exposed group (Controls), suggesting that exposure to wood dust and other irritants in woodwork industry predisposes to lung function impairment. In view of the findings of this study therefore, the government (through relevant ministries), non-governmental organizations and professional groups should expedite efforts towards educating woodworkers in both formal and

informal work environments to limit exposure to hazards of woodwork place and to promote the use of protective devices amongst workers.

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Table I: Socio-demographic characteristics of the respondents

Characteristics	Woodworkers (n=370) Freq. (%)	Non woodworkers (n=150) Freq. (%)
Age group		
15-24	96 (25.9)	36 (24.0)
25-34	135 (36.5)	53 (35.3)
35-44	71 (19.3)	31 (20.7)
45-54	59 (15.9)	25 (16.7)
≥55	9 (2.4)	5 (3.3)
Ethnicity		
Hausa/Fulani	288 (77.8)	112 (74.7)
Yoruba	22 (5.9)	8 (5.3)
Igbo	31(8.4)	20 (13.3)
Others	29 (7.9)	10 (6.7)
Educational status		
No formal education	118 (31.9)	81 (54.0)
Primary	98 (26.5)	29 (19.3)
Secondary	142 (38.4)	36 (24.0)
Post secondary	12 (3.2)	4 (2.7)
Smoking status		
Current smokers	60 (16.2)	17 (11.3)
Non smokers	310 (83.8)	133 (88.7)

Table II: Respondents' type of work

Type of work	Woodworkers (n = 370) Freq. (%)	Non woodworkers (n = 150) Freq. (%)
Sawing	99 (26.8)	-
Sanding	52 (14.0)	-
Stacking	66 (17.8)	-
Joinery	50 (13.5)	-
Spraying	42 (11.4)	-
Trading of wood	61 (16.5)	-
Sell provisions/ food items	-	112 (74.7)
Sell dresses/ shoes	-	38 (25.3)

Table III: Mean ventilatory indices of woodworkers

Age group	FEV1M(l) ± S.D	FEV1P(l) ± S.D	PPFEV1 (%) ± S.D	FVCM(l) ± S.D	FVCP (l) ± S.D	PPFVC (%) ± S.D	PEFRM (l/sec) ± S.D	PEFRP (l/sec) ± S.D	FEV1/FVCP (%) ± S.D
15-19	2.43± 0.50	3.05±0.10	79.59±14.89	2.97±0.44	3.50±0.40	85.33±9.92	419.12±84.65	496.87±53.02	77.86 ± 9.31
20-24	2.24± 0.51	3.14±0.28	75.80±15.26	3.11±0.42	3.52±0.34	88.72±10.46	404.90±80.58	528.47±53.16	75.81 ± 10.86
25-29	2.29± 0.30	3.10±0.26	*73.87±16.29	3.13±0.34	3.53±0.32	88.82±8.51	389.66±80.33	526.85±46.25	*74.16± 10.46
30-34	2.40± 0.27	3.27±0.32	*73.60±15.28	3.16±0.42	3.79±0.41	83.53±7.72	414.03±83.58	508.75±56.92	*73.82 ± 8.14
35-39	2.54± 0.20	3.25±0.29	78.24±12.54	3.09±0.36	3.75±0.31	82.40±8.37	454.58±85.22	506.90±87.17	77.51 ± 10.29
40-44	2.53± 0.14	3.10±0.15	81.45±10.54	2.83±0.35	3.55±0.2	79.77±9.65	472.67±67.25	514.60±35.70	79.83 ± 7.76
45-49	2.22± 0.21	3.09±0.17	*72.18±15.58	2.82±0.32	3.45±0.13	81.87±9.72	445.83±108.37	534.67±20.23	75.86 ± 7.06
50-54	2.24± 0.20	3.11±0.15	*72.10±14.01	2.72±0.29	3.45±0.19	79.15±10.09	443.55±98.74	541.03±21.25	78.04 ± 5.87
55-59	2.07± 0.15	2.94±0.19	*70.94±14.34	2.70±0.19	3.24±0.17	83.45±5.40	409.89±84.69	508.44±15.36	78.28 ± 12.83

Table IV: Mean ventilatory indices of non woodworkers (Control)

Age group	FEV1M(l) ± S.D	FEV1P(l) ± S.D	PPFEV1 (%) ± S.D	FVCM(l) ± S.D	FVCP (l) ± S.D	PPFVCM (%) ± S.D	PEFRM (l/sec) ± S.D	PEFRP (l/sec) ± S.D	FEV1/FVCP (%) ± S.D
15-19	2.59±0.15	3.2 ±0.35	80.43±5.85	2.89±0.14	3.63±0.55	81.34±13.32	450.60±11.16	461.00±7.61	80.82 ± 3.00
20-24	2.65±0.47	3.14±0.22	85.10±17.87	3.10±0.28	3.49±0.37	89.81±12.44	438.12±53.15	493.00±61.91	79.46 ± 8.37
25-29	2.68±0.39	2.94±0.22	91.04±9.61	2.86±0.31	3.33±0.31	86.11±6.30	474.88±62.15	508.47±63.52	83.44 ± 11.82
30-34	2.76±0.36	3.38±0.18	81.83±10.84	3.34±0.17	3.70±0.19	90.84±5.84	480.58±73.97	534.55±34.27	77.26 ± 4.58
35-39	2.67±0.21	3.14±0.21	85.27±7.56	3.04±0.23	3.56±0.28	86.08±10.86	497.87±43.74	528.25±8.31	78.36 ± 2.99
40-44	2.74±0.14	3.15±0.19	87.19±5.71	3.19±0.10	3.51±0.24	91.15±4.83	522.77±21.66	547.63±54.27	76.80 ± 1.42
45-49	2.56±0.28	2.97±0.16	86.01±8.41	2.87±0.24	3.42±0.30	84.19±6.49	506.92±58.35	543.07±16.36	78.58 ± 4.48
50-54	2.80±0.40	3.23±0.11	86.54±11.65	3.14±0.11	3.61±0.23	87.50±8.59	486.08±55.72	552.33±17.80	81.61 ± 8.68
55-59	2.52±0.28	3.14±0.17	80.65±11.18	2.89±0.30	3.44±0.31	84.99±14.36	456.00±102.16	532.85±28.37	79.75 ± 3.78

Parameter	Study	Control	t – test	p – value
Mean FVCM	3.0 ± 0.4	3.1 ± 0.3	-2.16	0.03 (S)
Mean FEV1M	2.4 ± 0.5	2.7 ± 0.3	-9.08	0.0001 (S)
Mean PEFRM	420.4 ± 88.3	487.1 ± 59.2	-10.01	0.0001 (S)

Table V: Comparing means in lung function parameters between study& control groups

VI: Relationship between wood dust exposure and lung function impairment

Lung function	Exposed Frequency (%)	Non- exposed Frequency (%)	Total
Impairment (% predicted ratio < 75%)	138 (94.5)	8 (5.5)	146
Normal (% predicted ratio >75%)	232 (62.0)	142 (38.0)	374
Total	370	150	520

$X2 = 54.0$ df = 1, $p = 0.0001$ O.R =10.56

Table VII: Relationship between type of woodwork and lung function

Type of woodwork	Lung function		X2	p-value
	Normal	Impaired		
	Frequency (%)	Frequency (%)		
Sawing	74 (74.7)	25 (25.3)	8.38	0.004 (S)
Sanding	25 (48.1)	27 (51.9)	5.53	0.018 (S)
Stacking	41 (62.1)	25 (37.9)	0.01	0.914 (NS)
Joinery	36 (72.0)	14 (28.0)	2.14	0.14 4 (NS)
Spraying	12 (28.6)	30 (71.4)	32.60	0.001(S)
Trading	44 (72.1)	17 (27.9)	2.78	0.096 (NS)

S= Significant NS = Not significant